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ACCEPTANCE

This dissertation, INVESTIGATING THE EXPERIENCE: A CASE STUDY OF A SCIENCE PROFESSIONAL DEVELOPMENT PROGRAM BASED ON KOLB'S EXPERIENTIAL LEARNING MODEL, by BRIAN LINDELL DAVIS, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Doctor of Philosophy in the College of Education, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chair, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty. The Dean of the College of Education concurs.

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ABSTRACT

INVESTIGATING THE EXPERIENCE: A CASE STUDY OF A SCIENCE PROFESSIONAL DEVELOPMENT PROGRAM BASED ON KOLB'S EXPERIENTIAL LEARNING MODEL

by
Brian L. Davis

Professional development for educators has been defined as the process or processes by which teachers achieve higher levels of professional competence and expand their understanding of self, role, context and career (Duke and Stiggins, 1990). Currently, there is limited research literature that examines the effect a professional development course, which uses David Kolb's experiential learning model, has on the professional growth and teaching practice of middle school science teachers. The purpose of this interpretive case study is to investigate how three science teachers who participated in the Rivers to Reef professional development course interpreted the learning experience and integrated the experience into their teaching practice. The questions guiding this research are

1. What is the relationship between a professional development course that uses an experiential learning model and science teaching practice?
2. How do the Rivers to Reef participants reflect on and describe the course as a professional growth experience?

The creation of the professional development course and the framework for the study were established using David Kolb's (1975) experiential learning theory and the reflection process model designed by David Boud (1985). The participants in the study

are three middle school science teachers from schools representing varied settings and socioeconomic levels in the southeastern United States. Data collected used the three-interview series interview format designed by Dolbere and Schuman (Seidman, 1998). Data was analyzed for the identification of common categories related to impact on science teaching practice and professional growth. The major finding of this study indicates the years of teaching experience of middle school science teachers significantly influences how they approach professional development, what and how they learn from the experience, and the ways in which the experience influences their teaching practices.

INVESTIGATING THE EXPERIENCE: A CASE STUDY OF A SCIENCE
PROFESSIONAL DEVELOPMENT PROGRAM BASED ON KOLB'S
EXPERIENTIAL LEARNING MODEL

by
Brian L. Davis

A Dissertation

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Degree of
Doctor of Philosophy
in
Teaching and Learning
in
the Department of Middle-Secondary Education and Instructional Technology
in
the College of Education
Georgia State University

Atlanta, GA
2008

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Brian L. Davis
2008

DEDICATION

This dissertation is dedicated to all of those who have come before me, those who have stood next to me throughout this process and those who come after me that I can provide a foundation to stand upon. It was not long ago that someone like me would not have been allowed to pursue the highest level of educational attainment. I complete this task placed before me to honor those who fought to ensure that I could one day have this opportunity. I complete this task placed before me for my wife and children who have stood beside me and continually provided me with words of encouragement. I complete this task placed before me to let my brothers know that I have not lost faith in their ability to flourish, as I am confident that we will one day be placed properly; amongst greatness.

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I also want to acknowledge the Georgia Aquarium and its staff for providing me with an opportunity to utilize your facility to better serve the needs of the educational community. Jeff, Bruce, Kim and my educational family thank you all for your support.

Last, but certainly not least, I want to acknowledge Dr. Thomas, Dr. Martin-Hansen, Dr. Geeta, and Dr. Dias. You all have supported and assisted me in the obtainment of a dream. Thank you all.

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CHAPTER 1

INTRODUCTION

In 1983, the education community was informed of the urgent need for science education reform as the results of the National Commission on Excellence in Education report, *A Nation at Risk*, were made public. This landmark publication ignited the flames of education reform in the United States, particularly in the areas of science and mathematics. *A Nation at Risk* served as the impetus for science education reform on several fronts. One of the most notable publications to follow the report was Project 2061 Benchmark for Science Literacy (American Association for the Advancement of Science [AAAS], 1993). Project 2061 is an educational initiative aimed at providing science education reform for students in an effort to ensure scientific literacy for all Americans by the year 2061. Nearly 20 years after the initial report, U.S. students were tested again on their scientific knowledge, and they demonstrated that they still lagged behind their global competitors as reported by Bennett et al. (1998) in their article, “A Nation Still at Risk.” This result illuminated the continued deficiencies of U.S. students and placed their lack of scientific literacy at the forefront of future science education reform initiatives.

Science literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity (National Academy of Science, 1995). Scientific literacy has not been easily achieved as science students are still struggling to perform as well as their global counterparts (Martin, Mullis, Gonzalez & Chrostowski, 2004).

However, Bennett et al. (1998) did note one important component of education reform: “Every child has the right to be taught by teachers who know their subjects well.” Those sentiments are being echoed today as the *No Child Left Behind Act* (2001) has placed professional development for teachers as an integral component for increasing student achievement.

Science teachers in the United States are currently engaged in a renewed and focused effort to increase achievement for all students (Wald & Castleberry, 2000). Research indicates that students and teachers acquire a deeper understanding of scientific concepts when learning with an inquiry-based, or experiential instructional model (Leadership and Assistance for Science Education Reform, 2006). However, when teachers have not been exposed to professional development experiences that use this model, they are unable to teach their students using this format. Simply stated, people teach as they are taught (Loucks-Horsley, Hewson, Love, & Stiles, 1998). If inquiry-based, experiential learning promotes student achievement and if most teachers fail to implement these practices, then many students may never have an opportunity to achieve academic success in science.

The Rivers to Reef professional development course was formulated on the premise that experiential learning positively affects teachers’ conceptual understandings of scientific concepts and pedagogy. In this study, I examine the impact that the Rivers to Reef professional development course has on the teaching practice and professional growth of three middle school science teachers.

Background Information

The role that teachers play in the academic success of their students has been explored from various perspectives, and the research indicates that teachers have a significant impact on student achievement (McCaffrey, Lockwood, Koretz, & Hamilton, 2003; Tal, Dori, & Lazarowitz, 2000). Carey (2004) prioritized the importance of the role of teachers as one that is greater than race, poverty level, or parent's education. Teachers on average reach between 120 and 150 students each year, making them one of the best conduits for providing students with information and preparing them for their future (Ohme & Rayford, 2001). Knowing that teachers have such a profound impact on students and student achievement, national education policymakers have placed professional development as a critical component of education reform and allocated millions of dollars to improve professional development courses (Craft, 2000; Guskey & Huberman, 1995; Loucks-Horsley et al., 1998).

On many occasions the lack of academic success that a teacher has with her or his students is blamed on inadequate teacher preparation (Center for Science, Mathematics, and Engineering Education [CSMEE], 1997). This lack of preparation could have its origins in the preservice teaching program that they were involved in or professional development programs that they have experienced throughout their teaching career (Craft, 2000). The inadequacies of professional development programs affect student learning because they influence the preparedness of teachers and affect teachers' development as professionals (Bransford, Brown, Cocking, Donovan & Pellegrino, 2000). Teachers recognize that professional development experiences have deficiencies, and revisions to the traditional professional development format are necessary for

teachers to maximize the learning experience in the classroom (Corabi, 1995; Husby, 2002).

The traditional professional development format involves information being delivered to a group of passive receivers of information, at a 1-day workshop, by an external expert, centered around a district-wide goal that provides limited information or activities that can be used in the classroom (Husby, 2005; National Research Council, 1996). The traditional method of professional development has been deemed antiquated and ineffective (Darling-Hammond & McLaughlin, 1995; Horsley & Loucks-Horsley, 1998; Lieberman, 1995). Conversely, there are several models, including the community centered model, the Learning through Inquiry Science and Technology model (Gerber et al., 2003), the case-based model, and the Experiential Learning Model (Kolb & Fry, 1975) that are being explored for their effectiveness as professional development tools for science teachers. I selected the Experiential Learning Model for this study because each of the abovementioned models has components of the experiential learning model interwoven into its overall design. The experiential learning model serves as the overarching model for this study, and the findings offer contributions to the abovementioned professional development models.

There exists a need for more research in the area of professional development for science teachers, specifically in relation to experiential learning and teacher practice (Bransford, Brown, Cocking, Donovan & Pellegrino, 2000). How and what teachers learned during a professional development course that integrated the experiential learning model was the major focus of this study. How teachers learn is extremely important in understanding what educators, teachers, and professional development leaders must do to

prepare teachers and ultimately to enhance learning opportunities for kindergarten through 12th grade students.

In this context, the Georgia Aquarium has designed a professional development experience for teachers integrating the components of Kolb and Fry's Experiential Learning Model (see Figure 1) called the Rivers to Reef professional development course. The impetus for using this model was based on feedback from teachers and the Educational Advisory Committee, a subcommittee within the aquarium, indicating there is a need for teachers, especially science teachers, to better understand the aquatic ecosystems of Georgia. The Educational Advisory Committee suggested having the participants of the Rivers to Reef program learn about the ecosystem by providing experience with all of the components that comprise the aquatic ecosystem. From these recommendations, the Rivers to Reef program was developed and was conducted for the first time in the summer of 2004. The course has been implemented for three consecutive summers. Throughout this time, evaluation data has been collected and revisions have been made to the course based on the feedback of its participants. However, there has been minimal effort placed on understanding the effectiveness of the professional development design and its impact on the teaching practice of its participants. The Rivers to Reef program was selected for this study because the program is new and its impact on the teaching practice and professional growth of its participants have not been examined.

The Georgia Aquarium is located in a major urban center. It opened its doors in November of 2005. The aquarium staff has placed education, conservation, and research programs at the forefront of its outreach initiatives with the main goal being to enhance public knowledge of the complexity and importance of aquatic ecosystems while actively

engaging them in valuable learning experiences. One aspect of addressing their education initiative involved the creation of the Rivers to Reef professional

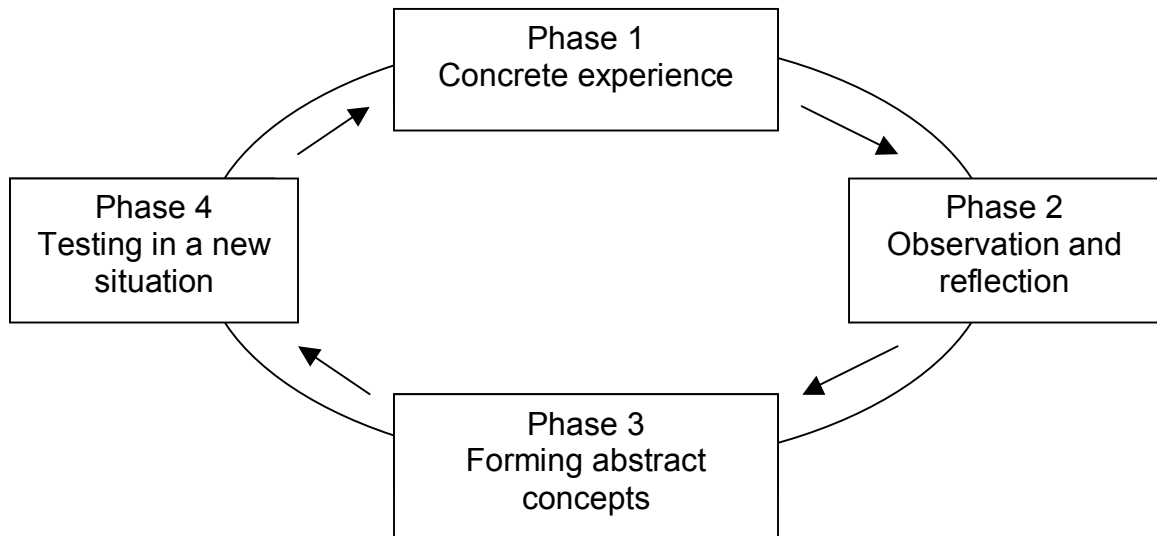


Figure 1. David Kolb's' Experiential Learning Model. The four phases of the model are indicated and the cyclic nature of the model is highlighted (Kolb, & Fry, 1975).

development experience for teachers. The Rivers to Reef program was developed by the Georgia Aquarium in partnership with the National Oceanographic and Atmospheric Administration (NOAA). NOAA summarized its commitment to education as follows: "For the American population to become more scientifically literate, greater emphasis must be placed on engaging individuals in the activity and nature of science" (NOAA, 2006). Based on the converging goals of these two institutions and their desire to increase scientific literacy, a collaborative partnership developed.

The Rivers to Reef professional development course was designed to provide teachers with an opportunity to be active participants in the process of learning scientific

concepts. This involves the immersion of teachers into the learning environment. Immersive learning seeks to offer a transformative growth experience by involving participants fully in a specific context and skill set (Baker, 1993). The Rivers to Reef program is a 5-day immersive learning experience where teachers receive hands-on reflective learning opportunities while exploring a river system from its headwaters to the coast. While participating in the Rivers to Reef experience, the teachers are provided with activities that they could apply to their kindergarten through twelfth grade science curriculum. The principles of Kolb and Fry's (1975) Experiential Learning Model were highlighted throughout the course in hopes that the participants would apply these principles to their teaching practice. The Rivers to Reef experience concluded in July 2006, and the data collection portion for this study began in April of 2007.

Statement of the Problem

The research literature indicates that individuals learn best when they are taught using an experiential learning model (Boud, Keogh, & Walker, 1985; Fiszer, 2004; Ghaye & Ghaye, 1998). However, teachers rarely infuse the experiential learning model into their science curriculum even though research supports the beneficial nature of this teaching method (Hein, 1995; Knowles, 1984). Teachers do not have adequate training using the experiential learning model and if they are not exposed to professional development courses using this model they cannot provide their students with optimal scientific learning experiences. Throughout the Rivers to Reef experience, the teachers were exposed to the experiential learning model and challenged to find ways to create similar learning opportunities for their students. The teachers were not explicitly informed of Kolb and Fry's model; however, each teacher was exposed to the

components of the experiential learning model, which includes having an experience, reflecting on the experience, forming new ideas or concepts and then applying that information to a new setting (Kolb & Fry). Interaction and reflection are two critical components of the experiential learning model, and human learning is optimized when these two components are integrated into learning opportunities (Bransford et al, 2000; Dewey, 1938; Vygotsky, 1978).

Two major problems are associated with the inability of science teachers to teach using the experiential learning model and to infuse this model into their teaching practice. The first problem relates to teachers' not having a thorough understanding of the experiential learning model and how it is integrated into the science classroom (Kendall, Duley, Little, Permaul, & Rubin, 1986). Teachers need opportunities to learn about the experiential learning model and effective methods for integrating the model into their science curriculum. Teachers then need to be provided with an opportunity to practice experiential teaching before they incorporate the method into their daily practice (Loucks-Horsley, 1998).

The second problem involves teachers having limited exposure to professional development programs that integrate the experiential learning model (National Research Council [NRC], 1996). Many professional development programs involve traditional lectures to convey science content, accompanied by an emphasis on technical training about teaching (Fischer, 2004). The NRC (2000) indicates that teachers learn best in environments where they are active participants in the learning process. Successful professional development programs involve teachers in learning activities that are similar to the ones that they will use with their students. Teachers and students, especially in

science, rarely receive learning opportunities that integrate the experiential learning model, so the lack of exposure to this teaching method impedes teachers' ability to integrate this method into their teaching practice.

If the theories espoused by Dewey and Hein are correct, then teachers and students would receive an optimal learning experience if their curriculum incorporated the experiential learning model. However, because teachers do not have adequate training using the experiential learning model and they are not exposed to professional development courses using this model, they cannot provide their students with optimal scientific learning experiences. The Rivers to Reef program provides teachers with exposure to and an understanding of the experiential learning model. In this study I examined the impact that a professional development course based on an experiential learning model had on the teaching practice and professional growth of its participants.

Significance of this Study

The existing research literature is rich in data related to the importance of professional development, the role of professional development in relation to teacher effectiveness, and the impact teachers have on student achievement. However, there is limited research related to how a professional development program that integrates the experiential learning model affects teaching practice and professional growth of its participants. This study analyzes the impact of the Rivers to Reef professional development program on the teaching practice and professional growth of three middle school science teachers to offer insights on this topic.

Loucks-Horsley, Guskey, Darlington-Hammond, Bredeson and Hein are just a few researchers who have documented the needs related to the improvement of

professional development programs for teachers. Their research has examined professional development on multiple levels, including problems associated with professional development, recommendations and models for improvements, the role professional development plays in the growth and development of teachers, and the impact that effective teachers have on student achievement. These researchers provide a robust picture of the current status of professional development but have also illuminated the deficiencies in relation to professional development. One such deficiency in the research literature relates to how science teachers integrate professional development experiences into their teaching practice.

The existing professional development research literature supports the idea that the most beneficial learning experiences for teachers are those that promote active participation or engage the teachers in the components of the experiential learning model (Craft, 2000; Fiszer, 2004; Loucks-Horsley, 1998; Senge et al., 1999; Wald & Castleberry, 2000). Hein, Loucks-Horsley, and Bredeson have all infused experiential learning opportunities as integral components of their plans for improvement in professional development. Their work indicates a clear connection between experiential learning and increased teachers' satisfaction related to professional development experiences and teacher learning. However, how teachers integrate their professional development experiences into their teaching practice and the impact it has on their professional growth have been minimally examined. This study is significant for its contribution in enriching the research literature on professional development and experiential learning for science educators.

Purpose of This Study

The purpose of this study was to explore how a professional development course integrating Kolb and Fry's (1975) Experiential Learning Model affects the teaching practice of three middle school science teachers. The selected teachers all participated in the Rivers to Reef professional development course in previous years. This research is based on examining whether and how the three teachers integrated the Rivers to Reef experience into their science teaching practice and the impact the experience had on their professional growth.

With sweeping changes in education reform and the requirement that all teachers will be deemed as "highly qualified" in their subject area (U.S. Department of Education, 2006), it is important to gain an understanding of which aspects of professional development has the greatest impact on science teaching practices. By investigating the participants' perception of their Rivers to Reef experiences and their current teaching practices, I gained insights into which aspects of the experiential learning model affect their science teaching practice. To obtain the data, I conducted interviews and document/artifact analysis. For the interviews, I employed open-ended questions as supporting prompts to elicit a deeper understanding of the experiences and its relation to the topic being studied (Seidman, 1998).

Guiding Questions

Previous research studies have indicated that professional development courses are often unsuccessful in yielding the intended results of providing science teachers with a beneficial educational experience (Fizser, 2004; Guskey & Huberman, 1995). Teacher professional development courses should be designed to equip teachers with the tools to

meet the needs of their students. To gain a greater understanding of the Rivers to Reef experience from the perspective of the teachers, I sought answers to the following questions:

1. What is the relationship between a professional development course that uses an experiential learning model and the science teaching practice of its participants?
2. How do the Rivers to Reef participants reflect on and describe the course as a professional growth experience?

To minimize confusion of terms used for the abovementioned guiding questions I will define them in relation to the purposes of this study. The terminology associated with this study has the potential to change over time as new research related to science education continues to develop. Providing the reader with clearly defined current definitions of the terms will ensure that the data obtained as a result of this study will be used in the appropriate context for future research studies.

The research related terms are defined as follows:

Professional growth is defined as how teachers think, what they believe and what teachers do in their classroom (Guskey & Sparks, 1991).

Experiential Learning Model is a model developed by Kolb and Fry (1975) that integrates four stages of learning: concrete experience, observation and reflection, forming abstract concepts, and testing in a new situation.

Science Teaching Practice is that which instructors do in the classroom to facilitate learning for students. This can include but is not limited to, instructional

choices, lesson plan choices, materials selection, technology integration, classroom design, and student/teacher arrangements.

Theoretical Framework

The theoretical framework informing this study is based primarily on the theories developed by John Dewey (1938) and David Kolb and Roger Fry (1975). The works of these scholars served as the foundation that guided this research study and its design.

Dewey has had a profound impact on education and education reform initiatives in the 20th century. His work is considered a mainstay in the education community and for this reason he is often cited in the justification of theories and practice related to student-centered learning (Wong, Pugh, & the Deweyan Ideas Group at Michigan State University, 2000). However, his work is often overstated, and in many cases Dewey is cited as a person that would be in support of initiatives that his research clearly states he would be in opposition to. One such area is experience and its relation to education.

Dewey acknowledged the benefits of educational opportunities based on experiences but he also acknowledged that not all experiences are beneficial from an educational standpoint. He made a clear distinction between “experience” and “an experience.” Dewey noted that in our daily work we have experiences that are the result of interacting with the living and nonliving components of our world. However, Dewey indicated that these experiences rarely develop fully to have any significant meaning because they lack coherence, development and flow, so that they become of minimal importance in our lives. On the other hand, Dewey described “an experience” as one that is lived to its fulfillment. These experiences involve anticipation, development, and unity

of its component parts which ultimately lead to the act of thinking and creating meaning related to the experience.

The act of creating meaning through thinking is a significant component in the examination of the guiding questions for this research study. Evidence of thinking (in relation to the Rivers to Reef experience) and creating (effective teaching opportunities) were analyzed in the interviews and documents/artifacts to determine if the three participants perceived the Rivers to Reef program to be an “experience” or “an experience.” One of the ways that this was accomplished was to explore if the participants see the program as an educative or miseducative learning opportunity.

Dewey addressed experiences from another perspective; the educative experience and the miseducative experience. As I mentioned above, Dewey (1938) made it clear that not all experiences were beneficial from an education standpoint. In *Experience and Education*, he addresses the components that distinguish an educative from a miseducative experience. Miseducative experiences are those that impede or distort the growth of future experience. One may assume that these are negative experiences that hinder the pursuit of future experiences, but this is not always the case. Experiences that are enjoyable yet disconnected can form a sense of complacency which could hinder future experiences as well. Conversely, educative experiences are those that have a positive impact on the future pursuit of an experience. All educative experiences are not borne of positive experiences in the same fashion that not all positive experiences yield educative results.

The two principles related to experience that serve as the foundation for this study are continuity and interaction. Continuity states that each experience a person has will

have a positive or negative influence on their future experiences. Interaction relates to the current experience of a person and the influence previous experiences have on the current situation. In this study, I examined the Rivers to Reef professional development course as an educative or miseducative experience in relation to Dewey's theory of continuity and interaction. The work of John Dewey laid the foundation for future works examining the role of experience in education. One such work was the theory and model of experiential learning developed by David Kolb and Roger Fry.

David Kolb developed the Experiential Learning Model (ELM) based on the idea that learning takes place as a result of an experience. Experience allows the learner to become an active participant in the learning process. Individuals who are not active participants in the learning process but instead are receivers of information do not obtain the same level of deep understanding of concepts as the active participant (Kolb, 1984). Learning theorists and organizational theorists posit that people learn best through active involvement and through thinking about and discussing what they have learned (Lieberman, 1995).

Kolb's experiential learning model incorporates the following four components: concrete experience, observation and reflection, forming abstract concepts, and testing in new situations (Kolb & Fry, 1975). Theorists would later use the foundation of Kolb's Experiential Learning Model for other theories, including the Adult Learning Theory (Knowles, 1970). For the most part, the model involved participants having an experience, reflecting on that experience, forming a new idea, and then applying what they have learned to a new situation.

For this research, Kolb's model served as the foundational concept for how teachers used the information they obtained in the Rivers to Reef professional development experience to their science teaching practice. To gain an understanding of this information from the perspective of the teachers, I used the reflection process model developed by Boud et al. (1985; see Figure 2). The reflection model provides a more detailed analysis of how teachers moved through stages 1-3 of Kolb's experiential learning model. I will discuss this model further in chapter 2.

Components of Kolb's Experiential Learning Model and the Reflection Process Model serve as the foundational aspects of my theoretical framework. This study explores the teachers' perspective of the Rivers to Reef program, the impact of the experience on the self-efficacy of the teachers, and how the experience translates into teaching practice. Stage 4 of Kolb's experiential learning model (testing in a new situation) was examined in detail through individual interviews. Kolb's Experiential Learning Model and the Reflection Process Model were also selected because they were appropriate models to aid in addressing the two guiding questions.

This research took place in three distinct phases, following the Reflection Process Model (Boud et al., 1985) of Experience, Reflection and Outcome. Table 1 displays the dates and the format used in the acquisition of data. The major focus of this research study was in the outcome phase of the Reflection Process Model.

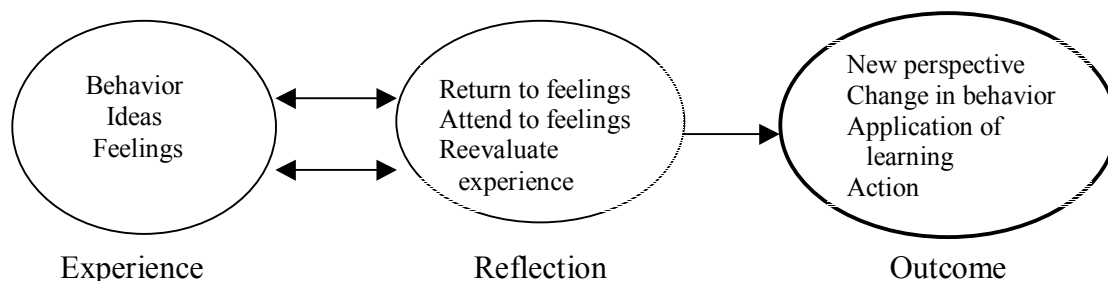


Figure 2. Reflection Process Model. The model describes how reflection affects the outcome of an experience (Boud, Keogh, & Walker, 1985).

Table 1

Comparison of the Research Study Phases and the Reflection Process Model

Reflection Process Model	Experience	Reflection	Outcome
Phases	Phase 1 Before the study	Phase 2 Interim	Phase 3 The study
Timeline from the Rivers to Reef course to the re- search study	Rivers to Reef Experience June-July 2005 and 2006	Teacher reflects on the experience and deter- mines what to do with the knowledge that she has acquired. June-July 2006 – April 2007	Action taken in the form of implementa- tion of experiential learning model as a teaching tool June 2006 – April 2007

In phase one of this study, 16 teachers participated in the week-long Rivers to Reef professional development experience. The second phase of the study involved teachers' reflecting on the information they acquired throughout the Rivers to Reef experience and how that information could be integrated into their science teaching practice. Phase three was the primary focus of this research study as it related directly to

the action taken on the part of the three educators that participate in outcome/ research phase of this study.

Research Design

As the researcher, I played the role of participant observer in this study. Three middle school teachers were selected from a purposeful sample process. This case study was conducted over the course of 4 months, and the study began 9 months after the teachers had completed participation in the professional development experience. Having the teachers participate in the study several months after the experience provided them with time to reflect on the professional development course and implement the learning experience into their classroom curriculum as well as examining what effects, if any, were present in the long term.

The primary data collection tool used for this study was a series of three interviews conducted with each participant. During the individual interviews, I acquired demographic information, information related to the participants' self-efficacy in relation to teaching science, and information related to the Rivers to Reef experience and the impact the experience had on each participant's science teaching practice.

Summary

Today there is a great deal of pressure at the local, state and federal level to find ways to support successful teaching and learning through effective professional development (Salpeter, 2003). The ways teachers learn may be more like the ways students learn than we have previously recognized (Lieberman, 1995). A significant number of professional development opportunities for teachers involve workshops, courses, or institutes that may not be appropriate to the learning goals and that may provide

inadequate support for teachers to apply what they have learned in the classroom (Loucks-Horsley et al., 1998). These issues play a significant role in perpetuating ineffective professional development experiences for teachers.

Researchers, including Hein (1995), Bredeson (2003), Loucks-Horsley et al. (1998), Guskey (2003), and Darling-Hammond (1997), support the use of experiential learning and inquiry-based lessons in professional development courses to enhance teacher satisfaction and content knowledge. However, minimal research has been conducted to examine the role that these professional development opportunities play in the teaching practice and professional growth of middle school science educators. Using interviews and document analysis, this study will explore how the Rivers to Reef professional development program affected the professional growth and teaching practice of three science educators. The research design for this study placed the perspective of the individual teachers as the highest priority for the acquisition of data. For this reason, an interviewing format was selected as the primary data source.

CHAPTER 2

LITERATURE REVIEW

Introduction

In this study, I explore how the use of Kolb's Experiential Learning Model in a professional development course affects the professional growth and teaching practice of three middle school science educators. Kolb's experiential learning model is grounded in the fundamental concepts of having an experience, reflecting on the experience, formulating new ideas, and testing the ideas in a new setting (Kolb & Fry, 1975). In this chapter, I describe the research literature associated with professional development and then examine the implications of professional development on the self-efficacy and teaching practice of science educators. Experiential learning and constructivism are examined for their role as critical components of the theoretical framework associated with this study. Lastly, I examine self-efficacy and the role it plays in the teaching practice of science educators.

Professional Development

Professional development for educators has been defined as the process or processes by which teachers achieve higher levels of professional competence and expand their understanding of self, role, context and career (Duke & Stiggins, 1990). In the *Education Evaluation of Statewide Staff Development Summary* (Georgia Department of Education, 2004), teachers acknowledged that staff development courses have the strongest impact on their professional growth and development as teachers. The

participation of teachers in professional development courses allow for teachers to remain in tune with the ever changing fields in which they teach. Throughout the education profession, the concept of continuing education through staff development to enhance skills, knowledge, abilities, and beliefs is inextricably linked to effective teaching and learning (deMarrias, Lewis, & Liljestrom, 2003).

Professional development takes place in many different forms that can range from half-day sessions to on-going courses that could last for several days or several weeks. Traditionally, professional development courses have been designed to have teachers acquire information related to state-wide or school-district initiatives over a short period of time. Often, the traditional professional development format has yielded dismal results (Knight, 2000; Little, 1993; Miles, 1995) and the traditional methods of professional development have been heavily criticized, leading to the search for new, more effective professional development opportunities (Haselhuhn, Al-Mabuk, Gabriele, Groen & Galloway, 2007).

Professional development has been placed at the forefront of education reform as research data continue to suggest that there exists a positive correlation between well prepared teachers and increased student achievement (Darling-Hammond, 1999; Marzano, Pickering, & Pollock, 2001). A plethora of literature related to professional development exists; however, most of this literature examines traditional professional development methods. In recent years, new research has emerged focusing on effective professional development courses by more closely examining how teachers learn (Bransford et.al, 2000). The results indicated that teachers learn more effectively when they are allowed to voice their needs and preferences regarding the content and design of

professional development, when they are actively engaged in the learning process, when the content is relevant to their instruction, and when the teachers are engaged in an on-going professional development experience (Porter, Garet, Desimone, Yoon, & Birman, 2000). In his research related to what makes professional development effective, Guskey (2003) found that providing teachers with a deeper understanding of the content they teach and ways for students to learn that content were paramount in their view of effective professional development (Thornton, 2004). Two components have been suggested repeatedly in the literature, inquiry and experiential learning (Trotter, 2006). For the purpose of this research study, I focus on the experiential learning model, its relation to professional development, and its impact on teaching practice.

Bredeson (2003) found in his research related to professional development and student's achievement that professional development is closely linked with school improvement and students' learning. He asserted that professional development should be placed at the center of educational reform in the United States and around the world. Teachers and researchers agree that professional development plays an important role in the continued growth and development of educators and is a vital component for the successful implementation of education reform initiatives (deMarrias et al., 2003). Loucks-Horsley et al. (1998) acknowledged that there are few that would debate the need for on-going professional development and that the call is heard at every level of education.

Professional development has played a significant role in teacher preparation for decades; however, prior to the release of *A Nation at Risk*, professional development remained minimally explored. The storm of education reform unleashed since the release

of the report has slowly pulled professional development to the vortex of education reform initiatives. In 1995, the National Educational Goals Panel recognized professional development as one of its primary goals and this resulted in a modern day scaffolding of the prioritization of professional development. The momentum continued in 1996 with the release of the National Science Education Standards. These standards supported continued professional development for science teachers in an effort to enrich the learning experience and increase science literacy for students. Later, in 1996, state governors and business leaders convened to create world class standards in critical content areas and address the need for continued professional development. By 1997, the need for an increased emphasis on professional development had made its way to the White House as President Clinton addressed the need for continued professional development in his State of the Union Address (Loucks-Horsley et al., 1998).

By the turn of the century professional development was firmly established as an area that needed continued support to meet the science education goals established by education reform initiatives. In 2002, the educational community made preparations for one of the most significant federal education reform efforts, the *No Child Left Behind Act* [NCLBA]. The NCLBA established new standards for accountability on the part of teachers and set the stage for requiring that all teachers were “highly qualified” in their content area. According to the authors of this legislation, a highly qualified teacher has a bachelor’s degree, full state certification or licensure, and proof that he or she knows each area he or she teaches (U.S. Department of Education, 2006). Although the obtaining of “highly qualified” status for teachers was largely left up to the state-level education departments, the federal government showed a commitment to the NCLBA by requiring

all states to submit a plan for getting teachers to the highly qualified level by the end of the 2005-2006 school year.

In an effort to provide teachers with the most beneficial professional development experience, new and effective methods of designing professional development courses have been explored in recent years. Two researchers took an innovative approach to developing professional development opportunities. Instead of creating a professional model to follow, they created guidelines that should be taken into consideration when creating professional development courses. The guidelines that were established by Bredeson (2003) and Loucks-Horsley (2000) provided professional development course developers with items to consider and incorporate when they created their courses, not a step-by-step format to follow.

Bredeson (2003) examined professional development courses at the turn of the 21st century, and found the existing professional development courses were not adequately meeting the needs of teachers. He argued that professional development courses tended to promote privacy, isolation, and individualism among educators. To combat this issue, Bredeson asked teachers to think about their learning and its connection with their primary work of teaching children. Their feedback led to the development of *The New Architecture for Professional Development*. Bredeson noted that in an effort to increase the effectiveness of the professional development experiences for teachers, professional development designers should incorporate the following six design principles when creating professional development courses:

1. Professional development is about learning;
2. Professional development is work;
3. Professional expertise is a journey, not a credential;

4. Opportunities for professional learning and improved practice are unbounded;
5. Student learning, professional development, and organizational mission are intimately related;
6. Professional development is about people, not programs.
(Bredeson, 2003)

The proposed new architecture requires three fundamental shifts in the landscape of professional development—rethinking, restructuring, and reculturing to create professional learning communities that expand the horizons for professional learning beyond models and activities (Bredeson, 2003). This concept was also used by Loucks-Horsley (1998) in *Designing Professional Development for Teachers of Science and Mathematics*. Loucks-Horsley explains the design process for professional development courses in science and mathematics. The design she proposed was based on a collective group of individual professional development designers who decided that it was important to avoid the promotion of a model for others to follow; instead, they chose to develop a process to use when thinking about designing professional development courses. The group used research, their knowledge of student learning, adult learning, and their beliefs about the nature of mathematics and science to design the process. Figure 3 was developed as a result of their concerted efforts (Loucks-Horsley et al., 1998).

At the center of this design process is the planning sequence for professional development programs. The planning sequence involves setting goals, planning, doing and reflecting. Each of the circles represents important items that affect setting goals and planning related to the professional development programs. The circles serve as a reminder for the professional development designers to focus on the factors that are specific to each professional development experience. These unique factors involve the context of the experience, the research related to professional development strategies,

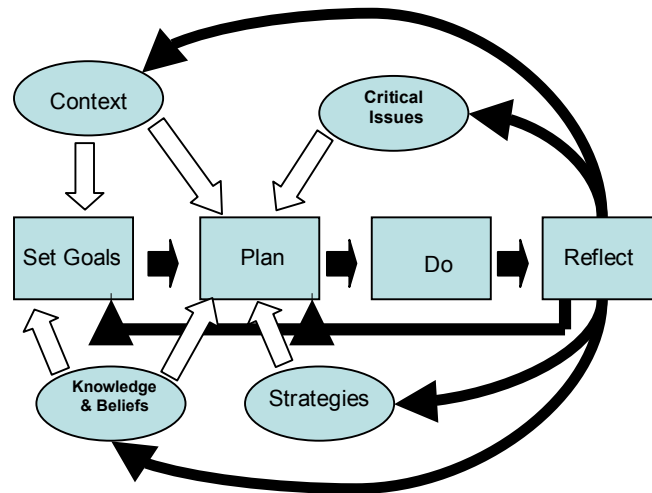


Figure 3. Professional Development Design Process for Mathematics and Science Education Reform (Loucks-Horsley, Hewson, Love, & Stiles, 1998).

issues critical to mathematics and science education reform, as well as their personal knowledge base and beliefs. Reflection plays a significant role in this process as it impacts setting future goals, planning future professional development experiences and all of the factors that influence these two areas. Reflection can influence every input, which in turn influences the creation of a new and better design (Loucks-Horsley et al., 1998).

Loucks-Horsley et al.'s (1998) process design and Bredeson's (2003) new architecture both approach professional development as a process of continued growth and development for teachers. Bredeson emphasizes that professional development is about learning above all else (Shymansky et al., 1997). The first principle of his new architecture explicitly indicates that professional development should focus on learning, and this idea is reiterated throughout the other five principles. Ultimately, Bredeson urges

the education community to move away from merely accumulating professional development courses and focus on courses that promote learning that responds to specific goals or issues (Heideman, 1990; Schibeci & Hickey, 2004). Loucks-Horsley et al.'s (1998) design integrates the components of plan, do, and reflect. The reflection affects the future goals and the plan for the teachers which create a process that is dynamic and always changing to meet the learning needs of the teachers (Ariza & Gomez, 1992; Heideman; Schibeci & Hickey; Zepeda, 1999). Like Bredeson's principles, Loucks-Horsley et al.'s process for design provides a guide that places teacher learning as a central component of professional development without creating a model that has the potential of becoming antiquated as professional development needs change over time.

The Rivers to Reef program was designed to be dynamic as well. Instead of adhering to a specific professional development model, the course was designed to allow for the maximum amount of flexibility where teacher learning would always be the highest priority of the course. The plan, do and reflect aspects of Loucks-Horsley design is an integral component of the experiential learning model, and this concept is interwoven into the fabric of the Rivers to Reef program. These components are characteristics of constructivism and the experiential learning theory. Dewey and Kolb have made significant contributions to the body of literature related to these areas and they will be explored further in the next section.

Constructivism and Experiential Learning

For decades teaching science involved taking a scientific concept and breaking it down into its basic form called the transmission model of teaching influenced by the reductionist thought of deductive reasoning in science. Through the 20th century,

Thorndike's behaviorist psychology was much more widely applied to teaching practice than Dewey's progressivism, which focused more on student interests. By the 1960s and 1970s, the reductionist view was replaced by far more complex nonreductionist views, including constructivism (Kelly, 1997). Constructivism involves the acquisition of knowledge by individuals through a process of schema development that occurs as sensory data is given meaning in terms of prior knowledge (Tobin, Kahle, & Fraser, 1990). In recent decades, constructivism has received a tremendous amount of support as a useful learning theory for informing instructional design and teaching (Desouza & Czerniak, 2003; Vagle, 2006). The speed of its growth has sometimes made constructivism seem like a recent development when, in fact, it has been emerging for centuries (Mahoney, 2004).

Constructivism has gained wide acceptance and a tremendous amount of momentum as it relates to preparing students to gain a deeper understanding of scientific concepts (Good, 1994; Shymansky et al. 1997). This is in part because constructivism takes the student from the role of passive learner to that of an active participant in the learning process (Educational Broadcasting Corporation, 2004). Findings also suggest that like students, teachers also benefit when learning is presented in a format that integrates a constructivist model (Bransford, Brown, & Cocking, 2000).

Recently researchers have taken inquiry, praxis, and constructivist thought into consideration when developing professional development programs. The move from a traditional professional development format where teachers are passive recipients of information, to teachers playing an active role in learning through constructivism have provided teachers with an increased understanding of scientific concepts (Guskey &

Huberman, 1995). Even though professional development opportunities that integrate constructivism are increasing, many professional development programs still focus on a very traditional classroom training format (Dass, 1997; Westerlund, García, Koke, Taylor, & Mason, 2002). Hein, Loucks-Horsley, and Bredeson have made a concerted effort to examine the learning phenomenon for teachers. In this study, I used the Experiential Learning Model developed by David Kolb to determine how teachers learn, what they learn as a result of the experience and what impact it has on their teaching practice.

George Hein is known for his research related to how individuals learn. Hein explored constructivist thought and the use of constructivist practices in an informal setting. Informal settings include any area outside of the traditional formal education domains including schools, colleges, or universities (Conner, 2005). He supported the idea that learners construct knowledge as they learn; they do not simply add new facts to what is known but constantly reorganize and create both understanding and the ability to learn (Hein, 1995). Hein developed nine principles of learning that relate to constructing knowledge, particularly how knowledge is constructed in an informal setting. Of the nine principles defined by Hein, the five I felt most saliently related to my study are listed below.

1. Learning is an active process in which the learner uses sensory input and constructs meaning out of it.
2. The crucial action of constructing meaning is mental: it happens in the mind. Physical actions, hands-on experience may be necessary for learning, especially for children, but it is not sufficient; we need to provide

activities which engage the mind and provide something to think about as well as something to touch.

3. Learning is a social activity: our learning is intimately associated with our connection with human beings.
4. Learning is contextual: we do not learn isolated facts and theories in some abstract ethereal land of the mind separate from the rest of our lives: we learn in relationship to what else we know, what we believe, and our fears.
5. It takes time to learn: learning is not instantaneous. For significant learning we need to revisit ideas, ponder them try them out, and use them.

Table 2 compares these five components of Hein's Principles of Learning to the River's to Reef Experience. The five areas are summarized as active learning, hands-on/-minds-on activities, social learning groups, contextual learning and reflection. The Hein principles were used in examining the Rivers to Reef program because the Rivers to Reef Course is a learning experience for teachers conducted in an informal learning environment. The table provides several examples of how the activities of the Rivers to Reef experience could have played a role in the acquisition of knowledge based on the principles that Hein developed.

The principles of constructivism have been integrated into many informal learning environments, schools and instructional curriculum. However, teaching in ways that support the learners' construction of knowledge requires more time than what is needed to merely transmit information (Brooks & Brooks, 1993; Phillips, 1995; Yager, 1991). In many informal education settings (e.g., zoos, aquariums, museums), individuals have a very limited amount of time to go through the process of constructing knowledge

Table 2

Sample Rivers to Reef activities in comparison to components of Hein's Principle of Learning Model

<i>Active Learning</i>	<i>Hands-on/-Minds on Activities</i>	<i>Social Learning Groups</i>	<i>Contextual Learning</i>	<i>Reflection</i>
Water quality testing	Water quality testing	Group reflections every evening	Water quality testing	Providing teachers with journals for independent reflection
Tracing the river from the headwaters to the coast	Canoeing in a freshwater river swamp	Teams collecting water quality data and analyzing results	Collecting biological samples throughout the experience	Group reflection opportunities every evening about the events of the day.
Driving the remotely operated vehicle on Gray's Reef	Basket weaving using the traditions of Sapelo Island natives	Working with representatives from state and federal agencies	Meeting with residents on Sapelo Island to understand cultural components of the island	

(Kisiel, 2003). When school groups visit informal education settings, they tend to have 2-3 hours to experience the facility. To go through the process of constructing knowledge within this time constraint is difficult at best (Cox-Petersen, Marsh, Kisiel, & Melber, 2003). In a recent article in *Visitor Studies Today*, Ridgeway, Livingston, and Smith (2005) stated, "Zoo managers aspire to extend visitor viewing time at exhibits to increase the opportunity for visitors to be adequately educated about the exhibit." However, the science classroom provides a considerable amount of time for students to experience fully the process of constructing knowledge. Providing students with additional time allows

them to reflect on the learning opportunity, an integral component of constructivism as well as the experiential learning model.

There have been several researchers who have made significant contributions to the body of literature associated with constructivism, experiential learning and the reflective process of learning. Dewey, Kolb, Hein, Schon, and Boud have all examined learning through experience and the associated reflective processes (Vygotsky, 1991). Their work in this area has generated significant research literature related to how teachers learn and their work also serves as the foundational research literature for this study.

Experiential learning has its foundation on the basis that individuals learn best by experiencing a phenomenon and then reflecting on the event. There are several models related to experiential learning but the basic premise is the same throughout: Individuals have an experience, then they reflect on the experience and learn (Osterman & Kottkamp, 2004). Experiential learning is far from new. It is a technique as old as learning itself, and everyone uses this form of learning at various points throughout his or her life. Experiential learning is education that occurs as a direct participation in the events of life (Houle, 1980). Here, learning is not sponsored by some formal educational institution but by people themselves. It is learning that is achieved through reflection upon everyday experience and is the way that most of us do our learning. However, some argue that participating in life experiences does not always translate into understanding (Dewey, 1938).

John Dewey is noted for his work related to thinking, learning and reflection. Dewey (1933) referred to reflection as active, persistent and careful consideration of any

belief or form of knowledge in the light of grounds that support it. It is this belief that provides an important link between Dewey and experiential learning. Dewey (1938) discussed his theory of experience in *Experience and Education* (1938). Dewey established that having an experience does not necessarily mean that learning will take place, that is, not all experiences are educative.

In most cases, experiential learning opportunities play an important role in providing students with practical experiences to enrich their learning. Experiential learning has been used heavily in the training of professionals in several fields including doctors, lawyers, educators and scientist. Geologists have long recognized they must go to the field to experience the scale and scope of geological materials and processes if appropriate training is to be accomplished (Drummond, 2003b). Educators have recognized that they must do the same in order to gain a true understanding of their learning environment. One of the most important components of the modern university curriculum is the concept of experiential learning (Drummond, 2003a). In the university setting, experiential learning can be highly organized or very informal. Many forms of experiential learning take place at the post secondary level of education and some of the more popular forms include problem-based learning, service learning and internships (Lockart & Butt, 2002).

Dunton (2006) addressed the benefits of experiential learning and used a problem-based experiential learning format to teach her students. In the creation of the “micro-society,” elementary school students modeled the daily roles of individuals within their society. Dunton noted that students learned best when they connected schoolwork with the outside world. One student stated, “Now I know why I need to understand percentages. It’s to figure out taxes.” Dunton further mentioned that the students in her

school made gains of 14.3% in math and 11.6% in reading compared to their scores from the year before, attributing much of this success to the micro-society format that used the components of an experiential learning model.

David Kolb was an advocate of the experiential learning model. He used the works of individuals before him, like Piaget, Dewey, and Lewin, to develop a model that would have a profound impact on learning. Experiential learning allows one to capture the interest and involvement of the participants, but most importantly, it contributes significantly to the transfer of learning (Luckner, 1997). Kolb had an interest in how individuals learn and his work led him to develop the experiential learning model integrating concrete experience, observation and reflection, the formation of abstract concepts and testing in new situations (see Figure 1).

Kolb spent many years developing the model that later gave rise to the experiential learning theory. In 1984, Kolb acknowledged the works of Rogers and Piaget related to experiential learning. Today, Kolb is acknowledged by academics, teachers, managers and trainers for his work related to experiential learning and fundamental concepts towards understanding and explaining human learning behavior and towards helping others learn (Chapman, 2006).

Kolb's model of experiential learning can be found in many discussions of the theory and practice of adult education, informal education and lifelong learning (Smith, 2001). Experiential learning involves a direct encounter with the phenomenon being studied rather than merely thinking about the encounter, or only considering the possibility of doing something about it (Borzak, 1981). This sort of learning is sponsored by an institution and might be used in training programs for professions such as social

work and teaching or in field study programs such as those for social administration or geography courses (Kisiel, 2003).

Kolb includes the experiential learning model in Figure 1 as a central principle of his experiential learning theory. In this four-stage cycle of learning the concrete experience provides a basis for observation and reflection. These observations and reflections are assimilated and distilled into abstract concepts producing new implications for action which can be actively tested, in turn creating new experiences (Chapman, 2006).

Kolb (as cited in Smith, 2001) stated, “ideally this process represents a learning cycle or spiral where the learner touches all the bases, a cycle of experiencing, reflecting, thinking, and acting.” Immediate or concrete experiences lead to observations and reflections. These reflections are then assimilated into abstract concepts which have implications for action. The person can actively test and experiment with the creation of new experiences. In reality, if learning has taken place, then the process could be seen as a spiral. The action is taking place in a different set of circumstances and the learner is now able to anticipate the possible effects of the action.

Table 3 parallels one of the Rivers to Reef activities to Kolb’s experiential learning model. In the example, the concrete experience is water quality testing. The observation and reflection phase involves reflecting on the health of the water that was tested and some implications related to their findings. The next phase involved forming abstract

Table 3

*Rivers to Reef Activity in Comparison to the Stages of Kolb's Experiential Learning**Model*

	<i>Phase 1 Experiencing</i>	<i>Phase 2 Reflecting</i>	<i>Phase 3 Thinking</i>	<i>Phase 4 Acting</i>
David Kolb's Experiential Learning Model	Concrete experience	Observation and reflection	Forming ab- stract concepts	Testing in new situation
Rivers to Reef Experience Example	Water quality testing in Macon. Analyzing the biological and chemical com- ponents of the water.	Reflecting on the health of water in an urban set- ting with other educators at the evening meeting.	Teachers ex- plore how stu- dents can learn about the health of a river by conducting biological and chemical water quality testing.	Have students conduct bio- logical and chemical analysis at a creek near the school.

concepts. This phase involved the teachers thinking about the water quality testing experiences and forming abstract concepts based on their reflection. The final phase involved having the teachers test their ideas in a new setting, the middle school classroom.

David Boud is another researcher that has played a role in the development of the experiential learning model. Boud has been involved in research and teaching development in adult, higher and professional education for nearly 30 years and has contributed extensively to the literature related to experiential learning. He is known for his work related to experience-based learning, adult learning and program development, researching educational practice, and analyzing professional practice (Smith, 2001). Boud was interested in how people learn and what could be done to foster their learning. Boud's

work ranges from curriculum design to work related to learning practices, including reflection. Boud played a significant role in the development of a model that outlines the reflective process.

Figure 2, the Reflection Process Model, is a three-stage model that describes the process of reflection in relation to an experience. In stage one the ideas, behaviors, and feelings of an individual in relation to an experience are examined. The key component in stage one relates to understanding that each experience has behaviors, ideas and feelings attached to it. The second stage of the reflective process involves the individual's reflection on the experience. This reflection serves as an impetus for a reevaluation of the behaviors, ideas, and feelings associated with the experience. The double arrow between the experience and reflection phases indicates that after the initial experience, reflection causes one to revisit the experience (in some cases, make several revisits to the experience) before one moves to phase three, the outcome. As indicated in Figure 2, the outcome occurs after the experience and reflection phase. The outcome could involve a new perspective, a change in behavior and/or taking action.

The use of the Reflection Process Model played an important part in acquiring an understanding of the Rivers to Reef experience from the perspective of the teacher participants. During the Rivers to Reef experience, the Reflection Process Model was used daily to gain an understanding of how each teacher processed the daily activities associated with the Rivers to Reef program. Each daily activity served as an experience. The teachers reflected on their daily experiences in their journal and in group discussions. The reflection time provided teachers with an opportunity to think about what they

experienced throughout the day and any changes they noted about their personal feelings, behaviors, or ideas.

During the study, the Reflection Process Model served to have teachers analyze the Rivers to Reef experience and examine the role the experience played in their teaching practice and professional growth. For the purpose of this research, the focus was placed on examining the outcome stage of the Reflection Process Model and how the Rivers to Reef experience provided teachers with a new perspective, a change in behavior, and how they applied what they learned.

In my examination of the experiential learning model and the reflective learning process, Donald Schon surfaced as a significant contributor to the body of literature associated with these topics. Schon (1991) was concerned with the development of reflective practice and learning systems within organizations and communities. He was noted for many contributions related to learning systems and organizational learning, but for the purposes of this study I will examine his work of reflection-in-action related to professional activity.

Schon focused a significant portion of his research on self-reflecting practice and he developed a series of books around the processes and development of reflective practitioners (Schon, 1983). His work was quickly, and enthusiastically, taken up by a large number of people involved in the professional development of educators, and a number of other professional groupings (Daniels, 2002; Norlander-Case, Reagan, & Case, 1999; Osterman & Kottkamp, 2004). The professional development community understood the importance of reflection based on the previous works of John Dewey. Dewey and Schon both believed in the practice of learning by doing. However, they did

have differing views on reflection. Dewey felt that knowledge was gained by reflecting after an event, and Schon felt that reflection should take place during the event. This study integrates the views of both Dewey and Schon. Throughout the Rivers to Reef experience the teachers were asked to reflect on their daily experiences following the reflective practice established by Schon. These were acquired in the form of group discussions and journal entries. The data collection process when the teachers return to their classroom followed the format established by Dewey, a reflection after the experience.

The impact of Schon's work on reflective practice has been significant, with many training and education programs for teachers and informal educators adopting his core notions both in organizing experiences and in the teaching content (Daniels, 2002; Osterman & Kottkamp, 2004; Zeichner & Liston, 1996). This reflection consists of strategies of action, understanding of phenomena, and ways of framing the situations encountered in day-to-day experience. This reflection-in-action may take the form of problem solving, theory building, or re-appreciation of the situation (Schon, 1985).

Hein addressed reflective practice and its benefits but added another dimension to the reflective process. Hein believed that learning through reflection was important but he emphasized that reflection/learning was best accomplished in a social setting. These ideals were firmly established by many social theorists that had come before him. Vygotsky, Piaget, and Dewey had conducted research related to social learning theories and addressed the benefits associated with learning in a social setting. Learning in a setting that allows for reflection within a group becomes increasingly more powerful

because learning can be built on the foundational knowledge of the group instead of the foundational knowledge of the individual.

Dewey encouraged the engagement of learners in experiences that are relevant to life and supports the development of citizens who have the ability to think beyond the memorization of facts (Nagel, 1996). Like Hein, Dewey recognized that learning was more beneficial as a social activity. Dewey saw that learning involved more than an interaction between the learner and the material, learning and use of conversation, interaction with others, and the application of knowledge is an integral aspect of the learning process (Dewey, 1933, 1938).

The research questions that guided this study were firmly entrenched in the research literature associated with experiential learning, constructivism and the reflective process. These three areas are tightly interwoven and provide a solid foundation for the further pursuits of this study related to how teachers learn. However, one additional area needs to be examined in this literature review in order to gain greater insights about teacher practice. An examination of self-efficacy will provide greater insights as to what teachers will do in their classroom once they have completed the professional development experience. The beliefs that teachers have about their ability to effectively teach using the experiential learning model and the science content will ultimately determine the teaching practice outcomes associated with the Rivers to Reef experience.

Self-Efficacy

Self-efficacy is mediated by a person's belief or expectations about her or his capacity to accomplish certain tasks successfully or demonstrate certain behaviors (Hackett & Betz, 1989). Bandura (1977), a prominent social learning theorist, referred to

the term self-efficacy as one's self-perceived capabilities (Thiessen, 1995). Bandura states that self-efficacy determines the level of motivation for an individual, and motivation causes behavior change. He states that if a person's behavior does not achieve success then the behavior is changed until success is achieved. Bandura also notes that efficacy beliefs do not always result in behavior change. Repeated failures can cause an individual to lower their efficacy standards in the same manner that repeated successes can raise efficacy standards.

Self-efficacy applies to all aspects of an individual's life and it governs people's behaviors, changes in behavior, motivation and affect. Teacher efficacy is related to teachers' confidence in their ability to promote students' learning. This was identified over 30 years ago as one of the few teacher characteristics related to student achievement in a study by the RAND corporation (Armor et al., 1976). In science teaching contexts, self-efficacy is an individual's belief that one has the ability to effectively perform science teaching behaviors (called personal science teaching efficacy) as well as one's belief that his or her students can learn science given factors external to the teacher (called science teaching outcome expectancy; Ramey-Gassert, Shroyer, & Staver, 1996). Elementary school teachers often limit the amount of time dedicated to science in their classroom. This is in part due to their low self-efficacy related to teaching scientific concepts. Studies have indicated that, particularly at the elementary school level, low self-efficacy toward science and/or science teaching tend to lead to the sporadic teaching of science, the teaching of science during inadequate blocks of time, or the omission of science instruction from the school day (Finson & Brewer, 1994; Koballa & Crawley, 1985; Riggs & Enochs, 1990; Wilson & Scharmann, 1994).

Teachers who were weak in content background tended to have significantly lower personal efficacy than did teachers with strong content backgrounds (Rubeck & Enochs, 1990). When teachers have low self-efficacy, their teaching tends to be characterized by authoritative, teacher-centered roles with a less clear understanding of the various developmental levels of their students (Theissen, 1995). For the purposes of this study, self-efficacy was examined as an emergent theme. In the analysis of interviews, I examined the data for patterns that emerged related how the participants felt about their abilities to teach science effectively and the methods they use to teach science concepts.

Summary

Teaching has traditionally been viewed as a technical exercise that can be improved with repeated training opportunities (Hunsacker & Johnson, 1992; Loucks-Horsley et al., 1998; McLaughlin, 1990). What is sacrificed in this mode of professional development, however, is an honest recognition of the complexity of teaching and learning (Gaudelli, 2001). The links to student achievement and quality teachers have been established (Darling-Hammond, 1997; Hawley & Valli, 2001; Thornton, 2004). Yet efforts to ensure that science teachers are adequately prepared have slowly moved to the forefront of educational reform in recent years.

Experiential learning, constructivism, and the reflective process all serve as foundational components for understanding the learning process of the Rivers to Reef experience from the perspective of the teachers. The research associated with the abovementioned areas provide a robust representation of how science educators learn. However, understanding how teachers feel about using the experiential learning model as

a teaching tool is equally as important in understanding the impact the Rivers to Reef experience will have on their teaching practice and professional growth.

CHAPTER 3

THE RIVERS TO REEF PROGRAM

Introduction

The Georgia Aquarium is one of the largest informal education facilities in the United States. The facility is located in a major urban center and opened its doors in November 2005. The aquarium is home to a diverse group of local and exotic aquatic organisms. During the developmental stages of the facility the aquarium staff placed education, conservation, and research programs at the forefront of its outreach initiatives. The main goal of the Georgia Aquarium is to enhance society's knowledge of the complexity and importance of aquatic ecosystems while actively engaging visitors in valuable learning experiences. One aspect of their education initiative involves the creation of the Rivers to Reef professional development experience for teachers. The development of this course was due in part to the examination of the science achievement scores for students in Georgia. As recently as 2005 Georgia still had an average of 37% of their fourth grade students scoring in the "below basic" category on the National Assessment of Educational Progress (NAEP) and 47% of its eighth grades students falling in this category (Lutkus, Lauko, & Brockway, 2006). The staff agreed that developing teachers' understanding of scientific concepts may be an effective means of reaching the students of Georgia.

The Rivers to Reef program was developed by the Georgia Aquarium in partnership with the National Oceanographic and Atmospheric Administration (NOAA).

NOAA summarized its commitment to education as follows: For the American population to become more scientifically literate, greater emphasis must be placed on engaging learners with the nature of science, especially its characteristic (active) ways of knowing (NOAA, 2006). Based on the converging goals of these two organizations and their desire to increase scientific literacy, a collaborative partnership between these two institutions was a natural fit.

The Rivers to Reef professional development course was designed to provide teachers with an opportunity to be active participants in the process of learning scientific concepts. The active participation involves teachers being immersed in the learning environment. Immersive learning involves a complete involvement in a phenomenon or experience in order to gain knowledge (Baker, 1993). The Rivers to Reef program is a 5-day immersive learning experience where teachers receive hands-on reflective learning opportunities while exploring a river system from its headwaters to the coast. While participating in the Rivers to Reef experience the teachers are provided with activities that they could infuse into their science curriculum.

Each year the Georgia Aquarium announces the dates for the Rivers to Reef professional development program and the criteria for being selected to participate, with an application deadline in February. This information is posted on the Georgia Aquarium website and with the Georgia Department of Education under their professional development program offerings. Interested teachers download and submit completed applications to the staff members at the Georgia Aquarium. Each year the Education Advisory Committee of the Georgia Aquarium has been instrumental in narrowing the

pool of applicants from nearly 80 teachers to the final 16 teachers invited to participate in the Rivers to Reef experience.

The Educational Advisory Committee (EAC) is a voluntary group of teachers, administrators, professors, state agency representatives, federal agency representatives, informal educators, and business leaders. This group serves as a sounding board to provide advice and guidance to the aquarium to ensure that all education programs meet state and federal standards. Each year, during the participant selection phase of the Rivers to Reef course, the EAC is charged with selecting teachers that provide the most diverse representation of teachers throughout the state of Georgia. This involved selecting teachers from various grade levels, various regions throughout the state, with varied years of teaching experience, with variations in gender, an ethnically diverse group and teachers that served students from varied socioeconomic backgrounds. The Rivers to Reef program had its inaugural debut in July 2004. In the years that followed, the course was revised several times in an effort to ensure that the needs of the program participants were being adequately addressed.

The 2006 Rivers to Reef course marked the 3rd year the professional development course was offered. Using feedback obtained in previous years, the staff members of the Georgia Aquarium revised the Rivers to Reef course. The 2004 and 2005 Rivers to Reef programs provided the Aquarium staff members with opportunities to test activities, the participant selection process, survey questions, and obtain vital programming information prior to the 2006 implementation. This section provides an overview of the 2004 and 2005 Rivers to Reef programs and the role the information obtained during these programs played in the development of the 2006 Rivers to Reef experience.

The 2004 Rivers to Reef Experience

The first Rivers to Reef professional development program was conducted in July 2004. The program involved taking 20 teachers from the headwaters of the Chattahoochee River to the coastal region of Georgia. The program began by exposing teachers to the freshwater ecosystem at Horse Trough Falls near the source of the Chattahoochee River. While in this area, the teachers learned how to assess the quality of freshwater using biological and chemical measures. Throughout the experience the teachers used the skills they acquired at the headwaters to measure water quality on several rivers and throughout the coastal water experience. After the headwater experience, the teachers visited Lake Lanier and conducted water quality testing on other portions of the Chattahoochee River while under the guidance of staff members from the Department of Natural Resources. The Lake Lanier visit was followed by a visit to a fish hatchery and a waste water treatment facility. Teachers received a thorough understanding of how water resources are used in rural, suburban, and urban areas. The group of teachers then proceeded to Savannah and Skidaway Island to explore the coastal regions of Georgia.

Twenty five teachers submitted applications for participation in the 2004 Rivers to Reef program. Everyone that submitted an application was sent a follow-up packet that provided a detailed overview of what the professional development experience would entail. During this time, the teachers were informed that the course was free of charge to all teachers selected to participate. The Georgia Aquarium had secured corporate sponsorship funds to cover the cost of food, lodging, and all activities associated with the professional development experience for each of the program participants. Sixteen

teachers confirmed their interest and four additional educators were invited to attend the course. The final group for the 2004 program consisted of twenty teachers. Twenty teachers were selected for the 2004 Rivers to Reef program because of the manageability of the group size, financial limitations and group size capacities associated with several of the experiential programming activities. Of the 20 teachers, 10 were selected from the coastal region of Georgia and 10 teachers were selected from noncoastal regions in Georgia. This format was used to provide teachers with an opportunity to interact with educators from different parts of the state and expose the participants to the aquatic ecosystems found in different parts of the state.

The program participants were kindergarten through high school teachers with 3-27 years of teaching experience and 3-50 professional development experiences prior to the course. On average the teachers had 11 years teaching experience and participated in 10.5 professional development courses prior to the 2004 Rivers to Reef program.

The philosophy of the Rivers to Reef program is to provide teachers with an immersive learning experience where they will gain a thorough understanding of the many uses of water. The program focused on studying how humans affect aquatic ecosystems, discussing what careers use hydrology or aquatic science, and providing teachers with an opportunity to meet professionals in aquatic related fields. The goal of this professional development course was to provide teachers with an experience that would enhance their content knowledge and ultimately enrich the learning experience for their students. Overall the 2004 Rivers to Reef program was a success. Table 4 provides an overview of what the staff members of the Georgia Aquarium

Table 4

Rivers to Reef Experience 2004 Evaluation Data

<i>What was learned from the teachers in the 2004 Rivers to Reef survey</i>	<i>What the Rivers to Reef staff learned from an analysis of the experience.</i>	<i>Feedback implemented into the 2005 Rivers to Reef Program</i>
<p>Teachers enjoyed the experience.</p> <p>Teachers wanted strategies and lesson plans to implement into their classroom.</p> <p>Teachers wanted to follow one river system from its headwaters to the coast. They felt seeing the dynamics of one river system changing would be more beneficial to them.</p> <p>Teachers said the experience was beneficial but they would have difficulty having their students experience a similar program.</p> <p>Elementary school teachers learned the most from the experience and felt more comfortable teaching science as a result of the experience.</p> <p>Teachers encouraged growing the program to get more teachers to participate. However, having more than 20 teachers at a time would compromise the experience.</p> <p>Teachers enjoyed the activities on the coast. However, they said the wastewater treatment facility was a great learning tool but it smelled, it was depressing, and it made water issues seem overwhelming.</p> <p>All of the teachers indicated that they would participate in another program similar to Rivers to Reefs and they would recommend the program to a fellow teacher.</p>	<p>The interaction between coastal and non-coastal residents was positive and welcomed.</p> <p>The interaction between elementary, middle and high school teachers has to be cultivated. Left on their own middle school teachers would spend most of their time interacting with other middle school teachers and the same would be true for high school and elementary teachers. However, when the groups interacted with teachers from other grade levels they had a tendency to gain some valuable insights.</p> <p>There was a need to provide teachers with methods and lessons to incorporate into their classroom curriculum.</p> <p>Journals and group discussions are important for gathering information from the perspective of the individual teacher.</p> <p>Teachers enjoy hands-on learning.</p> <p>Most teachers do not feel comfortable asking questions in front of other teachers. The journals served as a great tool for teachers to ask questions and get them answered.</p> <p>Minimize the travel time for teachers.</p>	<p>Teachers were provided with lesson plans and teaching strategies to implement into their classroom.</p> <p>Teachers followed one river system from its headwaters to the coast.</p> <p>Teachers were provided with contact information for each of the instructors that worked with the group throughout the course. This was done so each participant had access to professionals in the field if they wanted to implement portions of the experience back in their classroom with their students.</p> <p>The coastal experience was increased and the wastewater treatment facility was eliminated from the 2005 experience.</p> <p>Travel time on the bus was reduced and flights were integrated into the program to further reduce travel time.</p>

learned from the participant data obtained at the conclusion of the 2004 Rivers to Reef Experience.

The feedback received from the teachers in the 2004 program was integrated into the development of the 2005 Rivers to Reef program. After the 2004 Rivers to Reef program was completed, the feedback from the teachers and facilitators was analyzed and the abovementioned items were implemented in the 2005 program to better meet the needs of the teachers and assist the Georgia Aquarium with meeting their programming objectives.

The 2005 Rivers to Reef Experience

The 2005 Rivers to Reef program took place in June 2005. The 5-day program was conducted as a partnership program between the Georgia Aquarium and NOAA at Grays Reef National Marine Sanctuary. The program started at the headwaters of the South River in Atlanta and followed the same river system to the coastal region of Georgia and eventually to Gray's Reef National Marine Sanctuary located 18 miles off the coast of Georgia.

Sixteen teachers were selected to participate in the 2005 program, eight teachers from the coastal region and eight teachers from noncoastal areas. There were also two representatives from the aquarium and two representatives from NOAA for a total of 20 program participants. Fifty teachers submitted applications to participate in the 2005 program. The final 16 teachers were selected through a process that sought to get the most diverse group of teachers based on race, gender, grade level taught, number of years teaching experience, and their regional location in the state. The teachers selected for the

2005 Rivers to Reef course averaged 10 years of teaching experience and 11 professional development courses prior to participating in the program.

The teachers began their training at the headwaters of the South River in Atlanta. Here they learned the process of biological and chemical water quality analysis and recorded their first readings. The teachers boarded the bus and headed to Macon and then Lake Jackson to collect additional samples. The teachers canoed the Altamaha River, collected water samples, and learned about a freshwater swamp system. The group proceeded south to Darien, Georgia, and later to Sapelo Island. The teachers collected water samples in both areas and learned about the cultural components of the coastal region. On the last day, the teachers were able to board a NOAA research vessel and proceed to Gray's Reef National Marine Sanctuary. While visiting Gray's Reef, teachers were able to maneuver a remotely operated vehicle (ROV) around the reef while learning about marine ecosystems in conversations with marine biologist and oceanographers from NOAA. The experience concluded on Skidaway Island, where the teachers had an opportunity to receive a behind the scenes tour of the University of Georgia Marine Extension Center Aquarium.

The 2006 Rivers to Reef Experience

The information obtained from the previous programs aided in program revisions for the development of 2006 Rivers to Reef course. This section will provide an overview of the daily experience for the teachers that took part in the program. Each day is summarized to provide highlights of the daily events to illustrate the experience

Table 5

Rivers to Reef Experience 2005 Evaluation Data

<i>What was learned from the teachers in the 2005 Rivers to Reef survey</i>	<i>What the Rivers to Reef staff learned from an analysis of the experience</i>	<i>Feedback implemented into the 2006 Rivers to Reef Program</i>
<p>Teachers enjoyed the experience and were excited to be a part of learning in the environment.</p> <p>Teachers had limited knowledge of the river systems in Georgia. They were eager to get information about their local river systems.</p> <p>Teachers needed teaching strategies to take back to their classroom.</p> <p>Teachers needed to know how they could develop a similar experience for students. Many teachers felt this experience could not be duplicated for their students.</p> <p>The teachers learned a lot following one river from its headwaters to the coast.</p> <p>Teachers really valued learning about the scientific and cultural components of Sapelo Island.</p> <p>Elementary teachers felt empowered interacting with high school teachers. They felt high school teachers knew content but they knew students.</p> <p>Teachers wanted more than one teacher from each school to participate in the course. Having several teachers in each school participate in the program would provide more opportunities for teachers to develop unit plans together.</p>	<p>Journals and scheduled evening discussions were beneficial for teachers to exchange ideas, reflect on the day's events, and solidify concepts.</p> <p>Teachers had limited knowledge of Gray's Reef National Marine Sanctuary.</p> <p>Explaining the experiential learning model and providing teachers with resources to acquire more information were beneficial to teachers.</p> <p>Journals were more beneficial when teachers had leading questions to respond to.</p>	<p>Teachers received a substantial number of resources to use with their students in their classroom.</p> <p>Teaching strategies were emphasized.</p>

from the perspective of the teacher. The Rivers to Reef experience took place in various parts of Georgia from the headwaters of the South River to Gray's Reef National Marine Sanctuary. The professional development experience began by examining a watershed in an urban center. Throughout the experience the teacher's followed a single river system as it flowed to the coast. The River traversed through suburban, rural and other urban communities before it met the ocean.

Day 1

Teachers met in the early evening and were assigned their rooms. Upon check-in each teacher was informed that an evening meeting would take place, the meeting time and its location. The evening meeting was conducted over dinner where formal teacher introductions were made, teachers received a finalized agenda, and each teacher received a journal to use during their experience. The group discussed their expectations for this experience and also discussed the strengths and weaknesses of previous professional development experiences. At the conclusion of the meeting the teachers toured the Georgia Aquarium and returned to their rooms.

Day 2

The teachers met with a representative from the Georgia Department of Natural Resources and discussed components of the aquatic ecosystem including the headwaters, watersheds, and then focused on the impact of an urban area on aquatic ecosystems. The discussion focused on the impact of fertilizers, litter, and surface run-off on the biological and chemical components of the water.

Each teacher learned the process of conducting water quality testing; this included monitoring dissolved oxygen, salinity, temperature, pH, and turbidity. These components

were measured throughout the Rivers to Reef experience. The data collected at the first location was documented on the data collection sheet and the teachers were informed that they would be monitoring this aquatic system from its headwaters in Atlanta to the Georgia coast.

The group then traveled about 60 miles to Lake Jackson. When the group arrived at Lake Jackson the teachers met a representative from the Department of Natural Resources who is responsible for monitoring Lake Jackson. The group was informed about the historical and geographical aspects of the lake. Prior to collecting and analyzing their second water sample. Each teacher then documented their findings on a data collection sheet. At the conclusion of the day teachers were given an hour to reflect on the days events in their journal and in an evening group discussion.

Day 3

Day 3 began with teachers eating breakfast and discussing the agenda for the day. The group left Lake Jackson and drove south toward Macon. The group stopped in Macon to collect a water sample at a point where the river flows under a major highway. The teachers collected a water sample here to analyze the impact of an urban environment on the river.

The group boarded the bus and drove to the next location. The group continued to follow the river southward toward the coast. When the group arrived in Lumber City (see Figure 4), Georgia the teachers were paired up and assigned a canoe. They were led by a member of the Department of Natural Resources, who was very familiar with this river system. The teachers traveled down the Ocmulgee River by canoe and examined how the character of the river had changed from the source of the river in Atlanta to the point

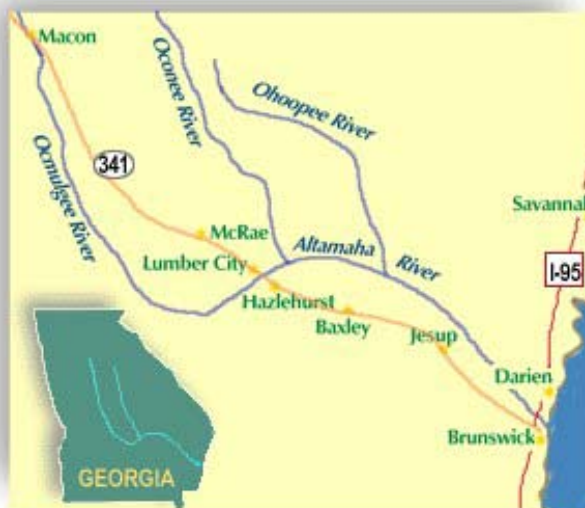


Figure 4. River System Map.

where they entered with their canoes. The group canoed through a river swamp and explored the characteristics of the swamp. The group continued to canoe to an area where the Oconee and Ocmulgee Rivers converged to form the Altamaha River. At the conclusion of the canoeing experience the teachers boarded the bus and were given time to reflect on their canoeing experience in their journals.

The group then traveled to Darien, Georgia and boarded a pontoon boat for an evening exploration of the coastal marsh region of Georgia. The teachers collected water samples and documented their findings. After the marsh exploration experience the teachers went to their hotel and were given time to reflect on the days events before the evening group discussion.

Day 4

Day 4 began with the teachers having breakfast and discussing the agenda for day 4. The teachers traveled to the local pier to board *The Sapelo Queen*. *The Sapelo Queen*

took the teachers to Sapelo Island located 5 miles off of Georgia's coast. Once the group arrived on Sapelo Island, they visited the SINERR (Sapelo Island National Estuarine Research Reserve; see Figure 5) center. While at the center the teachers participated in an educational program that provided them with an opportunity to cast nets and analyze coastal aquatic organisms. The participants also collected a water sample to conduct biological and chemical analysis.

The teachers visited various parts of the island to explore the unique characteristics of this coastal ecosystem. Later in the evening the teachers met with the natives of Sapelo Island to discuss the island from a historical perspective. The Sapelo Island residents provided the teachers with a basket weaving course, traditional storytelling opportunities and a customary meal where seafood was the main ingredient. After the dinner the teachers met to complete journaling and reflect on the day's events.

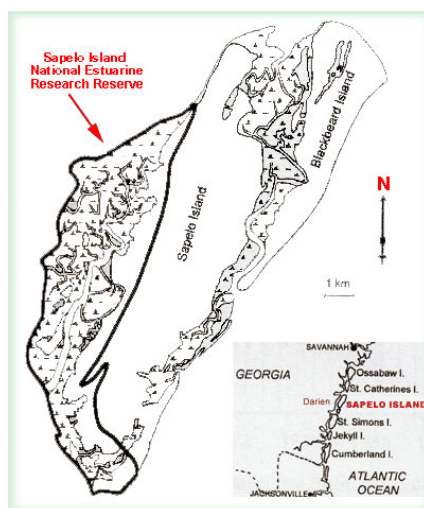


Figure 5. Sapelo Island Map.

Day 5

On the morning of Day 5, the teachers boarded a NOAA research vessel to head to Gray's Reef National Marine Sanctuary. Gray's Reef is located 18 miles off of Georgia's Coast. The teachers conducted water sample tests at three different depths and the tests were conducted at three different locations for a total of nine readings. This data were documented and added to their data analysis sheet.

The teachers arrived at Gray's Reef and met with NOAA marine biologist and oceanographers to discuss the research being conducted in this coastal region. Each teacher had an opportunity to maneuver an ROV around the reef. This provided teachers with an opportunity to explore the reef without entering and potentially destroying aspects of the fragile reef ecosystem. After the reef study, the research vessel proceeded to Skidaway Island where the group disembarked and stayed for the evening.

On the return to Skidaway Island the teachers were able to spend time discussing the day's experience and journaling. The group was able to discuss the Gray's Reef experience and what they learned throughout the entire Rivers to Reef course. The following morning the group was able to meet briefly to conclude the experience and depart.

Summary

Since the initial launch of the Rivers to Reef program in the summer of 2004, nearly 80 teachers have participated in the course. The teacher feedback in relation to the course has been overwhelmingly positive, and the participants have been eager to recommend the experience to their colleagues. The course has gone through several iterations and revisions based on the feedback of its participants and each year the

dynamics of the course changed based on that feedback. Now that most of the logistics and programming details have been addressed, it is time to explore how the program participants use the Rivers to Reef experience in their teaching practice and the impact the experience has had on their professional growth.

CHAPTER 4

METHOD

Introduction

In this qualitative case study, I examine three science teachers who participated in the Rivers to Reef professional development program and the impact the experience has had on their professional growth and science teaching practice. This chapter provides an overview of the methods used in the collection and analysis of data related to the study. Interviews were the primary tools used in the acquisition of data. The role of each of these items in the data collection process as well as justifications for the selection of each tool is also presented in this chapter. Table 6 provides a timeline for the data collection portion of the study. One of the study participants participated in the Rivers to Reef experience in the summer of 2005, while the other two participated in the course in summer of 2006. The data collection portion, including the interviews and artifact/-document analysis, for this research study took place April-June 2007. In June 2007, the final interviews were transcribed and analyzed, while the results of the research study were communicated in January 2008.

Establishing a well defined and justified protocol for the selection of the research participants is important. A selection criterion was established to generate a purposeful sample of teachers who would provide the most robust understanding of the experience from their perspective as well as being able to

Table 6

Study Timeline

Dates	Action
April 2007 – June 2007	Teachers participate in the research portion of the study
May – August 2007	Compile data
August – December 2007	Analysis of data and communication of findings

communicate the impact the experience had on their science teaching practice and professional growth.

Selection of Study Participants

The selection process for the three study participants involved the use of a purposeful sample criterion to obtain the most beneficial informants. A purposeful sample is used in qualitative studies to ensure the selected informants are capable of answering questions related to the study (Patton, 1990). The purposeful sampling format is used to increase the utility of information obtained from small samples (McMillan & Schumacher, 2001).

I chose to use the following criterion in the selection of the final group of informants: (a) teachers who were willing to talk about their previous as well as current professional development experience, (b) informants who represented various regions of the state, (c) informants who were certified teachers, and (d) informants who were middle school teachers. I used these criteria to maximize diversity among the informants and to address the questions that guided the research study adequately. Three teachers were selected as an appropriate sample size to provide each case with an appropriate analysis

in the acquisition of data and to provide a sufficient and manageable amount of data.

Creswell (1998) stated that multiple case studies are preferable to single case studies, but he cautioned researchers that including multiple cases limits the depth with which each case can be analyzed.

Adhering to confidentiality norms, the identity of each of the three informants was not revealed. Each informant and their respective schools were provided fictitious names to ensure anonymity and these names were used to assist in tracking data provided by each informant.

Choosing the Methodology

I used qualitative methods to assemble and analyze the data in this study. The use of qualitative methods in the examination of this experience allowed me to get a better understanding of the perspective of the study participants. One of the benefits of qualitative research is that it describes and analyzes people's individual and collective social actions, beliefs, thoughts and perceptions (McMillan & Schumacher, 2001). The goal of this research study was acquisition of information related to the thoughts, perceptions and beliefs of individuals that participated in the Rivers to Reef experience. Qualitative studies are important for theory generation, policy development, educational practice improvement, illumination of social issues, and action stimulus (McMillan & Schumacher). Many goals can be accomplished using a qualitative research method; however, it was the goal of improvements in teaching practice that served as the impetus for selecting a qualitative research design for this study.

The rationale for this study involved examining ways to provide teachers with a more beneficial professional development experience for increasing student achievement

in science. The descriptive, evaluative and interpretive nature of this research study served as critical components in determining that the case study format would be the most beneficial research method to answer the questions that guided this study. Case studies are characterized as being descriptive, focusing on the case, and accommodating a variety of disciplinary perspectives (Merriam, 2001). Case studies are differentiated from other types of qualitative research in that they are intensive descriptions and analysis of a single unit or bounded system (Smith, 1978). The boundedness of a study involves determining the number of people involved and the amount of time for observations. The bounded nature of case studies means the case is a single entity, a unit around which there are boundaries (Merriam). This study was bounded by a finite number of people who can be interviewed because of the finite number of participants in the Rivers to Reef experience.

Bromley (1986) notes the value of case studies by stating that case studies get as close to the subject of interest as possible, partly by means of direct observation in natural settings, partly by their access to subjective factors (thoughts, feelings, and desires) whereas experiments and surveys often use convenient derivative data. Case studies help us to understand the processes of events and programs to discover context characteristics that will shed light on an issue or object (Sanders, 1981). Merriam (2001) states that insights gleaned from case studies can directly influence policy, practice and future research.

The research methodology was shaped by two major aspects. First, the methodology was shaped by examinations of the literature and a desire to gain the greatest understanding of the experience from the perspective of the informants.

Secondly, the methodology was influenced by the use of constant comparative (Glaser & Strauss, 1967) methods. By continually analyzing the data for emerging themes and patterns, the data collection process was examined repeatedly to ensure the data was providing the most accurate picture from the perspective of the participants. Once the research method was selected it was necessary to select the data collection instruments. Unlike experimental, survey or historical research, the case study format does not claim any particular methods for data collection or data analysis (Merriam, 2001).

In qualitative case studies, interviewing, observing, and analyzing documents are commonly used to collect data (Merriam, 2001). Individual interviews were used as the primary data collection instruments for this study. The data collection process began nine months after two of the teachers had completed the Rivers to Reef experience and one year and nine months after the third teacher completed the experience. The third participant was added based on providing an additional perspective for the study to determine the impact the Rivers to Reef experience had on teachers beyond the first year implementation. The data obtained from the teacher who participated in the study in the summer of 2005 provided extremely valuable unanticipated results in relation to the study. These results will be addressed in detail in chapter 6.

Data Collection Process

To obtain a rich, descriptive understanding of the Rivers to Reef professional development program and the impact it had on the teaching practice and professional growth of three middle school teachers, a series of three interviews was implemented with each participant. This data collection method allowed the interviewer and participant to understand the experience and place it in context (Seidman, 1998). Following the

interview format, each interview lasted approximately 45–60 minutes and a timeframe of approximately 3 weeks elapsed between each interview.

The goal of the first interview was to have each participant reflect on the teaching experiences they had prior to the Rivers to Reef professional development course. During the first interview, the factors related to their pursuit of a career in teaching science, their teaching practice, and their professional development perspectives were examined. The data obtained in interview one, provided pertinent information related to the influence that family, schooling and previous careers had on their professional development perspective while also placing the Rivers to Reef program in context for the subsequent interviews. There were several common themes that emerged in the cross case analysis of the study participants in interview one and this data served as a tool for establishing the format for interview two.

The primary role of interview two was to have the participants examine the phenomenon in this case the Rivers to Reef experience, in relation to the research questions being examined. The data obtained from each of the participants was insightful and provided a rich description of pertinent highlights of the Rivers to Reef experience, the impact the course had on their teaching practice, and how they viewed the course as a professional growth experience. There were commonalities of discourse among the participants that emerged from the data. The information obtained was imperative in addressing the two research questions associated with this study:

1. How was the Rivers to Reef experience viewed by the participants as a professional growth experience?

2. How do the Rivers to Reef participants reflect on and describe the course as a professional growth experience?

Following the format of the three series interview, the primary goal of interview three was to examine how the teachers integrated the Rivers to Reef experience into their classroom curriculum during the school year and how they planned to integrate the experience into subsequent instruction. The three-interview series format provided teachers with an opportunity to review their teaching practice prior to the Rivers to Reef experience and examine the impact of the experience on teaching practice. This interview method provided an approach that focused on the perspective of the teachers and provided data to be analyzed in lieu of preprogram-postprogram assessment methods.

I used a semi structured interview format. In this type of interview format, specific information is desired from all respondents so pre-determined questions were developed. Also, questions that do not have predetermined wording or order were provided to further probe issues to be explored (Merriam, 2001). The questions for interview one are listed in Appendix B. The questions for interview two are listed in Appendix C. The questions for interview three are listed in Appendix D.

Figure 6 and Figure 7 illustrate the role each of the interviews played in the acquisition of data related to the research questions that guided this study. These specific items were analyzed using a cross-case format and examined for emerging themes related to the

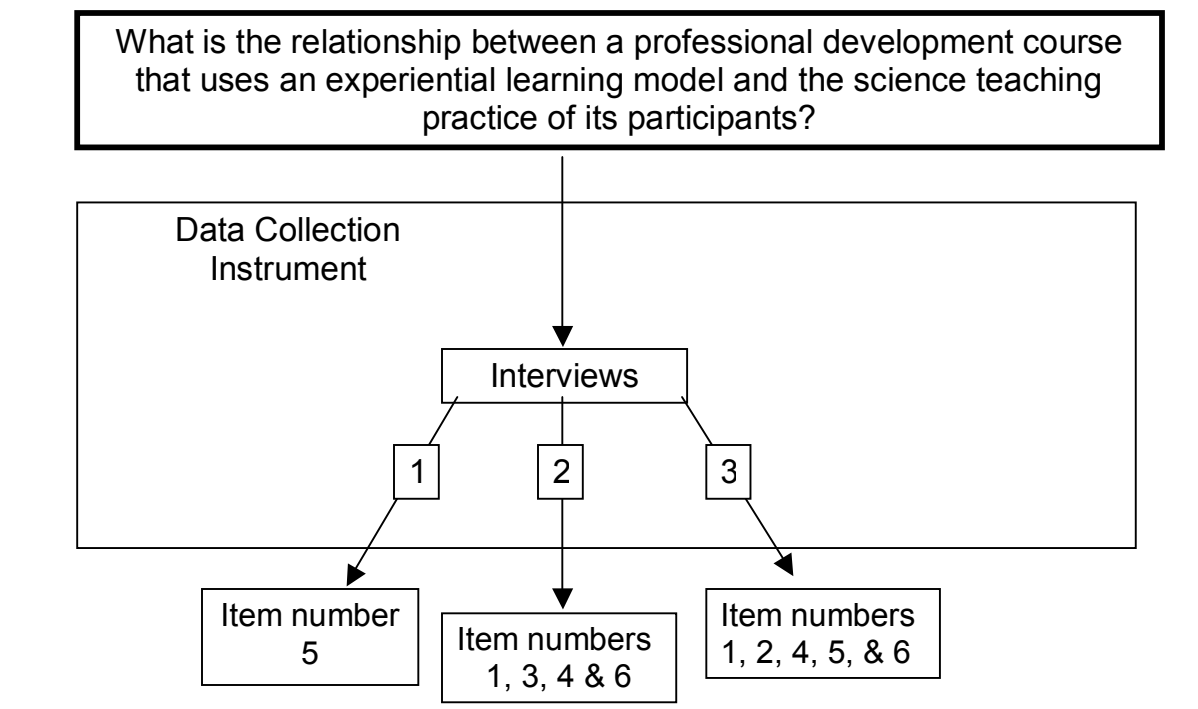


Figure 6. Relation of Data Collection Instruments to Guiding Question 1.

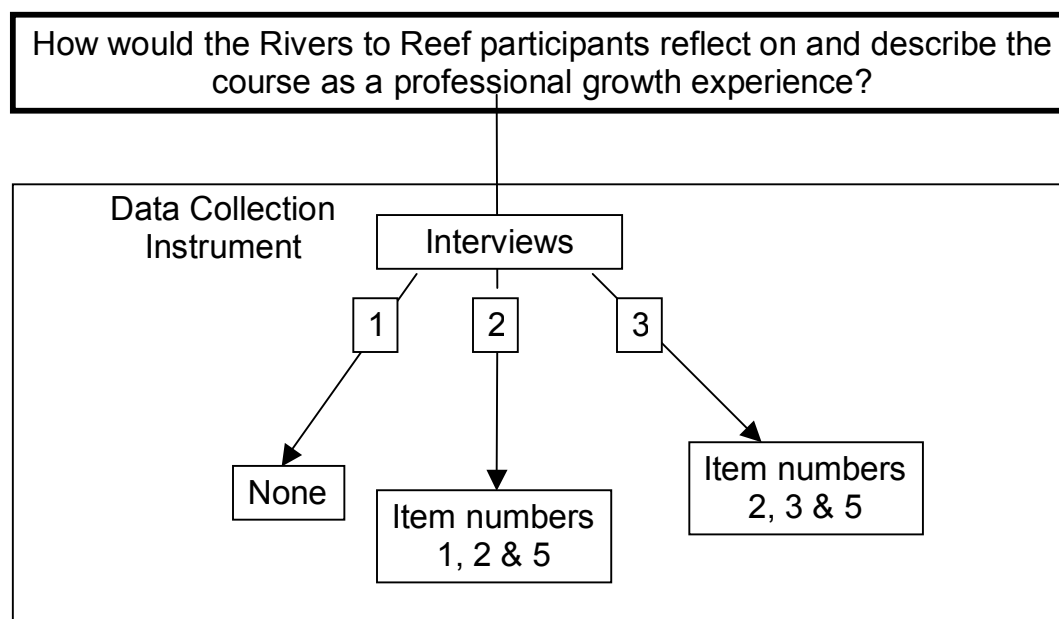


Figure 7: Relation of Data Collection Instruments to Guiding Question 2.

research questions. The analysis of the data collection instruments were further examined in the next section.

Data Analysis

The goal of this qualitative case study was to determine the impact the Rivers to Reef program had on the science teaching practice and professional growth of three middle school teachers. Two research questions guided this study and provided focus for the collection and analysis of data. The primary data collection tool for this research study was the three series interviews. For the purposes of this study, an inductive analysis format was selected. In the inductive format, categories and patterns emerge from the data rather than being imposed on the data prior to data collection (McMillan & Schumacher, 2001). The framework for data analysis was influenced by the works of Miles and Huberman (1994) and Wolcott (1994).

Data analysis involves organizing data, breaking it into manageable parts, synthesizing it, finding patterns, determining what is important, deciding what is to be learned and determining what to tell others (Bogdan & Biklen, 1982). Data analysis in the form of interim analysis began immediately following the initial interviews. Interim analysis is the frequent analysis conducted during the data collection phase. Interim analysis aids the researcher in making decisions about the data collection process and in identifying emerging topics and recurring patterns (McMillan & Schumacher, 2001). Wolcott (1994) suggests that data collection and data analysis should not be viewed as discrete stages; but rather, as data is collected, the researcher should begin making sense of it. This provides the researcher with the most robust understanding of the data from the perspective of the study participants because it enables the researcher to explore

emerging themes in subsequent interviews. Whereas analyzing the data in the post data collection phase could limit opportunities for probing and developing the richness of the data interpretation. This format was adopted for the purpose of this study. After each interview the data was transcribed and coded. This study was viewed as an iterative process as the data was continually examined in light of the development of new questions or the emergence of new themes. Wolcott states as a part of the iterative process the following questions were examined to ensure the analysis of data was continually linked to the questions that guide the research:

- What patterns and common themes emerge in responses dealing with specific items? How do these patterns (or lack thereof) help to illuminate the broader study question(s)?
- Are there any deviations from these patterns? If yes, are there any factors that might explain these atypical responses?
- What interesting stories emerge from the responses? How can these stories help to illuminate the broader study question(s)?
- Do any of these patterns or findings suggest that additional data may need to be collected? Do any of the study questions need to be revised?
- Do the patterns that emerge corroborate the findings of any corresponding qualitative analyses that have been conducted? If not, what might explain these discrepancies?

Throughout the data analysis process the data was analyzed using the cross-case and with-in case format. For the purposes of this study the cross-case format was the primary means of analysis. The cross-case format allowed the data obtained from each of the teachers to be analyzed in comparison to the other two teachers. This data analysis format was important in the recognition of themes or patterns in the data related to participants in the study. For example, comparing the data obtained in the first interview of each participant and finding commonalities that emerged served as an impetus for developing questions for interview two that would further investigate the findings from interview one. The with-in case format allowed for an in-depth analysis of each of the

individual participants. Data obtained in the first interview was further examined in subsequent interviews. For example, teachers that indicated in interview one, that they were using an experiential learning model for their students prior to the Rivers to Reef experience were probed further in subsequent interviews to compare their model of experiential learning to Kolb's model. Both the with-in and cross-case approach served as critical components in obtaining a holistic picture of each of the participants and their overall experience.

Figure 8 illustrates the framework for the data collection and analysis process. Before the first interview, the journals, the pre-experience questionnaires and the post-experience questionnaires were analyzed to generate the questions for interview one. The information obtained from the analysis of these three items was further examined in the first individual interviews. The data collected during the first interviews were transcribed, coded and categorized based on the emerging themes relevant to this study. This data contributed to the emerging themes as well as providing areas for further examination in subsequent interviews. Interviews two and three followed the same format and cross case inductive process related to the guiding questions presented.

This is a case study which had the purpose of obtaining a greater understanding of effective strategies for science related professional development courses. As the researcher, I ensured that the data presented at the conclusion of the study accurately depicted the perspective of the participants by utilizing the member check process.

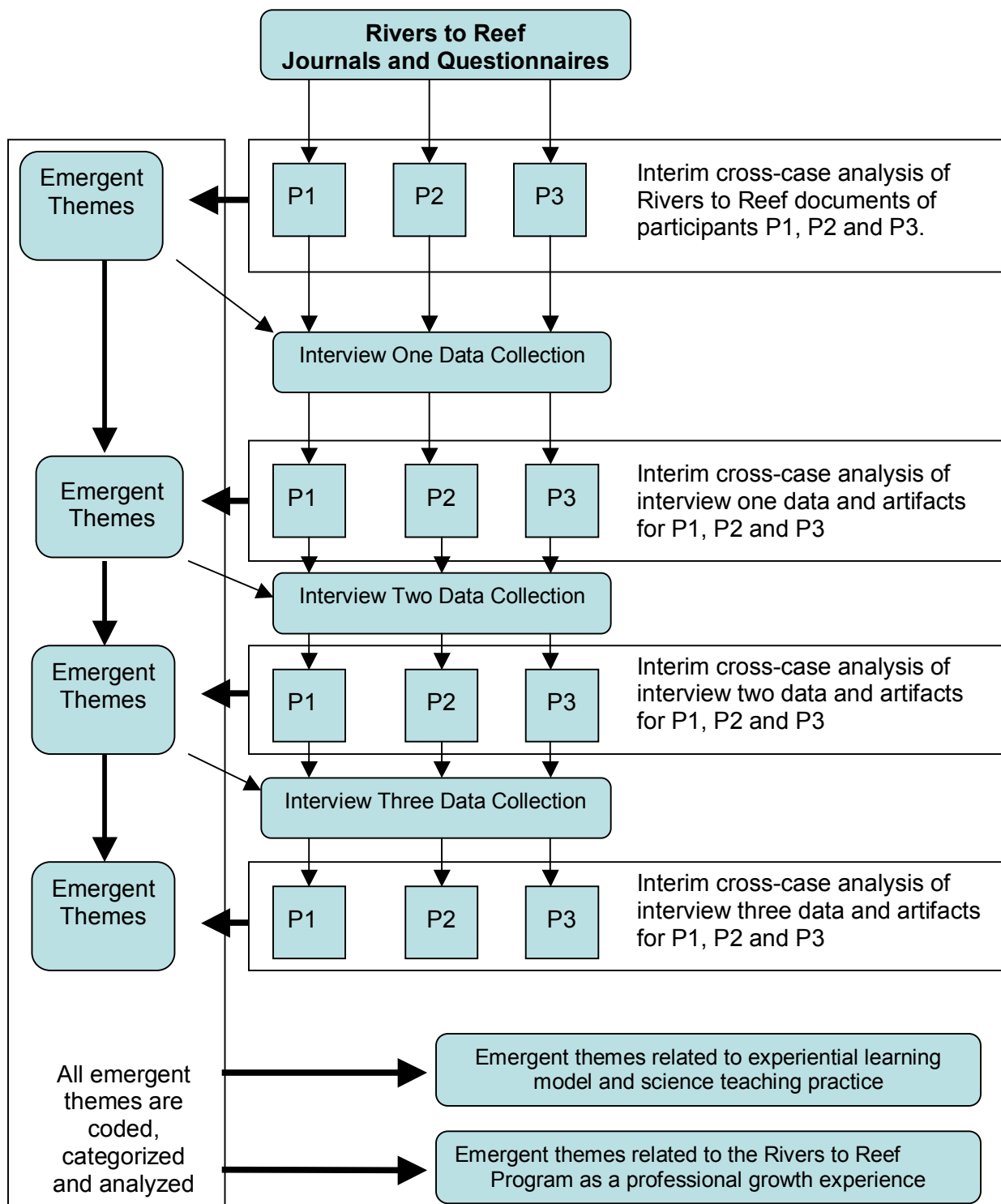


Figure 8. Data collection and Analysis Flowchart.

Ethically Responsible Research

As researchers we are responsible for ensuring that the data we collect and cases we develop are accurate representations of each participant. Researchers affect the research environment throughout the study despite efforts to eliminate this influence. Data collection is an intervention or “treatment” in research with humans. Doheny-Farina (1993) emphasized that the results of a study are based on what the researcher brings to the research. She goes on to say that researchers that observe groups must be aware of the influence they personally have on the group and the context of the study. This study was designed to ensure that the impact on the informants and the research environment is non-detrimental and as minimal as possible.

This research adheres to the Code of Ethics of the American Anthropological Association and is safe to all participants involved. The goals, format and objective of this professional development course for teachers has not been altered to accommodate this research study. The instruction continued throughout the experience with the learning experience of teachers being the primary goal. The identity of informants, the schools and school systems for each participant was protected and there was no damage to any of the above listed entities as a result of this study. The education community, professional development community and the communities of origin for the informants will benefit from gaining greater insights into how to create successful professional development courses to meet the needs of science educators and students.

All informants were assured that their identities would remain confidential and that the information they provided during this study would have no bearing or influence on the receipt of their Professional Learning Unit credits. Professional learning units are

credits that teachers in Georgia must earn in order to renew their teacher certification. In the state of Georgia, teachers must earn ten professional learning units every 5 years to have their certification renewed. All of the Rivers to Reef program participants earned professional learning units for their participation in the course regardless of whether they decided to participate or declined to participate in this research study.

A member check system was established to ensure that the researcher accurately portrayed the views of the informants. The informants were informed they could access the transcribed interview prior to the final analysis of the data. Any questions about any portion of the interviews were addressed with each of the study participants and clarifications in relation to the data were noted in the transcriptions. All of the participants felt they were accurately portrayed in the interviews and no corrections to transcripts were requested.

Several steps were taken to ensure the informants had a sense of comfort and legitimacy related to this research study. Each informant and school was assigned a pseudonym that was used throughout the study. Prior to the study each participant signed a consent form, a copy of my proposal and an opportunity to contact me to answer any questions related to the study.

Role of the Researcher

The role of the researcher in this case study is primarily that of an observer, interviewer and recorder to examine what educators learn as they participate in an immersive professional development experience. I have an interest in understanding the Rivers to Reef experience from the perspective of the participants as well as how they incorporate components of the experience into their classroom. This research provides

insights as to how teachers use the information gathered as part of a professional development program that uses the experiential learning model.

In this study, I was the primary data collection instrument. In qualitative studies, Merriam (2001) makes reference to humans as very beneficial in the data collection process. In a qualitative study the investigator is the primary instrument for gathering and analyzing data and, as such, can respond to the situation by maximizing opportunities for collecting and producing meaningful information.

As a member of the educational community who has participated in professional development courses, I share similar frustrations related to ineffective professional development courses. In this sense I am a part of the educators' community and share similar experiences. As a researcher it is important that I do not allow my prior experiences to dictate or influence the perspective of the educators. Merriam (2001) stresses the importance of qualitative researchers being good listeners. Through the process of listening, observing, and frequent member checks I was able to ensure that the emic perspective of the informants was documented and my biases were minimized.

Human as Instrument

Fourteen years ago, I started my career in education as an informal educator in an aquarium and zoo setting. Throughout my early experiences I spent a significant amount of time working closely with teachers in the formal education realm to determine what could be done in the informal realm to better meet their needs. My early assessments of the teachers through conversations (individual interviews) and occasional teacher meetings (focus group discussions) helped me to understand that teachers were generally displeased with their professional development experiences. The teachers often indicated

their professional development experiences did little to improve their teaching practice and provided them with little time to understand the complex scientific concepts they were required to teach. The research literature echoed the same sentiments from educators at all levels of science (Loucks-Horsley, 1998; Noyce, 2006).

Ten years ago I was promoted to a position that required me to develop professional development courses for teachers. The feedback I received from the teachers in the professional development courses was positive. Two areas surfaced as the primary reasons for the positive feedback. First, the teachers referenced my commitment to fostering their understanding of the material that was presented. Secondly, they noted that learning about animals, ecosystems, and habitats at the zoo, where they could visualize the concepts being presented, was extremely beneficial.

I later taught science courses in the middle school and eventually the high school setting. It was here that I was able to experience the shortcomings of professional development programs for myself. My professional development experiences as a teacher included attending mandatory half day professional development courses that required no follow up. The professional development presentations were often conducted by individuals slated as education experts that had limited or no classroom teaching experience in the middle school environment. At this point I felt I understood the disconnect that existed between the majority of professional development programs and what I, as a teacher, needed to enrich the learning environment for my students.

Eventually, I returned to informal education and played a significant role in the development of the Rivers to Reef professional development experience. My commitment lies in providing teachers with professional development experiences that

enrich their knowledge of scientific concepts and increase their ability to effectively teach their science students. My previous experiences related to professional development provided the framework for the format of this study and contributes to my biases related to professional development.

Currently, I am a middle school science teacher. Having this perspective provides me with greater insights into the daily lives and expectations of the study participants. As a teacher, I understand the importance of enriching professional development courses and the benefit that professional development courses can have on teaching practice. I am fully aware of the expectations and limitations that are often placed on middle school teachers. My teaching experience in a middle school setting and my current role as a middle school science teacher and department chair provides me with an understanding and empathy for the participants of this study. This credibility fostered a level of rapport that allowed me to promote dialogue and investigate the participants' perspective on this professional development experience.

I will present my biases and assumptions to ensure that individuals who read this study will take this into account along with my theoretical framework to acquire a full understanding of my perspective on this study. I have assumed the following:

1. Kolb's experiential learning model is an effective instructional design process for effective professional development.
2. Human learning is best achieved through a constructivist epistemology.
3. Teachers participate in professional development courses for the purposes of their professional growth and development with the ultimate goal of

positively impacting the conceptual understanding and achievement for their students.

4. Teachers have participated in this professional development course of their own free will and not through the coercion of other teachers and/or administrators.
5. Effective professional development improves teacher efficacy and student performance.
6. Teachers have participated in other professional development courses that were presented in the traditional classroom format.
7. Teachers can effectively communicate successes and failures within their classroom curriculum.

To ensure that my assumptions and biases did not affect the credibility of my data, I used a member check system to ensure the data collected were accurate and in accordance with participants of this study. During the member check sessions, each participant had an opportunity to review the transcribed data to ensure it accurately reflected their thoughts, views, and perspectives. The transcribed data was further examined by several of my colleagues to ensure that my interpretations of the data were consistent with their views of the data. This method of peer debriefing provided me with alternate interpretations of the data which further enhanced my understanding of the participants' perspectives.

The researcher plays a significant role in the how the data are collected, what data are obtained, and which aspects of the data are analyzed. The role of the researcher is significant in qualitative studies as their decision related to the treatment of the data

supersedes that of the data collection tools they select. Equally important is the setting in which the data is obtained (Creswell, 1994). For the purposes of this study the primary setting was the natural teaching environment of the participants, their classroom.

The Setting

The individual interviews for each of the study participants took place at the school where each of the informants taught. The goal of conducting the interviews at the site of the teachers is three-fold. First, I wanted the informants to understand my commitment to the acquisition of data and minimize any inconvenience caused by their participation in this study. Secondly, I wanted to meet in the natural setting of the teacher to ensure the maximum comfort level during the interview process. Lastly, meeting at their schools provided teachers with an opportunity to describe and provide examples of teaching artifacts related to this study. The setting of the interviews is discussed in greater detail in the following chapter.

Trustworthiness of Data

Qualitative researchers are interested in understanding the meaning that people construct from an experience in a given setting at a particular time (Merriam, 2001). The interpretive nature of qualitative research generated intense scrutiny from critics that prefer a quantitative approach to research. Lincoln and Guba (1985) responded by developing the four criteria of credibility, transferability, dependability, and confirmability to use for judging the trustworthiness of qualitative research.

Credibility ensures that the results of a study are believable and accurate from the participants' perspective. To ensure the credibility of this study, the informants were given the opportunity to read and comment on transcripts of interviews and group

discussions. The educators in this study had access to all documents artifacts, transcripts, and audiotapes to ensure that they are accurately depicted throughout the research.

Triangulation was accomplished using three individual interviews with each participant and artifact analysis in an effort to obtain converging lines of evidence related to patterns in the data.

Transferability is used to determine if the results of this study might be applied to another setting or context. Qualitative research is based on the events in a particular setting with a particular group of individuals at a given time. To address the transferability or limitations of transferability related to this study a “thick description” described by Geertz (1973) was utilized. This “thick description” provides future researchers with a thorough description of the setting, the events of the study and the informants; so these results may be related to similar settings. It is important to note that in the case study the ultimate interest is not the transferability of the findings (Stake, 1978): It is to present the case and allow the readers to determine the relevance of the study to their context.

In qualitative studies, dependability is based on the reliability of the data and data collection process. This ensures that the data collection process was logical and the findings of this study are based on sound research practices. Lincoln and Guba (1985) determined that the dependability of interpretive research is accomplished through triangulation of data collection sources and an audit trail. To accomplish triangulation this study used several methods of data collection in an effort of provide the most complete perspective of the informants.

Confirmability ensures that the findings of this study are confirmed by others. In this study I reported all aspects of the data that have supported and challenged my assertions. The raw data and my interpretation of the data were presented to the professional development facilitator and another graduate student as part of the interpretive process. My analysis of the data, the member check system and the peer debriefing ensured that the findings of this research was based on the data and not the biases of the researcher.

Summary

The methods used in this study were designed to follow a qualitative case study format. This research method was selected because it best serves the objectives of this study which involved the obtainment of a holistic and meaningful view of a phenomenon (Yin, 2003). In this case the phenomenon is the impact the Rivers to Reef program had on the teaching practice of three science educators.

The Rivers to Reef program is a week-long immersive learning experience for teachers, which integrates the experiential learning model designed by David Kolb. The study was designed to provide the researcher with a rich description of the experience from the perspective of the three science educators and how they use the components of the experience in their teaching practice. The interview process used in the collection of data incorporated the three series interview process designed by Dolbere and Schuman (Seidman, 1998) to place the experience in context related to their previous education experiences and their current teaching practice. The data were analyzed using an inductive cross-case format to illuminate emergent themes related to the two research questions that guided this study.

CHAPTER 5

THE PARTICIPANTS AND THEIR PROFESSIONAL DEVELOPMENT PERSPECTIVES

Introduction

It would be difficult to understand fully the impact of the Rivers to Reef experience without examining the factors that influenced the personal teaching history of each of the study participants. In this chapter, I provide a detailed description of the three Rivers to Reef participants, the factors that influenced their pursuits of teaching science, and their teaching practices, while also providing a picture of their professional development perspectives. The data presented in this chapter are the direct quotations from the study participants or as a result of data I obtained through my discussions with the study participants.

Marcie: The Experienced Teacher

Marcie has been teaching for 5 years in a coastal county in Georgia. Marcie is a middle-aged White woman who began her professional career as a nurse and later became a teacher. Marcie describes herself as someone that has a passion for teaching and a love of learning. She relocated to Georgia several years ago and continued working in the health field; however, interstate changes in the nursing policies and procedures drove her to explore other career options. Marcie had an interest in teaching for quite some time, but she was hesitant about leaving the health field. She eventually transitioned into the teaching field slowly and began working in the public school environment as a

school nurse. This provided her with an opportunity to work with students and gauge if she could make the full transition to teaching.

Marcie teaches in an ethnically diverse school with a student population composed of mostly White and African American students; at 57% and 34% respectively. As an 8th grade teacher Marcie teaches the earth science curriculum. She has taught this course for 5 years. During her first year of teaching the earth science curriculum, Marcie was unfamiliar with the content and did not have the necessary content knowledge prior to teaching the course. Her lack of content knowledge had a positive impact on Marcie's pursuit of a greater understanding of the content she was responsible for teaching. Her professional development experiences in recent years have helped her gain an in-depth understanding of the content she teaches, and this has had a positive effect on her level of confidence related to teaching the earth science curriculum.

Factors that Influenced Marcie's Pursuit of Teaching Science

Interview one provided pertinent information related to the factors that influenced Marcie's pursuit of teaching science. Marcie noted that her career choices prior to teaching, her personal education experiences, and her family all played a role in her pursuit of teaching science. This information provided me with a detailed understanding of Marcie and her teaching experiences prior to Rivers to Reef course.

Prior to entering the field of education Marcie had two careers that provided her with nontraditional exposure to teaching: nursing and public health. Marcie noted the relationship between some of the common components of nursing and public health to education in the statements below. Even though the health field is often not perceived as

an education related occupation, Marcie was able to provide clear connections and examples of how they influenced her pursuit of teaching.

Obviously, in nursing you do a lot of teaching. So I was always involved in patient education. I headed a cancer/substance abuse unit for like 20 years. So we did a lot with developing (pause) that was in the Dark Ages, so we had to write the educational materials (pause) and when you get your chemotherapy (pause). What would happen? This was the whole dawn of patient education.

Marcie went on to say that her experience related to education outside of the classroom environment continued after working 20 years as a nurse in a hospital. She then moved from nursing to work in a physicians' office that served as a teaching program for doctors.

I left the hospital after 20 years and I worked for one of those physician offices that was a teaching program; a residency teaching program. And we actually wrote files on training the new doctors; on how they should approach patients.

Throughout her nursing career the majority of her teaching experience involved the development of training programs related to direct patient-doctor interactions. As she later transitioned into her public health position, she began to see the connection between her existing career and teaching:

. . . for nursing and then came to (pause) and public health you do a lot of education. So, that was kind of when I started looking at gosh, I might like to do this on a regular basis.

With nearly 30 years of teaching in education environments outside of the traditional classroom, Marcie felt she was prepared to pursue a career in teaching. However, Marcie had spent her nearly 30 years educating adults. She had limited experience working with children. Before she made the final transition into the classroom setting, she began working at a school as a nurse to determine if teaching would be an appropriate career choice.

I was at Southwest Middle School as a school nurse. To make sure I would like kids before I made the jump into education I wanted to make sure I liked kids. I mean I have my own kids (pause) but I figured kids were okay; but I wanted to make sure I could stand them on a day-to-day basis.

After deciding that she had the patience and motivation to work with students, Marcie enrolled in an alternative teacher preparation program where she obtained a Master's degree in education and her teacher certification for the state of Georgia. The science content courses she completed during her undergraduate nursing program served to meet her science content requirements for her Master's degree. While participating in the alternative preparation program, she went through several weeks of extensive teacher training which emphasized teaching strategies and best practices but placed minimal emphasis on content knowledge before she was placed in the classroom setting. Marcie had to rely heavily on the scientific content knowledge she acquired while earning her bachelor's degree to get her through her first year in the classroom.

Aside from her previous career choices influencing her pursuit of teaching science, Marcie indicated that her family played a significant role in her decision. Marcie's father was a teacher, and he played a role in her pursuit of a teaching career later in life.

Well, my dad was a bartender and he went back later in life and became a teacher. I mean I know we both went back late in life.

Throughout the interview Marcie made several references to her father and the admiration she had for him. When she was asked about what was the greatest influence in her pursuit of a career in teaching she responded:

My dad; and I don't want to say because my dad was a teacher because I think he was a teacher long before he was a teacher. And he gets on my nerves we fight something fierce. But I think he always inquired about things. I mean before he went back to school and he was tending bar and if

there was something interesting that someone brought into the bar he would have to bring it home and show it to us. That was just the way it worked.

Marcie's father was a science teacher and her exposure to science began early in life as her father provided her with science related experiences that seemed to be integrated into many aspects of her daily life.

Well, he taught everything. He taught at a Catholic School, but he went back when he was like in his thirties and when he went back to school everything became about science.

Marcie was able to reflect on her childhood and how science played such a significant role in her daily life.

Dinner became about science. He [her father] would have a little box on the table and there would be something in the box and you had to guess what was in the box. I mean really something to do with science; maybe a set of pulleys. I mean I was maybe 6 or 7 playing these games at the dinner table. I would never get it right because I had older sisters who would know science and talk like what is that in the box. So he would say you need to get the weight of the dog and umm you don't have a scale. They were the clues for the pulley. So my sister would say put him in water and take his volume. In my little mind I'm thinking the dog like submerged in the bathtub but my sister is thinking density.

The conversations related to science were not just left to an inquiry lesson at the dinner table. Science ultimately became a significant part of her childhood. Marcie reminisced on how science was an integral part of the holiday season.

And you were in New Jersey, first of all for our Christmas he [her father] would get cigar bands because we did not have any money so he would get cigar bands to send away for things. And in those catalogues for the cigar bands it usually was not your traditional stuff, you know whatever (pause) so we would get some weird things. And then the other thing they would do is whatever money we got they saved (pause) anyway they would save it all and drive us to Edmonds Scientific in New Jersey.

Marcie was being exposed to science regularly at home during evening family time and the holidays.

And we would get our Christmas presents from Edmonds Scientific, which no longer mailed the catalog. It was a stand alone store and you would go in there and it was just aisles and aisles a big warehouse of science products and we would go in there and take whatever money we had and we would buy whatever, basically you did not have a choice, but you did not know any better because that's what happened every Christmas you went to Edmonds and buy the science stuff. You were going to like science one way or another. So they do get credit for that.

She credits her parents and the early exposure to science with sparking her love and interest in science. She went on to say that even though she did not receive a formalized science class until she was in eighth grade her constant exposure to science at home played a significant role in her career choices.

Because I went to Catholic School and they did not teach science. It was just math and language arts. So it was not until I went to public school that I even had science. But I would get it at home though in an indirect way between all those years without the formal science, first formal science was in 8th grade that was Biology. So it's never too late. So I would say at an early age being introduced to science where your thinking gosh this is the way to go.

During interview one Marcie did note the positive experiences she had related to science in school. When discussing these experiences, she focused on the teachers she had as well as positive overall science experiences: "Yep, I have to say I had outstanding science teachers. I really did. Absolutely incredible." Marcie attended private school until eighth grade and she did not have any formal science education prior to her eighth grade classroom experience. She did note that her science related experiences from eighth grade on were positive and she truly loved attending science classes in the public school setting.

Those positive experiences in her education ultimately played a role in Marcie's becoming a science teacher. But her day-to-day interactions with students and the interactions she had with close friends left her disheartened by what she was hearing in relation to students and their views about science.

Also because I felt like I had really good experiences in school and I was not seeing those experiences in other people.

Marcie had noticed that students were being turned off to science and she was unclear of the reasoning behind this phenomenon. This information left her perplexed but motivated to get the appropriate credentials to teach science and encourage students to share her love of science.

Like these kids were getting turned off by science and yet I always loved it from like minute one. So I thought like maybe its time to go into the science field to help kids understand that there is so much out there that you can do in science, not just in health, but in anything to do in science.

Marcie's early exposure to science, the strong influence of science in her home, her positive science related experiences in school and her education related careers prior to teaching all influenced her pursuit of a science teaching career. These influences not only played a role in Marcie's pursuit of teaching science but they also influenced how she taught.

Marcie's Teaching Practices Prior to the Rivers to Reef Experience

An essential component of examining the impact of the Rivers to Reef experience is to understand the teaching practice of the study participants prior to the experience.

Marcie described her teaching practice in her early years of teaching as reflective, and the reflective nature of the classroom played a significant role in her classroom environment.

The classroom environment could incorporate the teaching strategies she uses in her classroom as well as a host of other factors that would influence her classroom setting.

Two major categories emerged from interview one related to her teaching practice:

(a) classroom environment and (b) her concerns about the science content.

Marcie has been teaching science for 5 years, but she still appears to need validation from others to ensure she is presenting the material to her students in the most

beneficial manner. This may be due to the teacher training program that required her to learn a substantial amount of information about teaching in a relatively short period of time. Marcie spoke about her son and some of his challenges in relation to his chemistry class. Yet after her son spent a semester in a chemistry class where the teacher taught using a total inquiry based teaching method, her son developed a love for chemistry. This led Marcie to question her method of teaching and ask others for advice related to an inquiry based teaching format.

Now the guy at UGA, because I was beating myself, like I need to do more inquiry because of my son and he said sometimes they need all of that content support before they can do inquiry.

The validation from the professor made Marcie aware that not all teaching methods are beneficial for all students all of the time.

They make the jump and say inquiry is the new bandwagon that everything has to be inquiry, he [professor at UGA] said he [her son] needed some of those more routine science skills and definitions, and math applications before you could go okay go off and your full inquiry. So it was probably just the right time for him not that nobody had done it before.

Marcie's seeking validation from an outside entity about her teaching method and the best practices for teaching students science indicated her commitment to teaching students' science effectively. It also supports the idea that Marcie reflects on her teaching practice. The reflective nature of her teaching practice was further emphasized in the action research that she conducts in her classroom.

Yeah, and then I did a class to compare free inquiry to traditional science fair and see who performed better.

Marcie is not afraid to integrate teaching strategies that may be beneficial for her students into her classroom. She actually created a small scale study with the science fair projects

to determine if free inquiry or traditional science fair formats would produce a better science fair project.

I took the CRCT questions that were, that they sent (pause) were, ummm, inquiry based questions and scientific method questions and pre and post tested them. So the kids that did free inquiry they just went through the Sea Spangler catalogue and they said you know this fake snow looks like something I would like to explore. There was a rubric and guidelines and they were just free, like whatever you think about this. You know. Look things up whatever you want to do and the other guys were tradition (pause) here is the guidelines I need the triptych, I need this and this and this. And they performed the same on the test, no difference in the results no difference at all and I was shocked. I thought the kids who did (pause) and they and they researched things they would have never looked up on their own.

The results she obtained from the small scale study were surprising but it indicated that Marcie is committed to understanding the needs of her students. Marcie stated that the results were surprising because the research data related to inquiry indicated that students that are exposed to this teaching format should perform better on standardized tests and gain a greater understanding of scientific concepts. She was surprised to find that students who were exposed to a traditional science learning format performed as well as students who were exposed to an inquiry based format. She went on to say that she will continue to examine her data in hopes of providing her students with the most beneficial learning experience.

. . . and I am like what is going on with these results because I had my own bias, I thought of course these kids who got to choose their own are going to do better and the literature says that their going to do better and they did not. And I was real, real (pause) I was just like whoa. Now I am trying to compile the attitude and inventory thing we did pre and post to see is there a difference in their attitudes toward science between the two groups.

Not only is Marcie willing to examine the scores of her students but she has since decided to examine the test scores of other teachers.

I really want to see how her [another teacher at her school] kids do because I may have to (pause) rebalance inquiry and book, and read, we don't bother with the book. We just really don't. And that may be where I need to rethink (pause) that so (pause) that's why I thought. Ann and I kind of teach there's not a whole lot from the book, Jack [another teacher] never uses the book. And here is somebody [another teacher] that heavily uses it. I have never been able to see data from somebody who is really using the book.

Interview one indicated that Marcie is reflective and tests current research strategies to determine effective teaching practices. Interview one also indicated that Marcie has an understanding of student achievement and uses the data obtained during her reflections to better prepare students to meet science curriculum goals.

A part of Marcie's reflective nature could stem from concerns in relation to the content she teaches. This may originate from her alternative teacher preparation program.

The program focused on teaching practices but placed minimal emphasis on content.

Well, I had never done earth science, so the content because then, the only bad thing about GTAPP is since you're in that program you really have not finished that program, so I did not get my earth science content until the following summer. But yet earth science was what the school needed so that's the slot that I was plugged into.

After she completed the initial portion of the program, Marcie was offered a middle school teaching position as an earth science teacher, but her undergraduate coursework was primarily related to biology. She accepted the position with apprehension because of her lack of content knowledge. Even though Marcie was not familiar with the content, she worked hard to meet the demands of her new position and improve her earth science content knowledge. Her lack of content knowledge limited her ability to teach in a manner that she felt was most beneficial for her students, and this ultimately became an obstacle for her during her first year of teaching.

So, you know I mean (pause) and it happens to teachers when their grade levels are changed. I mean you're just a couple of pages ahead of the kids.

But you don't have any of the . . . (pause) you can look at a book but you don't have . . . (pause) you don't have the hands-on either, how can you teach hands-on when you haven't put your hands on anything. So that was the biggest problem the first year.

Marcie received training related to the content knowledge for earth science the summer following her first year of teaching. Having a course that provided her with the content knowledge she needed had a significant impact on her second year of teaching.

I felt like I needed to take earth science. It was a summer class, and it was the first summer after I started teaching. Second year was much, much better because of knowing more. I'll be honest I did not know enough the first year.

Marcie feels strongly about having a firm grasp on content knowledge before teaching students. She now analyzes her students' standardized test scores and uses that data in selecting the most beneficial professional development courses to increase her content knowledge and better meet the needs of her students.

But now, we were looking at data and saying, "Okay, if I am weak in this area, you know, how come? Is it because I am having a problem with content?"

She uses the information she acquires during professional development courses and her students' performance on standardized tests to reflect on her teaching practice.

So for me personally, I can, I will be able to track, what content things I had and look at the scores to see have I made a difference. Like, obviously, that second year, my earth science scores specific to rocks and minerals, were way above everyone else. And I know why.

The upcoming school year will bring yet another change for Marcie as she will now be teaching physical science. Marcie does not have a firm grasp of the content related to physical science; however, she is working this summer to enhance her content knowledge in that area prior to teaching the course.

I have to really try to get into physical science; I'll try. I'm in class now and I have three more scheduled over the summer. I'll get through it. I know I need it.

Marcie acknowledged her content-related deficiencies and worked hard to address these obstacles so they did not impede the academic success of her students. Her reflective nature guided her to the professional development courses that were most beneficial for her professional growth and the academic success of her students.

Marcie's Professional Development Perspective

Marcie found that her participation in professional development courses increased her understanding of the science related content while ultimately increasing her confidence with teaching the content. The impact professional development courses have had on Marcie's confidence with teaching the content was apparent throughout all of the interviews. The passage below relates to Marcie's content knowledge related to earth science in her first year of teaching compared to her second year of teaching

My earth science teaching that second year was so much better than that first year; Oh! You can't even compare them. 'Cause the first year you're kind of (pause) all of you are picking activities from the book. Everything is safe, you have the answer key, you know. (pause) If a kid gets it wrong you spout off the answer from the answer key which just makes them feel (pause) like you know (pause) that they were dumb or something.

After taking part in a professional development course related to earth science, she acknowledges a marked improvement in her effectiveness as a teacher,

But the second year was just so much better because you could say, "Yeah, I made that same mistake." Yeah, I came to that same conclusion when I did it, and you're more authentic. (pause) Like they know you're not asking them to do something that you have not done. (pause). You just came across as much more credible. Although I am sure they thought I was credible the first year but I knew I was not credible the first year.

Professional development experiences not only improved Marcie's self-efficacy, it also played a role in shaping her teaching philosophy. Marcie made reference to one

specific professional development experience that shaped her teaching philosophy. This professional development course took place at a local university, and she described the course as hands-on, interactive, and experiential.

He was an old, old geologist at Armstrong. He was a professor, he's retired now. But he was just . . . (pause) his background was not as a teacher, his background was a geologist. So what he took us out for, (pause) and it was a field experience combined with a class. (pause) And those field experiences might be 12 or 14 hours long. (pause) And you had a big project at the end where you had to get your rock collection, you had to identify all of them but he took us out and we collected rocks and identified them.

But in order for the professor to know the level of understanding of his students he tried to gain some insights into their prior knowledge.

So I guess he was trying to get prior knowledge and then he was clued in that that prior knowledge just wasn't there. But he was just like real energetic, old, but real high energy. And I was really [indicating that she was jumpy/energetic] I mean I think he kept us like vibrating all the time because that's the way he was. But you felt like you had the opportunity to have this sage teaching you and it was, you couldn't help but to be captivated. He would do crazy things. (pause) The first I remember the kaolin, him eating the kaolin.

The professor went to great lengths to engage his students in the learning process. The professor took an innovative approach to engage students by piquing their natural curiosity while providing them with subject area content.

That's like one of the first things they [the professors] do you know, "Well, what do you think about this? It's not really a rock it's a mineral and hey you know what? You can eat it. And then he bites into it. And we're like ah you just ate that, you know so—So he was modeling it's like wax on wax off like at the end of it you realized that everything he did to you he was trying to say this is how you should be approaching your students. Not saying to students, "I'm delivering content to you."

After an engaging learning experience, the professor took Marcie and her group to the side and had them reflect on the information they received

throughout the course. Throughout the experience he was modeling the teaching strategies the teachers should use to engage their students.

It's trying to say, and you don't realize this to the end, when he says well how do I get this across to the students? He is like, do you remember what I did with you the first day? Do you remember? And you're like oh, you tricky man (laughter). And that was the first one, and he truly modeled science.

Marcie added this level of engagement to her teaching practice as well as student opportunities for reflection. This professor played a significant role in shaping the teaching philosophy that has been integrated into Marcie's classroom.

In Marcie's summation of the Rivers to Reef experience, she highlighted some significant events that left an impression on her. She began by describing the experience as "The best! Exceptional! There was content. Its like one of those movie build ups there's suspense, there's action, there's drama it was competitive." She went on to say the whole experience was great, and she initiated a discussion about Sapelo Island.

The whole thing was great. I think going to Sapelo was interesting because it tied so much in together that there is a group of people that have lived that way forever and that it ties to Georgia, I know these kids don't even realize that those people are there still with the old ways.

Marcie found Sapelo Island and its inhabitants fascinating and their traditions intriguing. While on the island, her group came in contact with another group of teachers studying on the island.

There was a class there studying turtles, another grant group was out there at the same time. And it's cool because we knew some of the teachers it was kind of neat that you saw . . . Like parallel learners, they were learning something different but it was still everybody was doing something; different things, and cool things. It was nice because you got to see people that you knew.

Marcie was excited to see that other teachers were taking part in a similar learning experience and being able to reap the benefits of being on the island. But she was also disturbed by some of what she saw on the island. She was concerned about the culture of the island inhabitants disappearing as the youth began leaving the island and moving to settle on the mainland. Marcie did not want the culture of the island to vanish and was concerned about the possibility of it happening.

No, there was a girl there that was a high school teacher and she taught some of the kids that were on the island and she just was a matter of fact that they were going to move away, that that's where the opportunities were, you didn't see, (pause) there was no incentive to get them to stay.

The discussion about the island and the culture disappearing from the island continued for some time. Eventually, Marcie shifted her discussion to her canoeing experience, but it was apparent that the Sapelo Island experience had a significant impact Marcie. Marcie was really excited about canoeing and found the experience to be one of the highlights of the Rivers to Reef program.

I was with a guy who was certified and he said sit there and do not move, he was nice about it, and I understood because he thought, and so Melanie said do you want us to paddle? He said, "no." Now Melanie could swim, his thing was he is responsible and we are not going to move and he is going to do all of the paddling and that's what he did. I said. "Okay. I'll take pictures and that's what I did."

She went on to discuss the canoeing experience as well as the impact construction adjacent to the river could have on the river system.

. . . where the Olmogee meets the Altamaha and we got out on the little . . . She [Cathy] had us get out we stood there and she showed some guy on the corner who was adding something to his property and what were the problems it was going to cause. I mean she just went through this whole little bit.

Reflecting on the experience seemed motivating for Marcie. In her mind, it was obvious that the activities she participated in as part of the experience were equally

enriched by the instructors. Cathy was one of the instructors that Marcie referenced several times; she found Cathy's personality and knowledge of the content motivating and equally as important as the activities she experienced.

. . . and Cathy was energetic and kept the pace going and fearless so you just felt if she can do it I can do it. And she was really just exceptional.

She went on to discuss how the knowledge base of the instructors made her feel comfortable enough to venture beyond her comfort zone and take part in the entire experience.

We got out on the beach, she took pictures and she identified every bird that flew by. I mean it was just amazing. It really was. Like I said it was all unusual things but I was fine with all of it.

Marcie found the Rivers to Reef experience to be an overall exceptional experience. She provided insights as to how the professional development course played a role in improving her self-efficacy through credibility and enhancing her content knowledge by providing her with an understanding of aquatic ecosystems from a larger perspective. The impact on her teaching practice included the integration of inquiry, journaling and modeling to aid in having students understand concepts.

During the third and final interview Marcie began our interview by reflecting on a professional development course she recently completed. She stated the course was similar to the Rivers to Reef program because it was experiential in nature and very hands-on. During the course, Marcie spent 2 weeks on one of the barrier islands on the Georgia coast and during that time she learned about the ecological and cultural components of the island. She was very excited about the course and felt that it was a perfect follow-up course to the Rivers to Reef program.

Sherri: The Novice Teacher

Sherri is a novice teacher who recently completed her second year of teaching. Sherri is a White woman who grew up in a rural community not far from the school where she currently teaches. Sherri is an unmarried mother who spends a considerable portion of her time outside of school raising her young son.

Sherri teaches at Tanager Middle School. Tanager Middle School was built recently, and it serves a rural community in the northeastern portion of the state. The school population is 83% White, 13% African American, 5 % Hispanic, 1 % Asian, and 1% other (Board of Education, 2007). The school system where she teaches is small in comparison to many of the nearby metropolitan school systems which are some of the largest systems in the nation. The student population for the entire city where Sherri teaches is under 1,500, whereas many of the larger school systems in the state have over 2,000 students in their high schools alone. The teachers in these small rural systems often perform many roles because they are required to teach several different subjects throughout the day. Sherri discussed that as a first-year teacher she was required to teach three different grade levels and five different courses each day including reading, language arts, social studies, and science. In her second year of teaching, Sherri taught several subjects as well, but unfortunately she did not teach a science course. Even though she was required to teach three other subjects, she noted that she still created opportunities to integrate science into the courses she taught. At the end of this school year Sherri will be teaching science again as her mentor, a 7th grade life science teacher, has accepted a position abroad. Sherri discussed how eager she was to return to teaching

science, but she also expressed concerns about teaching science without the support of her mentor teacher.

Throughout the three interviews Sherri indicated she was not very confident about her science content knowledge, but she did indicate that she was willing to learn and work to help her students understand scientific concepts. To ensure she was providing her students with accurate scientific information she worked closely with Karen, a seventh grade science teacher that served as her mentor. Her lack of confidence with the science content could be the result of earning her teaching credentials in a nontraditional manner. Sherri earned her teaching credentials while working full time and going to school part time in the evenings. This segment of our first interview provides a brief description of Sherri's teacher preservice program.

Brian: And how was that college experience?

Sherri: It was really good. I went to Piedmont and they worked so well with me I got to work full time, went to school full time and a full-time mom. I'm a single mom. So . . .

Brian: Wow.

Sherri: And they worked with me so well. I mean they worked around my schedule at work and my work worked around my schedule at school.

Brian: Now is there a special program?

Sherri: They have the adult learners program.

Brian: Oh, good.

Sherri: I mean it's not really called that, but it's night school. I only had one class during the day.

Brian: Okay. Wow.

Sherri: During the whole session.

Brian: That's great.

Sherri: I mean it was long days. Because I would get up at 7 o'clock and get home at 10 o'clock.

Brian: Wow.

Sherri: Yeah, go to work at 7 o'clock and get home from school at 10 o'clock yeah it was hard and then homework on top, but looking back it was worth it.

She noted the flexibility of her teaching program as being important because as a single mother she would not have been able to earn her teaching credentials without the flexi-

bility of the preservice program. However, she felt her teaching program provided her with a general overview of education, and it did not provide her with a firm grasp of the content, especially the science content. To gain a more in-depth understanding of Sherri and the reasons behind her lack of confidence in teaching science, it was important to explore the factors that influenced her pursuit of teaching science.

Factors That Influenced Sherri's Pursuit of Teaching Science

To obtain an understanding of Sherri's perspective and the impact the Rivers to Reef experience had on her teaching practice and professional growth, I examined the factors that influenced her pursuit of teaching science. Throughout interview one, Sherri provided information pertinent to the factors that influenced her to pursue teaching science, insights into her teaching practice, and the impact professional development experiences have had on her teaching. She noted that her previous educational experiences and her family members had a significant impact on her pursuit of a career in teaching science.

Like Marcie, Sherri did not start off pursuing a career in teaching; a unique set of circumstances played a role in creating a teaching opportunity for Sherri. After high school, Sherri started her career working several odd jobs, but prior to teaching she worked at K-Mart. She was very discontented working in the retail arena, and she soon began to reflect on her mother's career as a teacher. Sherri's mother was a teacher and Sherri found aspects of her mother's career worthy of exploring.

My mom got her teaching degree late in life and I'm like well, if she can do it (pause) and she is 60 when she is graduating. You know I would be 29 when I graduate, so I'm like okay I can do that. And then time (pause) like you, your son says, Dad, I need you at home. My son was not even a year old and I was working at K-mart. And I was like I can't see myself working every single weekend and him never have me come to a baseball

game or I can't (pause) What job would let me do that, that I would enjoy. So, I went and I enrolled in college, and started three days later and that was it.

The flexibility of teaching afforded her to spend more time with her son and this played a significant role in her selecting teaching as her career choice. But Sherri's pursuit of a career in teaching science was also influenced by her father. Sherri's father worked for the department of forestry, and she spent a considerable amount of time outdoors working with her father, but Sherri never viewed this exposure as providing her with a foundation that would allow her to teach science. When she was asked if she ever thought about a career in science she responded:

No. No. And which is weird because my dad was in forestry and we would go outside and we were outside all the time learning about the environment and stuff, and I am big on the environment but I didn't think that that was a science aspect. I mean I didn't think that that was something I could teach in science.

Aside from the influence of her family, Sherri's experiences in school played a role in her pursuit of a career in education. Unlike Marcie, the classroom experiences that Sherri experienced were not always positive. Her negative experiences served to motivate Sherri to teach so other students would not experience what she endured during her schooling. She went on to further discuss her negative classroom experiences:

Hated it. I hated . . . (pause) and that's why I wanted to teach reading and social studies because I hated both those teachers. (pause) I despised them because, umm, I was humiliated in my Romeo and Juliet class in my 9th grade. I was humiliated!

She reflected on the learning environment that eventually caused her to pursue a career in teaching:

So, again I thought to myself then that I can do a better job than that. I can teach them better than that. She would get (pause) she actually had a platform and she would get up on her platform and tell the students, "I am the teacher and you are the students." And it was like that Matilda movie: "I

know everything and you know nothing.” (pause) And I’m sitting there like, oh, my gosh. Ninth grade (pause) So, that was my literature experience, hated Shakespeare ever since, until college.

Sherri went on to discuss her science-related school experiences.

Brian: Did you have an interest throughout high school or middle school?

Sherri: No.

Brian: In science, no.

Sherri: I hated frogs the dissection of frogs, hated that. That was my seventh grade teacher. Um, my college experience was pretty good, but I didn’t have anything life science I had mostly physical science and the mathy stuff science. So I hated that.

Brian: Physics and chemistry?

Sherri: Yeah. And I had a really good teacher. I had Dr. Dalton, who actually taught me science in high school.

Sherri’s reflections on her school experiences were not positive. In fact they were so bad that they motivated Sherri to teach in hopes of improving learning opportunities for other students.

The experiences Sherri had in college were in stark contrast to her middle and high school experiences. She described her college experiences as positive and she seemed to find a renewed excitement about education. The positive experiences she had during her undergraduate program had a significant impact on Sherri because she managed to find a renewed interest in social studies, science and as for Shakespeare: “I love Shakespeare. I love Shakespeare.” It was apparent from this interview that Sherri’s educational experiences improved in all academic areas as she moved into the undergraduate setting. Along with providing information about her educational experiences Sherri also referenced her school administration and her mentor as factors that influenced her pursuit of teaching science.

Sherri was very upfront that she had absolutely no interest in teaching science. When I inquired about how Sherri came to teach science, she stated, “It was given to

me.” I probed further and asked if it would be accurate to say that the administration was one of the greatest factors that influenced her becoming a science teacher. She agreed and followed up my comment with the following statement.

Karen! (pause) That would be her. I was forced into it, I was told okay I had this science position I was really the overflow teacher so, everything, all the classes that were too large they just gave to me.

Karen served as Sherri’s mentor at school. Sherri relied heavily on Karen throughout the year and used her expertise to guide her through her first year as a science teacher.

So, that was the one that I got to take over. And I was a little nervous and she helped, she gave me all of her plans and this is what we’re doing and towards the end of the year I was like “I want to do this, this is fun,” I would spend my planning period in her fifth period. Working with her and the fifth period class.

Sherri developed a positive working relationship with Karen, and Sherri’s interest in science continued to develop as her working relationship with Karen continued to grow. Based on the interview, Karen presented science in a manner that was understandable to Sherri so in working with Karen’s fifth period class Sherri was able to gain a greater understanding of the content she was teaching.

Factors That Influenced Sherri’s Teaching Practices

The year prior to Rivers to Reef program was Sherri’s first year teaching, and her comfort level with the curriculum was limited. Two categories emerged from the interviews with Sherri relating to her teaching practice prior to the Rivers to Reef program, and they centered around her concerns related to the content and her classroom environment.

Sherri made it clear that she was not comfortable teaching the science content and that she was working hard to obtain a better grasp of the material in order to provide her

students with the necessary content knowledge they needed to perform well academically. She described how she felt the first time she learned that she would be teaching science:

Umm, I was very fearful. I mean I . . . I wasn't certified in science, I didn't know anything about science. I'm like I am not going to do well. These kids are going to absolutely know nothing. And I learned the same time they learned and then last summer I took the [certification test] on it and passed the [text] with flying colors and I'm like, "Cool!"

Sherri expressed a major concern about teaching science content that she was not familiar with teaching based on her limited content knowledge. Her discomfort with science was obvious but it appeared that she would be willing to work to obtain a greater understanding of the content. Her anxiety related to the science content was apparent, but Sherri indicated that she had significant concerns about the math-related components of science: "Yeah, (pause) so there was a connection there and I enjoyed that but it was still math parts and the formulas."

The integration of mathematics into the science curriculum significantly increased Sherri's anxiety related to the curriculum.

I was very worried. Umm, Humm. [Shaking her head, she does not like math]. Math and I don't get along. I went to a literacy conference in Athens and I missed the little part about teaching math with picture books, I so wanted to read that.

Sherri expressed a major concern related to mathematics as she shared a story related to math and her son. Sherri has deeply seeded fears related to mathematics at its most basic level. Her level of concern related to math indicated in this segment of an interview.

Sherri: My son comes home with math and I'm like, hummmm.

Brian: Now how old is your son now?

Sherri: In first grade.

Brian: Really.

- Sherri: And he comes home with his math problems and I am like, “ I don’t know what this is.”
- Brian: (laughter)
- Sherri: I have to call his teacher like “Melanie, I don’t know what this is, I don’t understand this.” (Laughter).
- Brian: That’s alright.
- Sherri: And its everyday math so it’s like taking everyday regular things that you would see everyday and putting it in a math situation. I’m like I don’t know what this is talking about.
- Brian: (laughter)
- Sherri: This is not what I did in school.
- Brian: (laughter)
- Sherri: And then she will explain it to me and then I’m like “Oh, I get it. We can do this.”
- Brian: Right, right.
- Sherri: He’s learning polygons and.
- Brian: Yeah, they’re going to this new math.
- Sherri: Trapezoid and I’m like, “What? You’re in first grade, he’s 7 years old, he’s not supposed to know that stuff. I didn’t know that stuff until I was in 6th grade.

The conversation was light and she was laughing throughout, but she was clear that mathematics had a significant impact on her discomfort with teaching science.

Sherri’s concern about the content and her classroom environment were intertwined. She expressed her concerns with the science content and how her first year of teaching science was stressful and she needed to learn in the same manner her students learned. As she reflected she was very dissatisfied about her teaching practice during her first year of teaching science. Most teachers with limited content knowledge seek professional develop to enrich their content knowledge. However, Sherri had a professional development perspective that was extremely negative, especially for a novice teacher.

Sherri’s Professional Development Perspective

I wanted to investigate what role professional development played in her transition into teaching and in shaping her teaching practice. Sherri had no professional development experiences beyond her preservice program prior to the Rivers to Reef

course, so I expected the impact of professional development on her teaching practice to be minimal. Throughout the interviews two categories related to her professional development perspective emerged: professional development experiences and views about professional development. My thoughts related to her professional development experiences were confirmed as Sherri stated that Rivers to Reef was her first professional development experience that she actually completed. She was supposed to take part in two this year, but she explained that the Rivers to Reef course is the only one she completed. Since completing the Rivers to Reef experience, she has indicated that she is interested in pursuing a professional development course during the upcoming summer: “The next one I want to do is “Paddle Georgia.”

Although Sherri has had minimal professional development experiences she demonstrated intensely negative views related to professional development courses. Being a new teacher I found it intriguing that Sherri had such strong, predetermined views about professional development courses and their benefits. In interview one when I asked her what she thought about when she heard “professional development,” she responded, “Boring.” I thought it was ironic that in her limited exposure to professional development experiences she would categorize professional development courses in that manner. She went on to describe the intended professional development course that she was supposed to take as follows:

Sitting in a classroom, learning about the GPS [Georgia Performance Standards]. That was supposed to be my second one, and it was sitting in a classroom learning about the GPS. (Pause) I think my aunt, she had a tumor, a brain tumor and she died the day that my class started and I think she did that on purpose.

Instead of just describing what she thought the experience would look like she provided some additional information that I found to be very interesting. Sherri added that she

believed her aunt died to get her out of the professional development course. This statement sent a strong message about Sherri's views related to professional development courses and her apprehension to participate in them. Throughout the three interviews, Sherri was never fully able to describe the origin of the negative views about professional development she held prior to the Rivers to Reef experience but she was able to describe the components of the Rivers to Reef course she found beneficial.

During interview two, Sherri discussed the Rivers to Reef course and provided a detailed account of her experience. She began her discussion about Rivers to Reef course with the following statement:

Even Rivers to Reef I knew I was going to have some hands-on; I didn't realize it was like dump me in the water.

This statement was descriptive of the experience and captured the ideals established by the creators of the Rivers to Reef program. The course was designed to be an immersive learning experience for teachers, and Sherri viewed the course as one that immersed the participants in the aquatic realm.

Her description of the experience continued as she reflected on the science courses she completed as part of her undergraduate program of study. She noted that the courses she took were not memorable and had minimal long-term impact. In contrast she discussed aspects of the Rivers to Reef program as follows:

I had to take two science classes, I think environmental science and I don't even remember the professors' name . . . it was early on in college but it was still only 3 years ago, 4 years ago. And I still don't remember his name. There was just nothing, nothing memorable about it. Whereas Rivers to Reef I could tell you what I did every day, I could probably tell you what I ate for breakfast.

She continued discussing the experience and aspects of the course she found memorable.

There was one statement or phrase that Sherri made reference to on several occasions,

“everyone lives downhill.” She remembers the statement, but she also used that information to help her students understand water quality and related issues.

So they realized that was not a good thing, which I probably not had thought that if it wasn't for Kim saying everyone lives downhill, everyone lives down stream.

Her memory of the water quality testing was still quite vivid, and she indicated that she still knows how to do it because she was responsible for doing it everyday. She attributed the knowledge she obtained related to water quality testing to the course providing her with daily opportunities to collect water sample in a naturalistic setting.

Like I said, I learn more from that, just getting that hands-on, interactive; okay you go do this and I could probably go through the whole water quality testing even though I haven't done it in since last year. But I could probably do that just because I did it everyday.

Sherri learned a great deal about how she learned, and it was apparent that she felt she was a hands-on learner. As she talked about how she learned throughout the experience she also began discussing specific details about the Rivers to Reef experience. One activity that had a major impact for her was the first day of water quality testing. She talked about the quality of water before it reaches major cities, in this case, Atlanta.

We got there and I was so excited, we went to Sandy Springs. Sandy something park and the water was disgusting. I was like ill. I cannot believe this is what is coming from, because it's so pretty up here [where she lives in north Georgia] and I would always go to the headwaters of the Chattahoochee and its so pretty. But you have to go through Helen and you have to go through Lake Lanier and then you have to go through, (Pause) I am like I'm so sorry. I don't put any of that trash in the water but I am so sorry because I live up here and it's so pretty up here.

She also discussed how the water quality started to improve as she moved further from the city. She was surprised to find that the water had an ability to rebound, but her discussion of water quality quickly shifted as she started to discuss Sapelo Island.

Surprisingly enough, the further we got down the water started to clear up because they had the River Keepers and everybody cleaning up the water. Why don't we have that in Atlanta? Why don't they clean up the water in Atlanta? So that's another issue that's entirely too big to follow. And when we got to Sapelo, I mean that's umm, Sapelo (indicating great pleasure) I love that place.

Initially, Sherri provided minimal details about her experience on Sapelo Island, but the experience appeared to have a significant impact on Sherri. During her reflection she paused often and was able to reflect on minute details of the experience:

And we saw crabs running everywhere from this size (indicating very small) to this size (indicating somewhat larger). They were cool.

Her reflection about Sapelo Island shifted to a discussion about Gray's Reef. Her discussion about the specific components of the reef were limited but she was able to focus on one aspect of the Gray's Reef experience, operating the remotely operated vehicle. She enjoyed driving the remotely operated vehicle so much that she planned to participate in a professional development course this summer that will allow her to build her own remotely operated vehicle.

But I want to go to the ROV workshop. After playing with the little remote control and working it I wanted to make my own.

The first two interviews provided me with a rich description of the Rivers to Reef experience from Sherri's perspective as well as the professional development perspectives Sherri held. Sherri viewed professional development opportunities as counterproductive to her learning style prior to the Rivers to Reef experience. The content knowledge she obtained from the Rivers to Reef experience was put into practice this year. Even though Sherri did not teach a science course this year, she found creative ways to integrate what she learned during the Rivers to Reef course into her reading classes. As

her reflection continued, Sherri's level of enthusiasm increased significantly, but in her summation of the experience, she stated, "This is one week where you learned by doing.

The Rivers to Reef experience was Sherri's first professional development course, and I expected that she would find the Rivers to Reef program as a beneficial learning experience because she was new to teaching and she had limited scientific content knowledge. My beliefs were correct as Sherri indicated that the experiential nature of the course increased her content knowledge and even though she did not teach science this year she found creative ways to integrate what she learned into her teaching practice. Sherri was excited about completing her second year of teaching, but she was even more excited to find that she would be moving back to teaching science next year. She stated that teaching reading, social studies and language arts were enjoyable but she stated that she was eager to get back to teaching science.

Marcie and Sherri shared several similar components that influenced their pursuit of teaching science and their science teaching practice, including their families and their educational experiences. Both the novice and experienced teachers were placed in a teaching environment with limited content knowledge because of their preservice teaching programs. However, Karen, the veteran teacher participated in a traditional preservice teaching program with a substantial number of science-related courses. Karen's firm grasp of the science content played a role in providing a unique set of experiences related to her pursuit of teaching science, her teaching practice and her professional development perspective.

Karen: The Veteran Teacher

Karen is a veteran science teacher who has been teaching middle school science for 17 years. Karen is a White woman in her 30s. She has a firm grasp on scientific concepts, by her own admission, and she is confident in her ability to relay effectively scientific concepts to her students. Karen recently earned recognition by the State Superintendent as a result of her students' top ranking scores on the statewide criterion reference test. She was invited to meet with the State Superintendent as well as conduct some teacher training sessions for science teachers in neighboring communities.

Karen earned her teaching credentials in a traditional education format, but she began her undergraduate program in pursuit of a veterinary degree. While enrolled in her course of study at a large university in Georgia, she realized that the veterinary program was no longer of interest to her, and she began pursuing a degree in middle school education. The middle school education program did not require her to take a substantial number of science courses, but her interest in biology and the life sciences fueled her to do so. Since the completion of her graduate degree, Karen has earned her leadership certification as well as her gifted science teaching endorsement.

Karen has taught in two other school systems prior to her current teaching position. Each of the previous systems where she taught were in rural counties; however, Karen described the first setting as one that would more closely resemble an inner city environment. She currently teaches at Tanager Middle School along with Sherri. Like Sherri, Karen has worn many different hats in her science classrooms. At one point she was the only gifted teacher in the system where she taught, and she was required to teach students science in grades 4–8; she taught five different courses each day. Karen main-

tained this rigorous schedule and served as the only gifted teacher in the system for 6 years. Two years ago, she began teaching at her current school where she works closely with Sherri and provides her with mentoring support. Karen and Sherri work just a few doors away from one another, and they spend a substantial amount of time exchanging ideas and planning lessons. Because of the size of the school system, Karen teaches every seventh grade student in the system. This places a great deal of pressure on Karen but also provides her with a great deal of recognition when her students perform well.

Throughout the interviews, Karen expressed a level of frustration with the system and indicated she was feeling burnt out with teaching science in this school system. She has since decided to leave her current school system to take a position abroad teaching adult learners. She hopes to work abroad and then return in 2 years with a renewed spirit for teaching in the middle school environment. In her absence, Sherri will be teaching her seventh grade Life Science classes. Throughout her 17 years of teaching science, Karen has obtained a great deal of knowledge related to scientific content and pedagogy. But in order to gain an in-depth understanding of Karen's teaching practice, it was necessary to explore her educational experiences prior to the Rivers to Reef professional development course. The examination of her educational experiences prior to the course began with Karen's discussion about the factors that influenced her pursuit of teaching science.

Factors That Influenced Karen's Pursuit of Teaching Science

While discussing how she became involved in science teaching Karen stressed two factors that proved most influential. Like Marcie and Sherri, Karen viewed her family and her educational experiences in school as the most significant factors in her

pursuit of a science teaching career. Our conversation about her pursuit of a science teaching career began with Karen's discussing her science related experiences in school.

I think . . . I had good science teachers for the most part. I can remember doing science fair projects, you know, and the teachers really taking time. And I remember winning and going to district and it was like at the mall, that's where we displayed our science fair projects so that really fueled it.

It was apparent that school played a major role in her interest in science. She discussed the positive influence of her teachers, her participation in science fairs and she even made reference to fieldtrips she experienced.

I'll tell you, one thing that always fascinated me was our school system, the Planetarium. Every year we went to the planetarium and that was probably my most favorite fieldtrip to sit in the planetarium and see the stars.

She even mentioned specific details about her classroom/school that fueled her interest in science.

And one other thing that just dawned on me that I still find fascinating was (pause) in my school, they set up, and you will find this fascinating, they set up, somehow they must have had a grant, (pause) they put these tubes in the hallway all over the school and they had bees and the tubes went outside and the bees would crawl along the tubes to this huge hive in the front atrium of our school.

But there was one event in elementary school that seemed to have a significant impact on Karen and her interest in science. Karen took part in a summer camp experience that provided her with her first exposure to dissections.

Third grade, I went to Atlanta, it was in Atlanta it was the Governor's Honor Science program. I don't even know if they still have that Governor's Honor Science program.

She referenced this as a life changing experience that really motivated her to delve into the world of science.

Went there and got to dissect my first frog, and she had eggs in her and I remember asking the lady, “Can I take the eggs home?” and she put them in a jar for me.

Her excitement about her first dissection did not end at the Governor’s Honor program it continued even when she went home.

I took them home, my mom sat them up on the counter, my parents were all into you know science too growing up; education period. So, I kept those on the shelf for months and that was just like fueled my whole dissection thing. I mean, from then on I was picking up road kill and dissecting it.

Karen noted her parents as being a major factor that influenced her pursuit of teaching science. These contributions were done in an indirect manner by just supporting Karen’s interest in science. From making space on the shelf for her frog eggs to exposing her to informal science environments like zoos and museums, her parents influenced her love of science. When I asked Karen about her parents’ supporting her interest in science, she responded,

Oh, yeah, just education period. You know just (pause) ummm traveling, going taking us to museums, taking us to Zoo Atlanta all the time and you know just, I mean just always, we were always just going and doing something.

She went on to discuss other areas that she found her parents to be influential related to her science education.

And like I said my parents definitely, they helped me with all those projects, and they took me places and we went to the beach all the time and they explored, you know.

Karen connected her classroom experiences and the influence of her parents with a love for learning: “I love to learn.” When I asked Karen, “How did you become interested in teaching science?” she responded,

I got them from always a life long love, I've always had bug collections and you know, I always tell the kids this story when I was in third grade I went to a science camp and dissected my first frog

She translates that passion for learning into her passion for teaching. Karen summed it up by saying that her passion for teaching science has a lot to do with her love for learning: "So . . . I love learning as much as the kids do." Her passion for learning and teaching has caused Karen to create a unique learning environment for her students. But the environment has changed over the years and even though she has a tremendous desire to provide her students with an enriching learning environment she has noted that in the last 17 years, her level of motivation and her teaching practice has changed.

Factors That Influenced Karen's Teaching Practices

During the initial interview, I wanted to gain insights into how Karen described aspects of her teaching practice prior to the Rivers to Reef experience. Throughout the interview, she described her classroom environment, how her classroom environment has changed, and how her concerns about the curriculum have affected how she teaches.

When Karen was asked to describe her teaching practice and how it has changed over the years, she began the discussion with the following statement:

I had guinea pigs in the classroom, I had birds in the classroom, I had parakeets. I had, you know, my classroom had snakes, you know, I think in 17 years I have gotten tired. You know. I think I am a good teacher and I hear the kids say they still love science, and I still try to do things like that, but I am not nearly as ambitious, probably as I was 17 years ago.

Even though she noted that her level of ambition was not as high as it was during her early years of teaching, she has made other positive changes.

On the other hand 17 years ago I wasn't probably nearly as organized, nearly as focused as I am today, nearly as efficient, I mean I was taking papers home every weekend to grade I was tired from that, I am not doing that anymore because I am much more efficient at school than I was.

However, even though Karen is focused and efficient the ambition that fueled Karen to develop a classroom that provides students with a productive learning environment has been diminished by her concerns related to the science curriculum.

I am still excited about teaching science but I just don't feel the energy you know, I think a lot of it has to do with 17 years of the same curriculum, same curriculum, same curriculum.

Karen stated that even though she feels somewhat burned out with teaching the curriculum, she had some genuine concerns about other teachers. This concern stemmed from teachers' not having the content necessary to teach the science curriculum. This concern seemed to overshadow any concerns she had about her personal lack of motivation related to the curriculum.

And I think they [teachers] do not get enough science at all, I have said for years that part of the problem is (pause), and I think we are getting better with this, but I have even told some of my professors at UGA that they did not teach enough content.

She went on to address her concerns about middle school teachers in particular.

See I had middle school certification. I don't have science education. I have middle school with a concentration in science. I can teach 4-8 only, middle grades, with a concentration in science. But I have had soooooo much science background but that is because I wanted it, I fueled it myself.

Karen was confident that the lack of motivation in science on the part of students can be attributed to a lack of content knowledge on the part of the teacher.

I think part of the problem in science education is (pause) especially with elementary and middle school teachers, they graduate not having any content or very little content and then they get into school and they can't teach the content. I go to these workshops they can no more explain Darwin's theory of natural selection than (pause) they have no clue. They have no clue. Mitosis, meiosis.

In her interactions with other teachers, she noted that they had a limited understanding of the content they were expected to teach. Her concern about their lack of content

knowledge further fueled her frustrations related to the curriculum and student assessments in the state.

But what comes out with just me talking to them, them not telling me but just listening to them, they don't know the content. They do not know they don't understand, they don't understand six kingdoms of living things. I am like how can you teach life science all year and you have not taught. I had Blake City teachers come in a few weeks ago, stay all day with me and observe. At the end of the day we sat down and talked and they are like, here it is a few weeks before CRCT, well, we have not taught the six kingdoms of living things yet, I mean right here in life science.

By the end of interview one, I had noted that Karen displayed a lack of motivation and a sense of frustration with her school system. Karen has a long history of teaching science in the middle school environment and she noted the deficiencies in the preservice teacher programs as well as professional development programs for science teachers. Karen indicated that there was a clear connection between the overall lack of content knowledge for teachers and the limited academic success of their students. Karen stated, that in order for science teachers to increase their content knowledge preservice science teaching programs and professional development programs need to be revised to focus on science content knowledge.

Karen's Professional Development Perspective

In the past 17 years, Karen has participated in too many professional development courses for her to count, but throughout that time she has found that professional development courses can be beneficial learning opportunities for teachers if conducted in the appropriate manner. Throughout the first interview Karen provided some insights about her professional development perspective by discussing her professional development experiences prior to the Rivers to Reef course.

Oh, yeah. I go to a lot of professional development. I am really big into that, I mean I just like to go. (pause) I love learning so I just like to go.

Our discussion about professional development began with Karen's providing information related to her concern about the limited exposure science teachers have to professional development opportunities. She noted that the professional development courses that she experienced over the years required her to go to great lengths to find enriching science related professional development experiences.

The only in-house professional development that I am required to go to is like reading and writing across the curriculum or data analysis or (pause) but in terms of just specific science training, I have never been in a system, and maybe that is because I have always been in small systems not big systems like Atlanta or whatever. They have never offered just science professional development in-house.

She noted that her internal motivation to find science-related professional development courses has provided her with beneficial learning experiences. She was adamant that the school systems where she has taught have not provided her with access to science-related professional development experiences that enrich her classroom for her students.

No. Anything I have every taken, I have had to find on my own. And I find it through Athens Botanical Gardens, or Zoo Atlanta or the aquarium. Everything I have always found on my own to go.

But she admits that sometimes professional development is of little benefit, in part because of its presentation. During our first interview she was able to reflect on a recent professional development experience that she described as a waste of time.

I don't know where they find the people to teach those workshops usually, but they just to me don't seem prepared, excited about what they are doing you know, (pause) they are here to motivate us to take it back to our classroom. And I just feel like, (pause) Even those ESOL classes that I'm taking I had to have three, from fall to now every Tuesday night since last August. And he [the course instructor] is a really nice guy, but he is not organized, its just four or five hours each Tuesday night of wasted time. I feel like (pause) Somebody last night at class whispered "I have not learned one thing." I found to be in, (pause) I mean we paid \$1050, which my system is going to reimburse me for but a lot of people did take it because they want to get it on their certificate. And you feel like you don't

learn anything. Now mostly the science things I go to it seems like those people are pretty on the ball.

She was then able to reflect on some positive professional development experiences and the impact they had on her teaching and learning.

But when we go to good staff development like Rivers to Reef that does excite, that does feel good. I came back last year all pumped up and excited and ready to do this and this and this and I did do a lot of different things you know but, then again I already did.

She made reference to the Rivers to Reef program and its benefits as a learning experience. Karen also referenced that she has already incorporated several components of the Rivers to Reef program into her classroom curriculum since she took part in the course two years ago.

She went on to discuss her first science-related professional development course and how she integrated components of that experience into her classroom curriculum.

Yes, I came back and it taught me how to garden with the kids and we created a little outdoor flower garden/butterfly garden. Actually I came back and purchased grow lights to hang from the ceilings, and we created some indoor salad gardens in my classroom. and we made salad gardens with lettuce and stuff. And then we did a little butterfly garden outside, but that Principal was very hands-on. He is a science educator. He loved hands-on, I mean, he fueled what I wanted to do he was right there behind me supporting me all the time.

She also noted the impact a supportive administration, in her case, the Principal, had on her science classroom. Karen would go on to discuss in subsequent interviews that the support of the administration with a lack of financial resources is detrimental to the implementation of successful science professional development strategies.

Summary

Three teachers of various backgrounds participated in the Rivers to Reef experience and agreed to take part in this research study. The group is composed of a novice

teacher, an experienced teacher, and a veteran teacher. Throughout the course of 10 weeks, they each participated in the three interviews that provided a rich description of each of the participants, their teaching practices prior to the Rivers to Reef program, and their professional development perspective.

In this chapter, I focused primarily on the first interview and examined the factors that influenced their pursuit of careers in teaching science, their teaching practices prior to the Rivers to Reef program, and their professional development perspectives. Obtaining insights into their educational experiences prior to the Rivers to Reef program served to acquire a robust understanding of the study participants so a meaningful analysis of data from subsequent interviews could be accomplished. In chapter 6, I present data related to the Rivers to Reef experience and its impact on the professional growth and teaching practice of the three study participants and analyze them for commonalities, discourse, and emergent themes.

CHAPTER 6

RESULTS

Introduction

In this chapter, I discuss the two research questions that framed this study:

1. What is the relationship between a professional development course that uses an experiential learning model and science teaching practice of its participants?
2. How would the Rivers to Reef participants reflect on and describe the course as a professional growth experience?

Interview one for each of the participants provided me with insights into the science teaching experience of each of the study participants prior to the Rivers to Reef experience. In this chapter, I examine how each participant described the Rivers to Reef experience as a professional growth experience, the impact the Rivers to Reef program had on their teaching practice this school year, and any of their conceptualized plans for integrating the Rivers to Reef experience into their future science teaching practice.

Using a format similar to that which I used in chapter 5, I present and analyze the data for emerging themes acquired from the interviews and information obtained in discussions with participants. Initially, the data are presented from the individual professional growth and teaching practice perspective of Marcie, Sherri, and Karen. The commonalities that emerge from a cross-case analysis of Marcie's, Sherri's and Karen's interviews are presented and analyzed in this chapter.

Marcie

By the second interview I realized that Marcie was the most talkative of the three study participants. Marcie seemed to enjoy sharing the information she obtained throughout her experiences as a teacher and a learner. I also quickly realized from our discussions that Marcie loved to teach, but she loved to learn even more. By the time we began our second interview Marcie greeted and shared information with me as if we had known each other for years. I arrived at her school a little early for the interview, and I had a chance to get a glimpse of her interaction with her students. The relationship with the students appeared casual. They were chatty and loud, typical eighth grade students at the end of the day. The students seemed to have a healthy respect for Marcie and some students hovered around her room long after the last bell rang and our interview was well underway. She stated her room was the congregation room and students always just hung around there at the end of the day if they did not have to take the bus home. It was great to see that her enthusiasm for learning and enjoyment of teaching was recognized by her students as well. The interaction with her students also helped me understand why Marcie was so eager to find professional development experiences that enrich her classroom environment; she was committed to the success of her students.

The Impact of the Rivers to Reef Course as a Professional Growth Experience

My second interview with Marcie began with a discussion about how she viewed the Rivers to Reef program as a professional growth experience. Throughout our discussions two main categories emerged: the impact of the experience on her self-efficacy and enhancing her content knowledge. In our final interviews Marcie indicated that these two components were uniquely intertwined. She stated that as she obtained a greater

understanding of the content, her confidence with teaching science increased. Marcie summarized the Rivers to Reef program as having an impact on her self-efficacy because it made her more credible as an earth science teacher.

It [the Rivers to Reef program] really gave you the credibility to speak to the class about these things because you've done them. Like if I'm telling them about water quality, well, you were going to do water quality, if I was talking to them about river systems and watersheds, you saw them all. I hate to say it made me credible 'cause you should be able to teach content without, but I am sorry I feel like I have to be credible.

That credibility translated into a confidence when teaching the content: "It just makes me feel more confident when I am teaching it if I feel like I am credible." The confidence and credibility that Marcie acquired from the program was also noted in her interaction with local university professors. Marcie noted that the credibility derived from the Rivers to Reef experience not only affected her self-efficacy related to teaching, but it also played a role in the interactions with people she considered experts in the field.

So that was good, it grew I guess it started out (Pause) Rivers to Reef and that content but instead of just staying in those limits it just really expanded, which was nice because I felt comfortable with the content so when you're building on to the next part its not so scary and you can speak credibly to the [the local university] people. Like those professors they will come out and they are happy to show you things but if you don't know what to ask for, or you feel like you're so dumb that you can't even say the first thing because they are going to be talking up here [indicating above her head] which is the disadvantage because they are way up here [indicating above her head], so you feel like, "Oh well I did Rivers to Reef so I've got some smarts so it worked out really well."

Marcie was passionate about the learning opportunity she experienced in relation to the Rivers to Reef program. She has been teaching science for 5 years, and she appeared to be confident in her ability to teach the earth science curriculum effectively. But the confidence she displayed on the surface appeared to be a facade as Marcie clearly

indicated throughout our interviews a need to increase her confidence and content knowledge of the subject she teaches.

The other component indicated by Marcie relating to the Rivers to Reef experience as a professional growth had to do with the enhancement of her content knowledge. This had a positive impact on Marcie's self-efficacy. Our conversation relating to her content knowledge began by discussing a school she visited recently. While attending the school, she discussed a policy the school had that focused on the mastery of content. Students who attended this school are tested on their content knowledge at the end of each term, and if they do not master the content they are not promoted to the next grade level.

Because they don't let them move on. Now that part wasn't so good, but they have a lot of strategies to try to help them master content.

Marcie indicated that she had mixed feelings about this teaching method, but she also indicated that the students performed extremely well on statewide testing because only students that passed the class and mastered the content take the test. She indicated that she felt that this method of teaching may become commonplace throughout the state so she stressed how important it was for teachers to have mastery of the content.

She continued our conversation related to content knowledge acquisition by discussing how the Rivers to Reef experience helped her take a holistic approach to understanding aquatic ecosystems. The experience provided her with a comprehensive understanding of aquatic ecosystems and the connections it had to the earth science curriculum. Taking a holistic approach to aquatic ecosystems helped Marcie understand the content, assisted her in solidifying the water related concepts in relation to the

curriculum and it also motivated her to write a grant to acquire water quality analysis kits for her students.

. . . like just water quality (pause) and it would have given you some, (pause) but this made it just tie so nicely together. It made it look like from beginning to end everything fit it its own compartment, so that was nice. And then we wrote a grant to get water quality kits so we did some of that we actually did [In the Rivers to Reef program] water quality testing.

She went on to discuss the impact of her holistic understanding of aquatic ecosystems:

I am more passionate about it [water quality issues] because you get to see the effects, I mean we did see some of the pollution. Cathy gets you out there and says, “Look at that this is going to do this, and look at that you think that that is an innocent little soda can, let me tell you what it does.” So you got to see the big picture how something little can really just cause a problem.

Marcie indicated that experiential learning format of the Rivers to Reef experience motivated her to pursue similar professional development opportunities. In the summer preceding her Rivers to Reef experience, she took another course on Ossabaw Island that further enhanced her professional growth. The Ossabaw Island experience provided Marcie and several other teachers with a week-long opportunity to explore the biological and physical components of one of Georgia’s barrier islands. Marcie was able to obtain a substantial amount of relevant content knowledge from the Rivers to Reef experience and the Ossabaw Island professional development course.

I’m telling you between the Rivers to Reef (pause) kind of set the framework in my head and with each class, I’m going back to that original and making those links, (pause) and without that I probably would not have gotten out of Ossabaw what I did. It’s almost like everything is going in the perfect little sequence, like God planned it that way.

She went on to discuss the connection between the two experiences.

So now in my mind the links that I’m making are all making sense to me because I started with something that took me through the whole geography of Georgia and had me travel down the river system so when you

have me here at Ossabaw things are making sense because I know where it all started from.

She found the impact of the Rivers to Reef program followed by the Ossabaw Island course to be so significant and enriching from a content knowledge standpoint that she wanted the courses to be taught sequentially to provide teachers with a holistic view of aquatic ecosystems.

And I'm actually going to write to them [the organizers of the Ossabaw course] for their follow up class they don't go back to Ossabaw they go out to the Appalachians where it all started from because I think I am the only one that had all the connections about how that flowed down stream and they did not make that clear enough in this class [The Ossabaw Island course] but all you would have to do is start this class out there.

Marcie had a strong desire to pursue enriching professional development courses. This is evident in her selection of the Rivers to Reef course and the Ossabaw course. Her desire for professional development courses has continued as she stated that she is waiting for her participation in another hands-on learning opportunity that will enrich her content knowledge related to physical science: "And now I will be building ROVs the week after next and that will be more physical science." Marcie will be moving to another school next year, and she expressed a concern about not having access to the information related to professional development opportunities, but she is determined to find quality professional development opportunities in the future even though she knows she will have to work harder to do so in the new school system.

And they're out there, it's a shame for people with little kids I understand that they can't do it and I don't see how the state can fix it, but for those of us who can get there (pause). In Bryant County I won't because they just don't get the memos out as much. But hopefully the Chatham people will send them to me. A big system like Chatham gets, you know they pass everything along from the state whereas Bryant it gets bottlenecked. But that's okay I will find them, I will figure out where they are next year.

Marcie's existing participation in and desire to find future professional development opportunities indicates she is committed to her continued professional growth. Throughout this series of interviews Marcie has indicated that professional development courses have been extremely beneficial for her professional growth and she has also gained insights into her personal learning style and content knowledge. Marcie has learned that it is necessary for her to make real world connections with the curriculum in order for her to truly understand the information being presented.

I need a real world connection, it needs to make sense to me. You know I can read it in a book and I can help them learn what's in the book but once I see it for myself and experience it myself then I usually . . . Somebody asked me to describe this program and I said it's like those books when you were a kid and it had the human body in it and you would have the transparencies and you would put the one layer on and it would have the bones and then the next layer and it would have the skin and then the next layer, and when I go to a program and experience it its like when you put that final layer on you see the whole body and it all makes sense.

Understanding how she learns has helped Marcie to understand better the professional development courses she should take part in to improve her content knowledge related to the curriculum she will be teaching. Knowing that she needs real world connections in order for concepts to make sense to her she has also found that her professional growth is impacted by opportunities that provide experiential learning opportunities. It is important that these courses integrate relevant content knowledge that Marcie could use in her classroom.

Marcie concluded the interviews discussing how the Rivers to Reef and Ossabaw Island experiences assisted her with adjusting to the changes in the eighth grade curriculum. The Department of Education at the state level has determined that the eighth grade curriculum for the upcoming school year would be changed from the earth science curriculum to the physical science curriculum. Marcie was hesitant about making the

content area transition because she was unfamiliar with the physical science content. She felt that now that she had obtained a firm grasp of the earth science curriculum, she was being required to learn a new content area. However, she indicated that the Ossabaw Island experience has helped her feel more comfortable with the transition because the experiences provided her with an opportunity to see the connections between the chemical, physical, and biological components of science.

It made it much easier for me to say that I know I don't want to give up earth science and I love biology but you know what this stuff is really critical and he [one of the Ossabaw program instructors] put it in that perspective that knowledge of these elements and this chemistry has such a big important part I was like, "alright, I guess that makes sense."

Marcie began making the connection between the Rivers to Reef experience, her teaching practice, and the impact it will have on student achievement. The curriculum connections that she addressed focused on her experience with the Rivers to Reef and Ossabaw Island courses. Marcie noted that she was uncomfortable teaching the physical science content; however, her experience with these two professional development courses had a positive impact on her confidence. She also realized that she could use her confidence related to the content and her students' interest in life science to teach other science disciplines like physics and chemistry.

That's what I am hoping, the guy Peter, Mr. Negative, boy, he turned out to do a lot for us. He said he started out for marine biologist, and he saw all of the problems that were going on with the ocean then he realized that if he wanted to have an impact on the biology he had to change his focus to the chemistry and work on that because that was they only way to save the biology. And I thought "Wow!" That is really amazing that if you really want to save the whale you have to know the chemistry.

This approach to science that connects various aspects of the science curriculum will aid in students learning that a true understanding of life science involves knowledge related to chemistry and physics. The connections were established for Marcie and she

saw this as a rich learning opportunity for her students. It was apparent that Marcie saw using the experiential learning format had a positive impact on how she teaches and ultimately helping students understand the content.

Because I have done everything that the brain likes, like these programs do what the brain likes it likes to connect it with real things, it likes to connect it to different areas kind of the cross curricular (pause) the environmental, the ecology, kids are really interested in all of that and they will remember it. These things make me a better teacher because I stop focusing on, the stuff that is actually getting in the way of teaching and like paralyzing me. Like I'm saying "Well I can't do this today because standard blah, blah, blah that's what I'm going to teach today."

Marcie was confident that her teaching would adequately address any needs for her students to be successful on the standardized test for the statewide curriculum. Having had limited experience with the physical science curriculum that she will be teaching next year, Marcie was able to draw on the Rivers to Reef and Ossabaw Island experiences to increase her confidence with the content. She has since developed a significant amount of confidence about her ability to teach these concepts.

With Rivers to Reef and, piggybacking this one (the Ossabaw Island course) that whole unit in matter and a good part of the unit on physics I am going to teach it from this [water and aquatic ecosystems] perspective, I mean I don't have any choice about quarterly assessments but I know that everything is going to take care of itself because they are going to remember what I am telling them.

The following statement addresses her confidence in teaching her new content area.

It's so interesting there is no way that they are not going to remember it. Maybe I am naïve but I really, I feel very comfortable about the chemistry part of it and part of the physical science part of it, for never having done this (pause) and I did not before I went. I was like, "Oh, my God, my kids are going to screw up on this and my first year is going to be a disaster with physical science and I really don't feel that way." I feel like I figured out a way to connect it, make it real for them and make it fun.

The Rivers to Reef program and the subsequent professional development experiences have had an impact on Marcie's professional growth. She has acknowledged

an increase in her content knowledge, her confidence and credibility related to teaching the science content, and a greater desire to seek professional development experiences that use an experiential learning format that will enrich her teaching practice.

Impact on Teaching Practice

Marcie implemented components of her Rivers to Reef experience into her classroom curriculum in the school year following the course. The information she presented focused primarily on how the course affected her teaching strategies and her desire to present her students with more experiential learning opportunities.

Marcie began our discussion about the impact the course had on her teaching practice by highlighting the teaching strategies she obtained throughout the Rivers to Reef experience. Marcie addressed how one of the instructors used modeling as a strategy for teaching. While searching for nesting sea turtles on Sapelo Island, Marcie described how the instructor was able to maintain the interest of the participants even when they were unable to locate any sea turtle nests.

Yeah, the turtles but she showed us these weird things like we couldn't find the turtle nest so she had us looking for alligator eyes with the red light, and then she had us use the green lights to look for spider eyes and she managed to flip flop what was a bust and "Okay, just say you can't do this but you can do this and this." So it was good modeling because that always happens in the classroom--something doesn't work out and you say, "Okay well now what do I do?" And she was like, "Okay, we can do this and this."

Seeing the teaching practices modeled solidified the power of modeling as a means of presenting scientific concepts to students. Marcie went on to discuss other teaching strategies she found as a result of her participation in the Rivers to Reef program. She discussed how the participation in the program enhanced the approach she

took when designing the curriculum for her students. She noted that the Rivers to Reef experience had the most significant impact on the curriculum design of her water units.

But I probably would not have known where to start had I not gone to Rivers to Reef program I would have kind of looked at what is in the book and said, “Okay, well I look up this on the internet at just general things.”

She discussed how the program had an impact on her teaching this year and how she plans to integrate what she has learned into next years curriculum.

And already planning on how to do it for next year. So it is kind of a perfect thing when you’re looking at heading an earth science, life science and physical science to format because of all of the chemistry. So it’s kind of one of those experiences that you can plug in wherever you need to, so that’s valuable.

Marcie felt that the program was a natural content connection across the middle school science curriculum, and she discussed methods she wanted to use to incorporate additional learning opportunities for her students by modeling components of the Rivers to Reef experience.

I wanted to do (pause) and I couldn’t. We wanted to do a boat trip with them and on the way we would stop and get some water quality [samples] there and then here and then out in the (pause). And do kind of backwards, like, okay, here are the numbers you got for the water quality so what is going to be able to live there. And then you have your little sheet that says this [plants and animals] lives here and what everybody needs to survive like the manatees need this pH and then the kids have to kind of plug it in and then work backwards to say, “Well was this a swamp? Was it an estuary? Was it an ocean?” Like they have to figure out what the water was from.

The sample above indicates a much more hands-on approach to presenting water related concepts. Marcie never said that she did not use this approach in the past but based on her excitement about integrating these lessons into her curriculum, I assumed that she had not used this method of integration to this degree in her classes previously.

Marcie talked about specific lessons where she had the students use a more inquiry-based approach to learning. She indicated that the Rivers to Reef experience was inquiry-based in nature because you did not know what was going to happen next. Previously, she attempted to use an inquiry-based approach to teach a group of teachers and she found that using this approach could be challenging. She discussed the feedback she received from a group of teachers as she presented them with her lesson plan for this unit. However, she found that the Rivers to Reef program presented the inquiry-based lessons in a manner that she found to be a beneficial teaching strategy and learning strategy for her students.

Figure it out? Oh, okay, here is this little Listosaurus, and this connects to the Listo. But they [teachers she was teaching] wanted as part of the way that I should be evaluating the students was to see the end result, and that is there (pause) on the rubric and you do hear that. Show them the end product so that they know. But when you're looking at science you have to throw some of that out of the window because you ruin it by telling them what it is supposed to look like; that a-ha! Which the Rivers to Reef, the experiential part was great because in all those activities you saw the a-ha happen in the classroom.

Marcie also decided to integrate a writing component into her teaching. During the Rivers to Reef experience Marcie was informed about the "River of Words" program. This served as an opportunity for students to combine their knowledge of aquatic ecosystems with language arts, poetry, or art. She found that some of her students flourished using this method to present the content they acquired.

Yep, oh, I agree, if you ask my kids that [the water unit] was their favorite. And the one girl won at the state level for River of Words and if I had not done Rivers to Reef, my kids would not have done River of Words.

Marcie noted several teaching strategies that had an impact on her teaching practice, but her teaching practice was also influenced by her desire to incorporate experiential learning opportunities. Marcie discussed infusing more experiential learning

opportunities into her classroom in interview two. In some cases she was met with resistance based on fieldtrip restrictions, but the desire for these opportunities was evident in many of her statements throughout interview two. She initiated her discussion related to her desire for experiential learning by reflecting on why she selected the Rivers to Reef course.

I looked at the thing (pause) the program [Rivers to Reef] outline (pause) I was worried about the water activities because I don't know how to swim. So that was one big drawback, but when I e-mailed them they said it was fine, I would just have to sit next to someone that was certified and that it would be fine. That made it seem like they were real approachable, and it made me want to go to the class right off the bat because they were making accommodations, like I'm a special ed (education) kid.

When she was asked to explain further the apprehensions she had about participating in the course, she stated, "probably because it [the Rivers to Reef course] was things that I didn't do, that I was maybe afraid to do."

As I noted earlier, Marcie could not swim but her desire to take part in an experience-based learning opportunity overshadowed her apprehensions. Her participation in the Rivers to Reef program spawned a desire for her to create a similar learning experience for her students. She talked about getting her students to participate in a program similar to Rivers to Reef, but she became disheartened as barriers to this learning opportunity began to arise.

And she [the storyteller from Sapelo Island] said if you ask for her to come as part of her DNR job description she can come and do it. But we did not do that, I should have, that's my one regret, there is so much push not to have, not to have fieldtrips, not to have speakers, just testing, testing, testing, so nobody did anything, that's real sad this year. (pause) That's the worse because I have not done nearly (pause), we wanted fieldtrips to Sapelo but all the fieldtrips were (pause) kind of cut. We were just told—the lessons that you had to submit to get them approved and there was a new bus company. And it was just. (pause) nobody went.

She talked about another fieldtrip opportunity that was approved by her administration and the county, but she also discussed the lengthy process required to have students to take part in a fieldtrip. She described the process for being approved below and the unrealistic expectations related to what they [the teachers] had to produce.

The only way it got okayed wound up being an 85-page lesson plan. That's how long, because I wrote it. And the final one that we sent down (pause) and it had the kids using GPS units to track through the park. They had map problems. I mean you would need a month to do the lesson that we sent out.... and a lot of teachers just said they were not writing those kind of lessons.

Marcie's frustration came from knowing that there were beneficial learning experiences for students that existed but the red tape of the school system could impede a potentially transformative learning experience.

So even if you had some of the opportunities with programs like Rivers to Reef, the barrier then becomes opportunities to do fieldtrips, to get them out there.

Her frustration related to the fieldtrip approval process was apparent, but she quickly noted that even though the barriers exist for students, she wanted to see more informal and formal education institutions play a more significant role in teacher development.

Marcie believed that providing quality professional development programs are beneficial for teachers and students.

If a teacher quality grant was written up that had them doing it that would work, too. I would love to see some of these different places kind of take ownership of teacher training, I think that would help. I know their focus is teaching kids but if you teach the people that teach the kids it makes it so much better.

Marcie described in detail the two major components of the Rivers to Reef experience that affected her teaching practice. The teaching strategies she incorporated into her curriculum included modeling and inquiry. She also found that providing stu-

dents with an authentic experience similar to Rivers to Reef would be challenging because of restrictions in place at the school and county administrative level. But she saw the fieldtrip experiences for students as beneficial for providing them with hands-on, experiential learning opportunities.

Sherri

By interview two, I realized that Sherri was a person who often covered her concerns with a joke or laughter. It appeared to be a way for her to shield any discomfort related to science topics or the interview process overall. With each interview she appeared rather nervous initially, but she soon warmed up and relaxed about 20 minutes into the interview. She concluded each interview by stating, “That was not that bad.” Our interviews consisted of lots of humor that was often followed by several questions aimed at determining her level of sincerity.

It was apparent that Sherri was very nervous at times, and I had to spend a significant amount of time ensuring that she was comfortable. I felt she needed to perceive the interview as a conversation. When she felt the interview was becoming too formal, she seemed at a loss for words and nervousness overtook her otherwise humorous, detailed responses. Our discussion began by examining the impact the Rivers to Reef program had on her teaching practice.

The Impact of the Rivers to Reef Course as a Professional Growth Experience

There were three components related to Sherri’s professional growth that she emphasized in her interviews: improving her professional development perspective, increasing her content knowledge, and aiding in her understanding of her personal

learning style. The Rivers to Reef course was Sherri's first professional development experience beyond her preservice teacher education program.

Our discussion began with my asking Sherri how she felt about other courses in relation to the Rivers to Reef course.

It's going to be boring after that [Rivers to Reef program]. Every professional development. (pause) I have to go to Perry next month on the 12th and 13th for a reading and writing conference. And I am going to be sitting. I just know it and there is not going to be any outside time and there is not going to be any hands-on. I think science is all by itself, I did not want to teach science I was really worried, I was not going to do well in science, science was not my thing, I hated science in school and now I love it. Now I want to be there. Science as a whole has ruined me.

Sherri acknowledged that she needs to partake in a professional development courses that allow for active participation for her to reap the benefits of the course. She discussed the Rivers to Reef course and science as "ruining her" because experiencing the course and teaching science involve active learning. Based on her participation in the Rivers to Reef course, Sherri now recognizes the benefits of professional development courses that incorporate an active learning design. Sherri indicated that she compared all of her professional development experiences to the format used in the Rivers to Reef course. She stated she was "ruined" by the course because Rivers to Reef has established an expectation of professional learning through active engagement.

The benefits of the active learning process were significant for Sherri and this was noted in the gains related to her content knowledge. She made an extremely profound statement about the Rivers to Reef program as a learning experience: "I probably learned more from that one week, real intense, than I did of all my science in college."

It was apparent that Sherri is a hands-on learner and that the format of the Rivers to Reef program was successful in meeting her learning needs. Her comparison of the

Rivers to Reef experience to her college experience spoke volumes to her learning style and the level of content she received as part of the Rivers to Reef program.

Like I said, I learned more from that [Rivers to Reef program] than I did in college as far as what to do in science, and the environmental aspects.

Sherri did not spend a lot of time focusing on specific content knowledge she obtained, but she did address the content connections in the following statement:

You see the light bulbs click on. You can feel the light bulbs click on in your head when you didn't get it and you say "Oh, I got that. Now I know what to do."

The professional growth Sherri experienced was related to an increased understanding of her content knowledge and a positive change in her professional development perspective. Her content knowledge was expanded but in her interviews she addressed the growth in this area by stating in a broad sense that it improved her knowledge of aquatic ecosystems without providing specific examples of how this was accomplished. However, in her discussion related to the course's impact on her professional development perspective, she was clear that the experiential learning methods used as part of the Rivers to Reef program were beneficial tools in altering her professional development perspective.

The most recent professional development program Sherri attended provided her with some additional information related to her professional growth. Sherri indicated in interview two that she gained insights about her personal learning style, and this topic was further examined in the last interview. Sherri began the final interview reflecting on her most recent professional development experience.

Sherri: I went to a professional development conference in Perry. . . .

Yeah, and it was boring.

Brian: And you predicted that.

- Sherri: We sit in meetings and we sit in meetings, an hour, an hour-and-a-half each. And some of them were okay, but one I fell asleep in.
- Brian: Oh, really.
- Sherri: Yeah, because he had the lights off and the speaker, he was talking about how pictures can really enhance, you know bring in your family portraits and bring in your family photos and talk about those and that will enhance the writing and get your students to write and I said “No, it will make them fall asleep.”

She compared her most recent professional development experience to the Rivers to Reef course and made mention of the hands-on nature of Rivers to Reef and how it kept her interest: “So yeah, hands-on is definitely, with the Rivers to Reef it was, I never fell asleep.”

She then focused on the instructors that led the Rivers to Reef course and the hands-on nature of their teaching method. Sherri acknowledged that she learns best when hands-on teaching methods are used and she also stated that her students learn best when a hands-on experiential approach [being outside and seeing what they are doing] is used.

Yeah, with Cathy and Kim, they did everything hands-on, and I’m a big hands-on person. I have to do things in order to understand [them], and I know kids don’t want to sit there and just read the book. So I know that if I incorporate those hands-on activities and get them outside and say okay this is what we are talking about, this is what we are doing.

Sherri went on to provide additional examples of why she feels she learns best when a hands-on approach is incorporated into the learning experience.

And it was just, (pause) and those things I remember because I was actually doing them instead of sitting there and taking notes and listening. I mean I look back at my notes [from her most recent professional development experience] and try to remember what she was talking about and how she did it but the ones that I actually did, same as Rivers to Reef, I did those things. I tested the water, I sat in the marsh and I was with the animals and plant life and I did that.

From a professional growth perspective the Rivers to Reef experience helped Sherri learn about her personal learning style, increased her content knowledge, and

altered her professional development perspective. Throughout her interviews she referred to the course as providing her with a better grasp of which professional development courses will best address her future professional development needs. She will continue to seek out professional development courses that are hands-on and interactive to increase her content knowledge and aid in enriching her teaching practice.

Impact on Teaching Practice

The impact the Rivers to Reef course had on Sherri's teaching practice was minimal. The major factor that contributed to the limited impact of the experience was directly related to Sherri not teaching a science course during the school year following her Rivers to Reef course. Even though she did not teach science this year, her teaching practice was influenced by finding ways to integrate what she learned in the Rivers to Reef program into other courses she taught.

Not this year because it has been reading (pause) but science, it will definitely effect my teaching. The end of the year we had science, an environmental lesson and I think I would change some things that I talked about. (pause) Like this year with the smoke up from the Okeefenokee we can smell it up here and we talked about that the last week of school. The kids were like someone is burning trash and we said no that is from three hours south of here.

She went on to discuss specific examples related to the content knowledge she acquired while participating in the Rivers to Reef program.

I said just imagine it's suppose to rain today and just imagine where that smoke is going. "In the clouds", and I said where is that going when it rains "in the ground" and I said "where is that going" "in the ground" and I said, no, that's going in our water supply. That we're drinking that polluted water.

I asked Sherri to think about which aspects of the Rivers to Reef experience would affect her teaching practice in the future. She discussed some ideas she had about integrating the experience into her classes.

- Brian: What could you see yourself doing with your kids that you actually did on the program?
- Sherri: (pause) Taking them outside and exploring. Cathy was so knowledgeable she knew the common name and the scientific name. “What? What is that? How many frogs are there? So we can do that here just because we are in a different area does not mean that we do not have organisms and things that they are not going to recognize.

She provided examples of how she could integrate the learning experience into the science classes that she will be teaching next year. But throughout this discussion she continued to reflect about creative ways to make connections between the Rivers to Reef program and other disciplines as well as providing creative content integration opportunities.

When they are in their own backyard we can go out here [pointing to the back of the school] and say what is this? What is this? And what is this? So we can do fieldtrips out and about. For reading we could have read poems and written poems about what we saw outside. We were going to do the River of Words but we didn’t get the updated package in time.

The manner in which Sherri sought opportunities for content integration was far more substantial than I initially anticipated. Sherri provided some specific examples of the content knowledge she acquired as a result of the experience while also discussing how she incorporated the overall experience into her classroom.

Yes, we talked about and we had a couple of books that we read and a couple of stories that we read that were environmentally based and I did not get a chance to read this one but I did give the book to a couple of them [her students]. It was *Stranded*.

She went on to discuss the details of the book.

By Ben Nicholson, and it was about the effects of people involved in saving animals and she wanted to keep them and they wanted to take them to the aquarium, it was let them be free try to make it on their own.

She was able to address some of the content related information she obtained in the Rivers to Reef course related to aquariums versus the natural environment as well as the

impact of ecological degradation on aquatic ecosystems. She went on to discuss that she continued to create opportunities to incorporate the Rivers to Reef experience into the curriculum she was teaching.

Like I did this year I threw in the environment as much as I could every time when we were just talking about random stuff. . . . I think I even wrote my lesson plan for *Stranded* (pause) using Rivers to Reef.

As the interview continued she was reminded of an activity she conducted with her students to help them visualize the concept that “everyone lives down stream.”

We did an activity where everybody gets personal belongings and, like we had markers and sunglasses, whatever we had on our person and we put it at our house that we had drawn and we all lived on the river and we picked up our river and kinda dumped all down at the end where Gray’s Reef would have been (pause). So all of our things ended up at Gray’s Reef, and everything that we had, so they were like oh, wow! You mean my sunglasses are going to be down there [indicating the area on the map as down stream or Gray’s Reef]? (pause) The basic stuff that I would have never thought of is going to end up somewhere else. Like the fertilizer that I put in my garden or whatever.

Sherri was creative in the manner that she used the Rivers to Reef experience in classes beyond the traditional science class. She focused on the broad scientific concepts of the course that centered on the environmental impact on aquatic ecosystems and infused that into her reading lessons.

The third interview concluded with Sherri’s discussing that she was able to see the course as being beneficial in relation to her teaching practice in science as well as the other courses that she teaches. She stated that the Rivers to Reef experience is going to have an impact on her future methods of teaching science because she now knows the importance of incorporating hands on opportunities that infuse real world applications into her classroom curriculum.

This is how it’s going to impact our Earth (pause) and you know just the things we are talking about in class (pause) and take them and show them

that this is the real world type stuff. That's what you are going to be encountering when you get out of school.

The real world examples that she discussed always seemed to be coupled with hands-on learning opportunities. Sherri noted how the integration of a hands-on approach in a similar manner as the Rivers to Reef course aids in effectively teaching science to students and adults.

Brian: What role do you see programs like Rivers to Reef playing in helping teachers effectively teach science?

Sherri: Programs just like Rivers to Reef?

Brian: Yeah, or programs that use that format.

Sherri: Very high. Science is so hands on anyway and I don't think I could ever go to a learning conference on science and just sit there in a classroom and come back with anything. The only thing I came back with from this reading conference that I went to on Tuesday were the ones where I was actually getting up out of my chair and doing things.

It was apparent that Sherri was using her understanding of how she learned to determine how her students will learn. Her teaching practice will infuse more real world examples and a more hands-on approach to teaching science in the future.

The final interview provided further insights into the impact of the Rivers to Reef experience. Beyond the science classes Sherri has developed a unique approach to incorporating what she has learned in the Rivers to Reef course into her reading and language arts curriculum this year. With her return to the science classroom next year, Sherri has conceptualized several ways that she can infuse what she has learned from her professional development experiences into the life science curriculum. It will be interesting to see how Sherri's more in-depth understanding of the content coupled with knowledge of her personal learning style will play a role in how she teaches science in the future. Sherri and Karen teach at the same school and collaborate quite often yet the

Rivers to Reef course had a different impact on Karen's professional growth and teaching practice.

Karen

Karen can be described as a person who is very comfortable speaking her mind. She always appears to be very clear and confident in her responses to the interview questions. Unlike Sherri, Karen seemed to flourish during the interview process. She viewed it as an opportunity to provide some personal feedback about the Rivers to Reef course and professional development experiences overall.

It appeared that even as a 17-year veteran teacher, Karen was experiencing the first time she had had an opportunity to express her views related to professional development. She welcomed the opportunity to do so. She stated that if the feedback she provided would help improve professional development courses, she was happy to assist. She indicated a change in professional development for middle school science teachers is necessary in order for teachers and students to learn the science content.

The Impact of the Rivers to Reef Course as a Professional Growth Experience

As a veteran teacher, Karen has had a substantial number of professional development courses, and it was my initial thought that the Rivers to Reef experience was going to have minimal impact on her professional growth and teaching practice. However, the data obtained from interviews two and three indicated that the Rivers to Reef experience did affect her professional growth and teaching practice. In terms of a professional growth experience, Karen discussed how the Rivers to Reef course increased her content knowledge, her motivation, and several other factors she addressed beyond the science

content. The following excerpts provide examples of how Karen perceived the Rivers to Reef course as affecting her professional growth.

In interview one, Karen was quite vocal about the impact the lack of content knowledge has on science teachers' ability to teach effectively. Karen has a firm grasp on the science content that she teaches but the Rivers to Reef program still provided her with additional content knowledge that she was surprised to find out about: "It definitely made me more aware of water and using water in my classroom." The use of water in her classroom was one aspect of her increase in content knowledge but the greatest addition to her scientific content knowledge was finding out about Gray's Reef National Marine Sanctuary. Karen was still noticeably surprised that this resource could exist off of the coast of Georgia, a place where she has lived all of her life, and she was not aware of it.

And I didn't know about Gray's Reef! I had never heard of Gray's Reef!
Never! Here we are missing this major resource off of our coast.

As I mentioned earlier, Karen feels she has a firm grasp of the content she teaches. So finding out there was a resource that she could have integrated into her classroom curriculum for the past 17 years was surprising and beneficial as a professional growth tool. She also noted that knowing how to collect water samples and conduct a water quality analysis enriched the professional growth benefit of the Rivers to Reef program. Aside from providing actual examples of content knowledge she acquired during the Rivers to Reef course, Karen mentioned several other components, not directly related to the content, of the experience that aided in her professional growth. I categorized these components that emerged from our interviews as "beyond science content knowledge." Karen provided a detailed statement of the benefits of the program that included providing her with an experience to bring back to her students, contacts

with professionals in the field, and an opportunity to listen and share classroom experiences with other teachers.

When looking at Rivers to Reef I considered myself quite the environmentalist with Sapelo but yet it really connected like I said earlier the whole water (pause) my (pause) impact here in the mountains versus the impact. I mean that whole experience, for me to be able to share that with my students, I mean bring it back to the classroom and make them aware of it, I think its like that saying “you give a man to fish and he can eat but you teach him how to fish he can feed his whole village” I think that’s what teaching is you know. If you can provide good experiences for the teachers and really meaningful experiences that are going to change their life, life changing experiences (pause) then, I definitely think the whole Rivers to Reef thing did, in a way, change my life. It gave me contacts for one. Contacts with you, Cathy, Kim, I mean anytime you can provide that for a teacher it is incredible. Plus with other teachers hearing what they are doing and connect with them but also if you can provide a life changing experience and they can offer that to their students. Just showing my slides to my students with the canoe trip. I mean I never been canoeing and I am very much the outdoors person, rode horses in survival camp but never had an opportunity really to canoe.

Her firm grasp on the content allowed Karen to focus on an appreciation of other aspects of the Rivers to Reef program. In this case these other aspects were being able to share with other teachers, developing contacts with other teachers, and experiences to share with her students.

Karen discussed in interview one that she had grown tired of teaching the same curriculum after 17 years. During interview two she often referred to the Rivers to Reef program as an experience that provided her with a renewed sense for teaching and she returned motivated to teach science.

For me I came back all excited. That was the summer I had just accepted this job so I really wasn’t in the school system yet. But I came back met with my principal the next week, wanting to adopt a stream all excited I spent a whole day driving around wanting (pause), trying to find a place where you can take a bus load of kids. Walked all the way back on our property, hiked through this thicket, found out there was a stream back there but it was too hard to get the kids to.

Having participated in the Rivers to Reef program motivated Karen to pursue ways for her students to experience opportunities similar to the ones she experienced during the Rivers to Reef program. When she was asked to respond to the effectiveness of the program she responded;

I think it probably (pause) It definitely rekindles; any time you have good staff development it rekindles that motivation, it gives you that new spark.

The Sapelo Island experience also served as a motivation for Karen. She was compelled to help the inhabitants of Sapelo Island and the preservation of their unique culture. As a result of her excitement about her Sapelo Island experience, she made the following statement:

I came back from that day thinking I want to do a video or some type of documentary of these people, somebody needs to save this. I mean I felt passionate about lots of different things when I came back from that trip.

The Rivers to Reef program played a role in Karen's professional growth in the areas of content knowledge, motivation and some areas beyond content knowledge. As she was a veteran teacher, I had a concern that she would not have gained as much from this experience as the other teachers who participated in this study. However, it appears that she gained valuable information, though not the same information as the other study participants. This could be attributed to her firm grasp of the content knowledge and her belief that she has the ability to teach the content to her students.

Karen provided detailed information related to her professional growth based on the Rivers to Reef course. Even as a veteran teacher Karen is still in search of learning opportunities that enrich her classroom. She found the Rivers to Reef experience beneficial even though the gains in the area of content knowledge were minimal. She did address an increase in her content knowledge related to water quality testing and Gray's

Reef. But for a frustrated veteran teacher her professional growth focused more on providing her with a sense of renewed motivation. The impact the Rivers to Reef program had on Karen as a professional growth experience culminated with a discussion of how the experience influenced her teaching practice.

Impact on Teaching Practice

Karen's discussion related to the impact the Rivers to Reef program had on her teaching practice began with interview two and continued throughout interview three. She noted that the Rivers to Reef experience had an impact on her desire to integrate more experiential learning opportunities. The discussion began with Karen's addressing how eager she was to provide her students with an experience similar to what she experienced during the Rivers to Reef course. However, she noted how her desire to provide her students with the experience was negatively affected by a major obstacle, a lack of resources.

The problem is that you come back from these things, you're all excited, pumped up, but you get shot down from our administration because of lack of resources. Well, we don't have the resources to hire a bus once a month to take the kids or how are you going to get them there or how am I going to purchase the testing supplies for the water testing. You know (pause) you all the sudden (pause) you hit this brick wall and I find that with every staff development. You come back excited, but it costs money to implement what you want to implement and you're shot down. There [is] a lack of resources.

In Karen's case, she had the support of her administration but limited resources became an obstacle that prevented her from replicating components of the Rivers to Reef experience in the classroom with her students. She was unable to gather the financial resources she needed to pay for the water quality testing kits, so she was unable to pass the learning experience on to her students. The barriers that prevented the integration of components of the course into her classroom were related to a lack of resources and the liability of

having students near water. However, Karen noted that if the obstacles were not present, she would be providing her students with experiential learning opportunities (collecting water samples) daily.

I would have been out there every day testing the water. Definitely. (pause) But I came back and I poured through catalogues and looked up what do I need for water test kits and of course you need, (pause) because your dealing with the safety too with children so were looking at we need rubber boots and we need (pause). It's not as simple as you just threw us out there in the river.

Karen stressed that providing teams of teachers with opportunities to participate in professional development experiences like Rivers to Reef would be beneficial. She discussed how teams or small groups of teachers would have a better chance of combining resources and working together to provide students with these opportunities.

But with our kids you know it takes a lot of (Pause) planning. And if you're by yourself like I am here, now had I gone with a team of teachers, and I think some staff development that have a team of teachers go, I noticed now that a lot of these big, like with the Athens Botanical Garden or the Atlanta Botanical Garden, they require now a team of teachers. Because I think when you have that support you know you come back with four teachers and everybody going to do an interdisciplinary unit then you got more ground to stand on, but you know I just came back by myself and then it was like "Okay, now what do I do? I am all by myself."

Karen even thought providing her students with small scale experiential learning opportunities would be beneficial. When she spoke to another teacher who had fish tanks throughout his classroom, Karen decided that she would provide similar learning opportunities for her students. Yet when she returned she found that a lack of resources would impede her ability to integrate these learning opportunities into her classroom.

And I really had intentions of doing the whole fish tank, like after being with Joe [a teacher that went through the course with her]. He had like 83,000 fish tanks in his classroom so I thought I'm going to come back, and I want to do tanks across the room and everything. (pause) But again resources I mean all of that would have to come out of pocket. It was just

something that didn't go the way I planned it to go. When I was in the program and had these great visions and (pause) it just didn't happen.

In interview two, Karen discussed the enthusiasm she had when she returned from the Rivers to Reef course; however, the obstacles she faced related to implementation were disheartening. Karen may not have been able to implement all of her initial ideas but she found other ways to incorporate the Rivers to Reef experience into her classroom

I did implement and I did, like I implemented a whole aquatic biomes unit specifically because of the Rivers to Reef program and we made this huge mural, I've done it for two years now in the hallway where the kids (pause) down on this end of the wall they create a whole river ecosystem with these huge elaborate like construction paper designs with information and then we (pause) I do a big arrow and they flow into, around the bathroom area right there is the estuary, and then they flow into the ocean.

She went on to discuss what the students need to complete related to this activity.

And then they do the ocean animals. They have to do one animal or plant from each of the biomes and then we do a whole aquatic mural out there [pointing to the hallway]. They do research on their three, they just put their information on little note cards and then they create, through artwork and construction paper and all kinds of, whatever they can think of to make a three dimensional model that kind of sticks out from the wall. And then some of them hang like the whales from the ceiling, it's just very three dimensional.

Karen discussed the components of this activity and how the community has come to embrace the model they create by having the local newspaper come out and publish photos of the project. Karen was pleased with the community support and exposing her students to the aquatic biome; however, it was apparent that she would have preferred to provide her students with an experiential learning opportunity related to water quality testing.

Overall, Karen described the Rivers to Reef experience as one that had an impact on her professional growth and teaching practice. Karen found the experience to serve as a motivational tool for a veteran teacher who is getting burned out teaching the same

curriculum. However, the barriers that limit her ability to implement the changes in her classroom make the rekindling of motivation short-lived. Her professional growth related to content was limited because she has a firm grasp of the content, but the knowledge she gained beyond the content was significant. Karen saw that sharing with her colleagues, taking part in experiences she could share with her students and developing contacts with experts in different fields were valuable professional growth items for Karen.

It was clear that the Rivers to Reef program had an impact on increasing Karen's desire to provide her students with experiential learning opportunities. Karen made suggestions about how to achieve beneficial learning opportunities for teachers while minimizing the resources required from each teacher. Karen saw the Rivers to Reef experience as a truly exceptional experience that in some ways changed her life.

Summary

During the second and third interviews, the participants appeared more comfortable with sharing details of the Rivers to Reef experience and the impact of the experience on their professional growth and teaching practice. In these follow-up interviews, I gained greater insights about the study participants and how to conduct the individual interviews to yield the most credible results.

The data obtained in the second and third interviews indicated some commonalities among the study participants. All of the participants noted an increase in content knowledge related to their professional growth and an increased desire for experiential learning opportunities in relation to their teaching practice. However, the variations in data obtained from each of the participants in relation to their teaching practice and professional growth was worthy of further examination in chapter 7.

CHAPTER 7

DISCUSSION

In this chapter, I reintroduce the reader to the purpose of this study and the existing research literature relevant to this study. This discussion section also serves to provide my perspective of the data that was obtained throughout the study and in relation to the existing research literature while exposing the reader to themes that emerged from the data analysis. The discussion section of this paper is divided into five sections:

(a) Introduction, (b) Impact on Professional Growth, (c) Impact on Teaching Practice, (d) Implications, and (e) Future Studies. The overall goal of this section is to provide a thorough understanding of my perspective in relation to the middle school science teacher professional development literature.

Introduction

In fall 2005, a new informal education facility opened its doors in Atlanta, Georgia. The facility members placed the education of its visitors as its highest priority. With education at the forefront of its initiatives, the facility leaders began to focus on how it could serve the students of Georgia in the most beneficial manner. As a result, innovative immersive learning experiences were developed for the students in a portion of the facility strictly dedicated to school aged children. Equally as important for the members of the facility was the development of enriching educational opportunities for teachers. Using the premise that developing innovative, immersive learning experiences

for teachers would positively affect students; the aquarium faculty created the Rivers to Reef professional development course.

The Rivers to Reef course was designed to be an immersive learning experience that integrated components of David Kolb's experiential learning model. The teachers who took part in the course convened at the headwaters of a river system in Atlanta and followed the river while examining the dynamic nature of the aquatic ecosystem. Over the course of 5 days, the teachers conducted water quality testing, explored the topography of the river system, examined the factors that influenced the health of the river, determined how the character of the river changed as it approached the coast, and investigated the human cultures that thrive in the aquatic ecosystem. As the teachers participated in the course, they experienced various aspects of aquatic ecosystems in hopes of increasing their content knowledge and exploring ways to integrate the experience into their science curriculum. The Rivers to Reef program has historically received positive feedback from its participants related to their views about the course as a learning experiencing, yet it was unclear what the teachers learned as a result of their participation in the course. Data related to what the teachers learned and how they integrated what they learned had not been examined. The purpose of this study was to examine the impact the Rivers to Reef course had on the professional growth and teaching practice of its participants.

The existing research literature clearly indicates the importance of quality professional development opportunities for teachers and the impact it has on student achievement (Hawley & Valli, 2000). The existing literature also indicates a need for the continuation and improvement of professional development programs for science

teachers because of the problems associated with the existing format used in professional development courses (Bredeson, 2003; Darling-Hammond, 1997; Guskey, 2003; Hein, 1995; Loucks-Horsley, 1998). There are suggestions and recommendations for the improvement of professional development courses for teachers that indicate that teachers learn in a similar manner as students. In fact, the literature states that the most beneficial learning experiences for teachers are those that integrate active participation or provide teachers with the components of the experiential learning model (Craft, 2000; Fiszer, 2004; Loucks-Horsley; Senge, 1999; Wald & Castleberry, 2000). Hein, Loucks-Horsley, and Bredeson have all infused experiential learning opportunities as integral components of their plans for improvement in professional development. Their work indicates a clear connection between experiential learning and increased teacher satisfaction related professional development experiences and teacher learning. However, how teachers integrate their professional development experience into their teaching practice and the impact of experiential learning on the professional growth of teachers has been minimally examined.

The purpose of this study was to explore how a professional development course that integrates Kolb's Experiential Learning Model affects the teaching practice and professional growth of three middle school science teachers. Middle school teachers were selected for this study in part because middle school teachers have been under a significant amount of scrutiny from educators and researchers in recent years (Lockart & Butt, 2002). I designed this study to gain greater insights into how a professional development course that uses the experiential learning model affects their teaching practice and professional growth of middle school science teachers. Using the theories

developed by John Dewey related to experience and education, I analyzed the data for the themes of *educative experiences and miseducative experiences*.

Two research questions were created to guide this study and frame its overall design:

1. What is the relationship between a professional development course that uses an experiential learning model and science teaching practice of its participants?
2. How would the Rivers to Reef participants reflect on and describe the course as a professional growth experience?

With sweeping changes in education reform and the expectation that all teachers will be deemed as “highly qualified” in their subject area (U.S. Department of Education, 2006), it is important to gain a true understanding of which aspects of science professional development courses have the best influence on teaching practices. By investigating the perceptions of three Rivers to Reef participants and their teaching practice, I gained insights into aspects of the experiential learning model and its impact on their science teaching practice. The data was obtained using Seidman’s (1994) in-depth interviewing format. This interview format uses open-ended questions as a scaffolding tool to acquire a deeper understanding of the experience and its relation to the topic being studied (Seidman, 1998).

The three participants in this study had varied backgrounds that I believe played a significant role in the impact the Rivers to Reef course had on their individual professional growth and teaching practice. Sherri was a novice teacher who had 2 years of teaching experience during the data collection phase of this study. As a science teacher, Sherri had

limited science content knowledge. This was in part due to her participation in a middle school certification program that did not emphasize scientific content. In her first 2 years of teaching, Sherri had taught several different subjects areas, including science, reading, and language arts. Marcie, on the other hand, is an experienced teacher with 5 years of teaching experience prior to participating in the data collection portion of this study. Marcie earned her teaching credentials in an alternative teacher preparation program that provided her with very little science content knowledge prior to being placed in a classroom and a preservice teacher training program that focused primarily on teaching methodology. Marcie did, prior to teaching, have a significant amount of science content knowledge because of her previous careers in the public health and nursing. However, Marcie was assigned to teach earth science, a course for which she had minimal content knowledge prior to teaching the course her first year. Lastly, Karen is a veteran teacher with over 17 years of experience as a science teacher. Karen earned her teaching credentials in a traditional education program at a large southeastern research university. Karen started her college career wanting to pursue a career in veterinary medicine so she had a substantial amount of science content knowledge in biology and life sciences prior to beginning her pre-service teacher program. Karen has taught science in a variety of settings and throughout that time she has earned statewide recognition for her student's performance on standardized tests. The prior experiences of each of the participants played a significant role in the impact the Rivers to Reef course had on their professional growth and teaching practice.

Impact on Professional Growth

Professional growth is defined as how teachers think, what they believe and what teachers do in their classroom (Guskey & Sparks, 1991). The impact of the Rivers to Reef professional development course as a professional growth experience was examined in detail throughout interviews two and three. Commonalities and discourse emerged from a cross-case analysis of the study participants. The data obtained were examined to determine if the study participants viewed the Rivers to Reef course as an agent of change based on the educative or miseducative nature of the course.

There was one commonality found in all cases related to professional growth in interview two: content knowledge. Each of the participants noted some growth related to various aspects of science content. The data obtained ranged from understanding water quality and the chemistry that supports the process of water quality analysis to having a better understanding of aquatic ecosystems and the cultural components of the inhabitants on Sapelo Island. Each of the study participants acknowledged that content was “key” for middle school science professional development courses. This notion is also noted in the National Science Education Standards that addressed the importance of science teachers having a firm grasp on the content knowledge they teach.

The National Science Education Standards (NSES) address the need for science teachers to have preservice and in-service programs that are more robust and provide a greater understanding of content knowledge. The professional development standard addresses the concerns related to courses that involve traditional lectures to convey science content and an emphasis on technical writing (NRC, 1996). These learning experiences do not provide adequate growth for teachers to obtain an in-depth

understanding of the content. Instead, the NSES supports providing teachers with learning opportunities that provide intellectual professional growth. One of the methods the NSES suggests is allowing teachers to learn through inquiry much in the same manner that students learn through inquiry. This becomes more important for the middle school science educator.

The NSES states that middle grade science educators must provide learning opportunities for their students that go into greater depth, require more sophisticated reasoning skills, and utilize apparatus and technology. Middle school educators need the same breadth of science content knowledge as their elementary school counterparts; however, the middle school is required to have a thorough understanding of one discipline to meet the needs of scientific education reform. McEwin, Dickinson, and Hamilton (2000) found that middle school teachers ranked breadth and depth in content knowledge as critical components in improving middle level teacher preparation. Jackson and Davis (2000) also suggested that middle level teachers should come to their first teaching experience with a strong conceptual grasp of their academic disciplines.

The data obtained from the Rivers to Reef participants supports the initiatives of the National Science Education Standards addressing the need for teachers to have a greater depth of understanding in relation to the courses they teach. The benefits of the Rivers to Reef course emerging from analysis of the data indicated participants gained other content knowledge in areas other than science. For example, all of the study participants indicated they gained a greater understanding of Sapelo Island and its inhabitants. Each of the study participants indicated how they could use or have used this in teaching about aquatic organisms or aquatic ecosystems in relation to their curriculum.

The Rivers to Reef course provided the study participants with a holistic view of aquatic ecosystems by infusing math (water quality analysis), chemistry (water quality testing), language arts (journaling), social studies (Sapelo Island and other coastal cultures), and science throughout the experience. The participants of the study gained content knowledge that went beyond the realm of science. The methods they used to integrate the content knowledge they acquired into their science curriculum also demonstrated the educative nature of the course.

The participants content knowledge growth exceeded my expectations but varied based on the number of years they had been teaching. As novice and experienced teachers, Sherri and Marcie noted a significant gain in their content knowledge. It also appeared that they were both seeking professional development opportunities to increase their content knowledge. Karen, on the other hand, had minimal gains in her content knowledge but far more significant gains in experiences she could bring back to her classroom, contacts with experts in the field, and opportunities to share best practices with other teachers. Karen made it clear that she did not seek professional development opportunities to increase her content knowledge because she felt she had a firm grasp of the science content. The content knowledge gained by each of the participants and the integration of the experience into the science curriculum served as evidence of the educative nature of the Rivers to Reef course. The course was educative because it built upon each participant's prior knowledge and also had different forms of continuance in subsequent learning. Along with content knowledge, the study participants addressed self-efficacy, motivation, personal learning style and a change in their professional development perspective as playing a role in their professional growth.

Sherri, the novice teacher, indicated a change in her professional development perspective and a better understanding of her personal learning style. In her first interview, Sherri expressed some intensely negative feelings associated with the professional development courses that she experienced prior to the Rivers to Reef course. The source of those feelings about professional development courses were never truly uncovered but are worth further examination in future studies. A potential source of some of her frustration could be provided in an examination of information related to traditional views about professional development courses. Teachers often describe these experiences as having an outsider come in and provide them with information, they play a passive role in learning, and they are expected to implement whatever they have learned in their teaching practice (Dass, 1997). Sherri expressed some of those feelings about professional development courses she participated in prior to the Rivers to Reef course.

Teachers often struggle with being treated as less than professionals when being lectured to instead of being an active participant in the learning process. These negative feelings can be further magnified when factors beyond the professional development course are added to the learning environment. Knight (2000) addressed some of the issues related to teacher's views about professional development in a paper appropriately named, *Another Damn Thing We've Got To Do: Teacher Perceptions of Professional Development*. In his paper, he examines several aspects of teachers' views about professional development but he also addresses the historical belief held by teachers that professional development is impractical. He addressed teacher's beliefs that the settings for professional development are often not conducive for learning, professional development presenters often do not provide enough time for information to be understood fully and

the outside “experts” often ignore teacher expertise. These factors all potentially play a role in shaping the learning environment for professional development courses and the outcomes of the experience for the teachers. One or all of these factors could have contributed to Sherri’s initial beliefs about professional development courses.

It was apparent that at some point Sherri had a miseducative experience related to professional development but the source of the miseducative experience was never divulged. The miseducative nature of her prior experiences were noted in interview one when she stated her aunt died because her aunt was aware that she did not want to attend the professional development course that was being offered. The Rivers to Reef course served as an educative experience for Sherri because she expressed her desire to participate in other professional development courses that use a similar format and eagerly expressed her interest in participating in an upcoming professional development course. Her views related to all professional development courses have not changed, she distinctly addresses the benefits of professional development courses that are hands-on. She made a clear distinction between the professional development courses and courses that use an experiential learning format.

It is also important to note that Sherri also gained greater insights into how she learns. It was obvious throughout this study that Sherri identified herself as a person that learns best by doing. This is congruent with the NSES recommendation that teachers must take science courses in which they learn science through inquiry, having the same opportunities as their students should have to develop understanding (NRC, 1996). The Rivers to Reef course provided a learning opportunity for Sherri that was similar to the learning experience for her students. This was primarily based on Sherri’s limited science

content knowledge and science pedagogical content knowledge. The standard goes on to state that in-depth experiences will allow teachers to develop an understanding of inquiry, as well as the structure and production of scientific knowledge. Sherri indicated that knowing how she learns helps her better teach her students.

In contrast, Marcie noted that she received better insights into professional development and her personal learning style, but it was apparent that her most significant professional growth gain related to self-efficacy. In the context of teaching science, self-efficacy is an individual's belief that he or she has the ability to teach science effectively as well as one's belief that his or her students can learn science despite factors external to the teacher's control (Ramey-Gassert et al., 1996). The existing research addresses self-efficacy and its impact on science teachers. When teachers have a low self-efficacy, their teaching tends to be characterized by authoritative, teacher-centered roles with a less clear understanding of the various developmental levels of their students. Marcie discussed on several occasions the confidence she gained as a result of the Rivers to Reef experience and her most recent professional development experience on Ossabaw Island. That confidence translated into Marcie believing that she would be a more effective science teacher and have a more significant impact on student achievement as a result of the Rivers to Reef experience.

Marcie's view of the educative nature of the Rivers to Reef course was two-fold. First, Marcie acquired content and confidence that she felt were valuable assets for her students and her classroom environment. Marcie felt the experience had a positive impact on her future teaching pursuits. The Rivers to Reef course also served as an educative experience because the course had continuity with the professional learning experience at

Ossabaw. Marcie indicated that she felt she was at a significantly greater advantage in relation to understand the aquatic ecosystems of Georgia than her counterparts this summer because of her Rivers to Reef experience. Marcie often spoke of having credibility with her students and the Rivers to Reef program provided her with the credibility she needed to teach effectively.

Rubeck and Enochs (1991) reported that teachers who were weak in content background tended to have significantly lower personal efficacy than teachers with strong content backgrounds. In contrast, teachers with a high self-efficacy tend to teach in ways characterized by the use of inquiry approaches, more student-centered thought, beliefs that they can help any student overcome learning problems and succeed, and are more knowledgeable of their students' developmental levels. One logical conclusion is that the way preservice teachers view themselves and their roles in a science teaching context is at least partially derived from their self-efficacy (Riggs & Enochs, 1990).

Karen noted that her professional growth was more directly tied to motivation. As a veteran teacher who has been teaching very similar content throughout her 17 years, Karen expressed a level of burn out with the subject matter in her first interview. Karen saw the Rivers to Reef course as an opportunity to renew her interest in teaching science. However, Karen also expressed her concern about returning to school and not having the resources she needed for implementation of the information she acquired.

Based on the interview discussions Karen loves teaching science but lacks the resources that she needs to create learning opportunities that are beneficial for her students. Research indicates that the middle grade level has teacher shortages that are more severe than any other certification level (Thornton, 2004). Some of the factors that

contribute to this include accountability to standards, increased pressure related to student performance on statewide testing, and the nature of the middle school child. Thornton states that there is not a shortage of prepared teachers. The shortage has more to do with an exodus of teachers leaving the classroom once they get there. The exodus is mainly related to job dissatisfaction (Woods & Weasmer, 2002) related to lack of resources, lack of administrative support, and limited input in decision making among (Abel & Sewell, 1999; Jensen, Mortorff, & Meyers, 1992; Shann, 1998). Karen addressed many of these same issues. At the close of the school year she departed teaching as a result of the lack of resources to teach in a manner that she felt was most beneficial for her students.

Karen may have been motivated to continue teaching in her school if she had a support group of teachers to work with. Karen noted that having others teachers to share information and resources with would have reduced her individual financial burden and provided her with additional support when she needed to obtain the support of her administration. The development of a community of learners might have been beneficial for Karen because it would have provided collegiality and collaboration, components researchers indicate promotes job satisfaction and feelings of professional involvement (Leithwood, Leonard, & Sharratt, 1981).

Karen noted that the Rivers to Reef course was an educative experience in relation to her professional growth. Karen stated that the Rivers to Reef course renewed her interest in teaching the life science curriculum that she has taught for 17 years, and the Rivers to Reef program increased her motivation to return to teaching. However, the educative nature of the course was short-lived. When she returned to school with a renewed interest and creative ideas for lessons, she realized that a lack of resources would

impede the implementation of the lessons she wanted to create. This turned her educative experience into a miseducative experience that ultimately played a role in her leaving her public school position and accepting a teaching position abroad.

The data clearly indicated that there were professional growth commonalities among the participants in this study. Providing each of the participants with a greater understanding of the content knowledge was an important component of this professional development experience. One of the participants stated, “Content is king!” and all of the study participants seemed to agree. The literature echoes these same sentiments, particularly for middle school science teachers. The National Survey of Science and Mathematics Education (Weiss, Banilower, McMahon, & Smith, 2001) provided statistical information that illuminates the issue related to middle school science teachers and their lack of content knowledge. The survey also describes middle school teachers as generally ill-prepared in the sciences. The study found that nearly two thirds of middle school science teachers received their undergraduate degrees in areas other than science or science education. Also nearly half of all middle school life, earth, and physical science classes are taught by teachers who lack in-depth preparation in any science. The National Science Teachers Association (1998) addressed the need for conceptual content when preparing middle school science teachers and the NSSME study states that there is a need to increase content knowledge of in-service middle school science teachers in all disciplines.

Understanding the importance of increasing the content knowledge was an expected result of this study; however, the additional gains in other areas were even more exciting. The impact related to motivation for a veteran teacher, the self-efficacy of an

experienced teacher, and the change in the professional development perspective of the novice teacher were all components that emerged from the data. Each of these components served the unique needs of the individual teacher based on where they were on their personal professional growth continuum. The importance of teachers' having a personal connection or goal related to the professional development experience plays an important role in the success of the course. Zhao (1998) stated that professional development experiences are successful when there are explicit connections to the teachers' needs. In the case of the Rivers to Reef program, each of the participants was at a different point in her professional career, and even though each did not take away the same experience, they all gained insights relevant to their individual needs.

Karen, the veteran teacher, had a firm grasp on the content and pedagogy, but the Rivers to Reef course renewed her interest in teaching a course she has taught for 17 years. She came back to school motivated to teach and engage her students in learning science. Marcie, the experienced teacher, had an adequate grasp on the content knowledge, but she had concerns about her ability to teach the science concepts. The Rivers to Reef course addressed some of her content concerns but more importantly the course had a significant impact on how she felt about effectively teaching the content. Marcie's personal needs and professional growth desires were addressed by increasing her confidence with teaching the content. The Rivers to Reef course met her personal and professional needs by increasing her credibility which in turn improved her teaching confidence. Sherri, the novice teacher, came to the Rivers to Reef program with the belief that professional development courses were boring and uneventful. Her views related to professional development courses changed as a result of the Rivers to Reef course. Sherri

was able to see the potential of professional development courses, and she is now seeking the type of professional development opportunities that are most beneficial for her personal and professional growth.

Figure 9 provides a visual summation of the impact of the Rivers to Reef course as a professional growth experience. All of the participants noted an increase in content knowledge; however, their separate benefits were identified as well. Marcie indicated that the course improved her confidence with teaching the science content. Marcie noted in the interviews that she was concerned about her limited content knowledge and she sought opportunities like the Rivers to Reef course to improve her content knowledge and her confidence with teaching the content to her students. Sherri noted a change in how she viewed professional development experiences and a greater understanding of how she learns. Karen focused on how the experience increased her motivation related to the content. This data emerged as the final interviews progressed. The preservice teaching program along with the individual teachers' years of teaching experience played a role in how the course was viewed as a professional growth experience by each of the participants.

There were anticipated and unanticipated impacts related to the professional growth of the three Rivers to Reef participants. The study revealed one major component related to professional development experiences: Science professional development programs can be designed to meet content knowledge needs. However, there are additional professional growth impacts that go beyond content knowledge, that are individual in nature and difficult to predetermine as outcomes of a professional development experience.

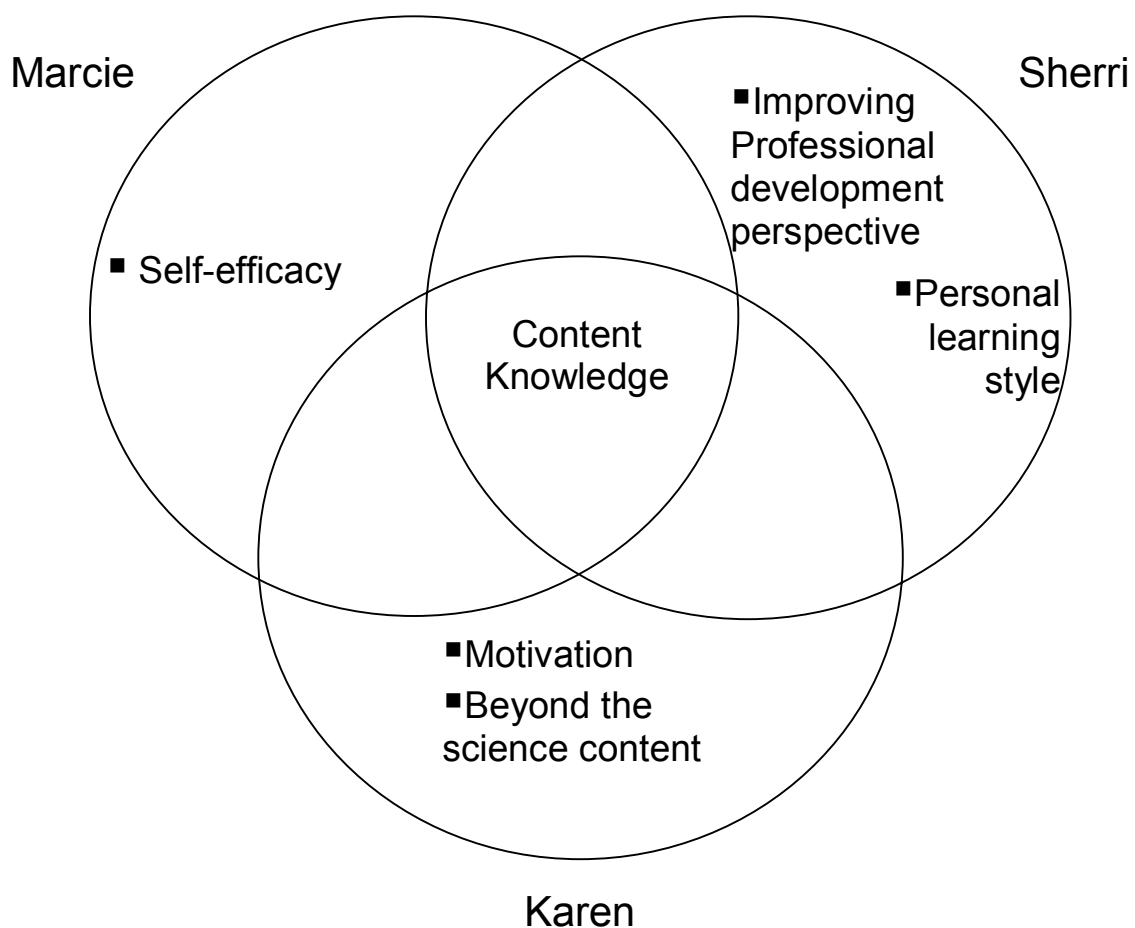


Figure 9. Study Participants' Views as a Professional Growth Experience.

Preassessing what the teacher would like to learn may play an important role in being able to measure what they have learned outside the content domain. Trotter (2006), states that allowing teachers to play a role in their professional development experiences will greatly increase their success in the journey to be lifelong learners.

Impact on Teaching Practice

One of the primary purposes of this study was to examine how a professional development course that integrates an experiential learning model affects the teaching

practices of its participants. Similar to the impact the Rivers to Reef course had on the professional growth of its participants, there were commonalities and discourse that emerged in an analysis of the participant data related to the impact the course had on their teaching practice. One area noted by all of the study participants related to the impact the Rivers to Reef course had on their teaching strategies. These strategies varied among the participants; however, the use of hands-on teaching seemed to increase for each of the participants, especially when addressing water-related curriculum items.

Marcie indicated the water portion of her earth science curriculum integrated the water quality testing components she took part in the Rivers to Reef course. Along with the integration of hands-on teaching strategies, including the water quality testing, Marcie stated that she would like to integrate journaling and an inquiry-based, hands-on approach to her teaching practice. She attributes her desire for the abovementioned integrations of these teaching practices to how they were modeled by instructors in the Rivers to Reef program. Marcie expressed some concerns related to integrating an inquiry-based approach to teaching because she had tried to teach using this method in the past and found it difficult to conduct. She stated making the transition from teacher to facilitator is difficult, but she felt it was beneficial for her students. However, as a result of the Rivers to Reef program and how the inquiry based teaching process was modeled, she was eager to get the training necessary to teach using an inquiry-based approach.

Karen noted that she was already a hands-on science teacher, and the Rivers to Reef experience only enhanced her desire to continue using a hands-on approach to teaching. Karen was eager to provide her students with hands-on experiential learning opportunities that infused real-world applications. Her initial desire to integrate the

experiential learning model into her instruction by conducting water quality testing with her students was altered because of a lack of resources. Even though Karen's students did exceptionally well on the statewide standardized tests, she expressed that her students would gain a more in-depth understanding of the content if they were able to experience what they were learning and had the ability to make real-world connections. The Rivers to Reef course had minimal impact on her teaching practice because she did not have the resources to implement the hands-on teaching opportunities she wanted for her students. However, the course did solidify her belief that the optimal teaching scenarios for students involve hands-on experiential learning that integrates real-world applications.

Sherri, on the other hand, did not present the perspective that the Rivers to Reef program had an impact on her methodology related to teaching science, in part because she did not teach science this year. Sherri did provide details about specific lessons she used with her students that were hands-on in nature. During her first year Sherri taught several subjects and infused minimal hands-on learning opportunities in science. This was due to a lack of comfort with the content and minimal time for classroom preparation because she was teaching five different subjects during her first year. In our interviews, Sherri made note that she was feeling more comfortable with environmental concepts, science content, and infusing her conceptual understanding of this subject into her reading classes and using a hands-on approach to do so.

All of the study participants acknowledged that the Rivers to Reef experience had an impact on their teaching practice. The most significant impact involved taking a hands-on approach to teaching their students science. With the integration of a more

hands-on approach, there also appeared to be an increased desire for allowing their students to experience science.

The desire for their students to experience science was evidenced by each of the participants. The study participants were not always able to provide the specific experiential opportunities that they wanted for their students, yet each of the participants did indicate a desire to infuse more experiential learning opportunities into their classes. When Karen returned from the Rivers to Reef course, she expressed her desire to have students go and actively engage in science. She wanted her students to “adopt a stream” and conduct water-quality testing on a local stream to monitor its health. Karen wanted her students to make real world connections between what she was teaching in class and their local environment. Karen was not able to get her students to adopt a stream or conduct the water quality testing in a stream because of a lack of resources, but she stated if the resources were present she would have had her students take part in the testing daily. The desire for experiential learning was apparent.

Marcie indicated she had a desire for her students to have experiential learning opportunities in order to learn scientific concepts. Marcie was able to have her students experience science using a water quality lab. Marcie appears to have the support of her administration. If resources are needed that her school is unable to fund, she acquires the funds through grants. Marcie made mention of writing at least three grants throughout our interviews. The first two grants were for professional development opportunities and the third grant was for the supplies necessary to conduct her water quality testing labs. Marcie’s desire to have her students experience science was significant, and she was not

willing to allow a lack of resources to impede her students' ability to experience hands-on science opportunities.

Sherri also indicated a desire to have her students experience science. Sherri had a unique barrier in place because she did not teach science this year. However, Sherri worked to implement what she learned in the Rivers to Reef course into the other classes she taught.

All of the teachers found a way to replicate the Rivers to Reef experience. Even though Karen did not have the resources to conduct the science experience in the manner she would have preferred, she did have the students create the Rivers to Reef mural. The students learned about the aquatic plants and animals found in each ecosystem in the same manner that Karen did when she experienced the Rivers to Reef course. In Marcie's classes, she replicated the Rivers to Reef experience by having students conduct water quality testing and determine through analysis, the pH, salinity, dissolved oxygen and origin of the water. The students were able to experience the river system in a manner similar to the way Marcie experienced the Rivers to Reef program. Sherri went as far as finding an appropriate place in her reading curriculum to integrate the Rivers to Reef experience. She created a river system that demonstrated how objects collect in a river as it travels toward the coast and the cumulative impact the components of the river has on the ocean. All of the teachers found ways to apply some elements of the Rivers to Reef experience in an effort to provide their students with a related experience.

The data obtained from this study indicated that Sherri, Marcie, and Karen all viewed the Rivers to Reef course as an educative learning experience in relation to their teaching practice. Each of the program participants found ways to integrate the overall

concept of the course into their classroom curriculum. Marcie was very successful with integrating the Rivers to Reef experience into her curriculum as she provided her students with hands-on water quality analysis opportunities. Sherri and Karen found ways to integrate the Rivers to Reef experience into their classroom curriculum to a lesser degree. Sherri did not teach science this year, and Karen did not have the financial resources to implement the water quality analysis components into her curriculum in a manner she deemed appropriate. The fact that each teacher presented their students with a lesson, unit or activity that replicated a river from its headwaters to the coast while emphasizing the health of the river indicated the Rivers to Reef course had a positive “educative” impact on their teaching practice.

Much of the data obtained during this study echoed the sentiments of previous research that states that science teachers learn best with hands-on learning opportunities (Bell et al., 2003; NRC, 1996), that science teachers need greater exposure to content in context (Dockstader, 1999; Zhao, 1998), that many preservice science education programs are not adequately preparing teachers for the teaching field (Loucks-Horsley et al., 1998), and that science teachers need resources, administrative support, and materials to teach effectively (Abel & Sewell, 1999; Gonzalez, 1995; Shann, 1998). However, there were two critical components of this study that emerged as unexpected findings. First, teachers’ prior experiences affect their professional development experiences. In this study the novice, the experienced, and the veteran teachers had three very different experiences. In the National Science Education Standards teachers are encouraged to embrace their role as lifelong learners (NRC). Where the teacher enters the professional development course on their professional development continuum influences the impact

the course had on their professional growth and teaching practice. Secondly, teachers who participate in a professional development experience that they feel could be a beneficial learning opportunity for their students will find creative ways to integrate components of the experience into their classroom curriculum. This was evidenced by all of the study participants, who applied the overall theme of the Rivers to Reef program into their science curriculum. The two components that emerged from the data and all of the existing research on professional development should be considered when developing future professional development courses.

Figure 10 provides a visual summation of the impact of the Rivers to Reef course on the teaching practice of the study participants. All of the participants noted an increase in their desire for hands-on/experiential learning opportunities. There were several other components of the course that were more individualized based on the study participants. You will note that the Rivers to Reef experience had minimal impact on Karen, the veteran teacher, whereas the impact was more significant on Sherri and Marcie. It is my belief that the impact of the Rivers to Reef program on the teaching practice of the study participants was based on their teaching experiences prior to the Rivers to Reef course; in the same manner that it was related to the impact on their professional growth.

The data obtained relating to the teaching practice and professional growth of the participants was insightful and worthy of further examination. The data indicates that professional development courses that integrate an experiential learning model increase the desire for the program participants to integrate experiential learning opportunities into their classroom curriculum. It is important that future professional development designers

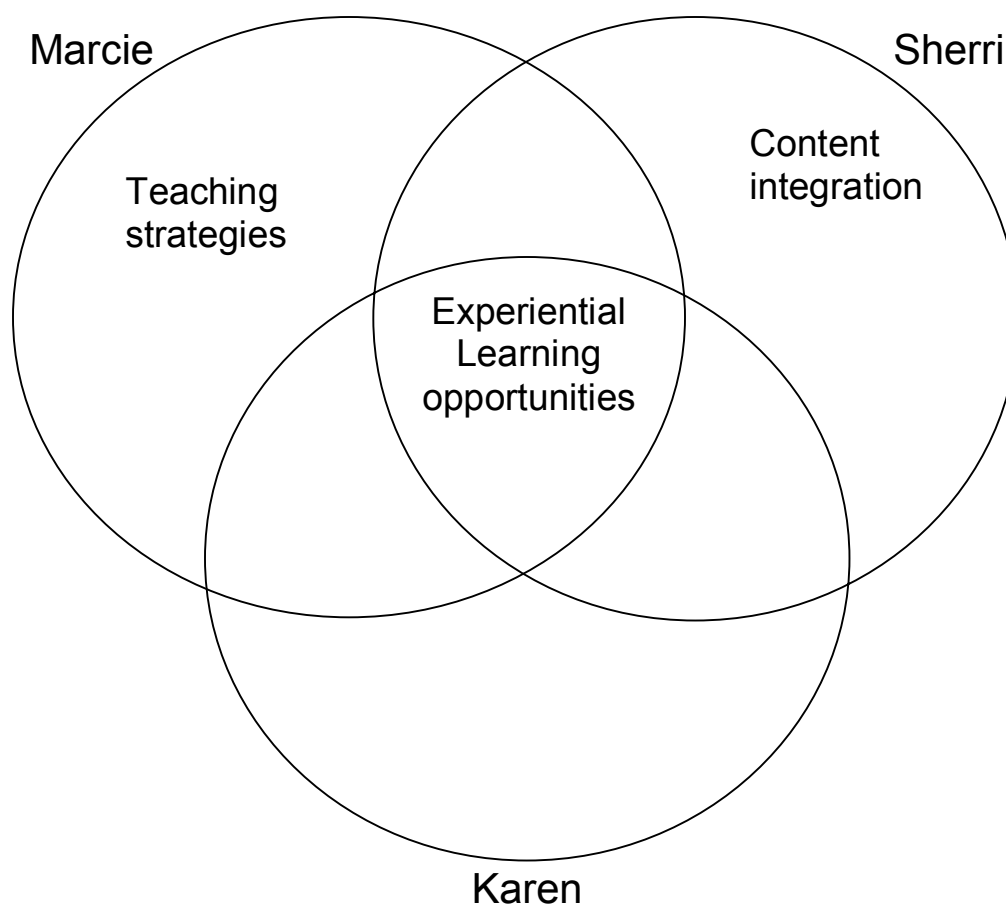


Figure 10. Impact of the Experience on Teaching Practice.

take this information into consideration when they are creating new professional development courses.

Implications for Future Professional Development Designers

Each of the participants in this study found some benefit to their participation in the Rivers to Reef professional development experience. The novice, experienced, and veteran teachers all found some aspect of the Rivers to Reef program as enriching to their teaching. One of the most significant components that emerged from this study was my view related to the professional development continuum (see Figure 11). The continuum

illustrates the impact a teachers' prior teaching experiences play in the anticipated outcomes of a professional development course.

The results of this study indicate that teachers who have an opportunity to select a professional development course enter the professional development experience with different outcomes in mind based on the number of years they have been teaching. The data indicated that the novice teacher seeks content knowledge and pedagogical understanding to meet their professional development needs. Whereas the experienced teacher, teachers with 4 – 15 years of teaching experience, seek to validate their pedagogical practice, enhance their pedagogy by seeking additional strategies and further enhancing their content knowledge. The veteran teacher, teachers who have taught over sixteen years, seek professional development opportunities to share their classroom experiences and best practices with others while also seeking ways to increase their motivation and renew their interest in the subject area they teach. The data related to these findings are worthy of future research investigations and should be taken into consideration with future professional development designers.

This study indicated that teachers would like to participate in professional development experiences that enrich their understanding of content knowledge and improve their ability to teach effectively. Karen addressed the concern that preservice middle school teachers do not get enough exposure to science content in their respective teacher training programs. This idea was also supported by Marcie, who acknowledged her lack of content knowledge related to the subject area that she was teaching. For teachers who have received their middle school teacher training certification in a

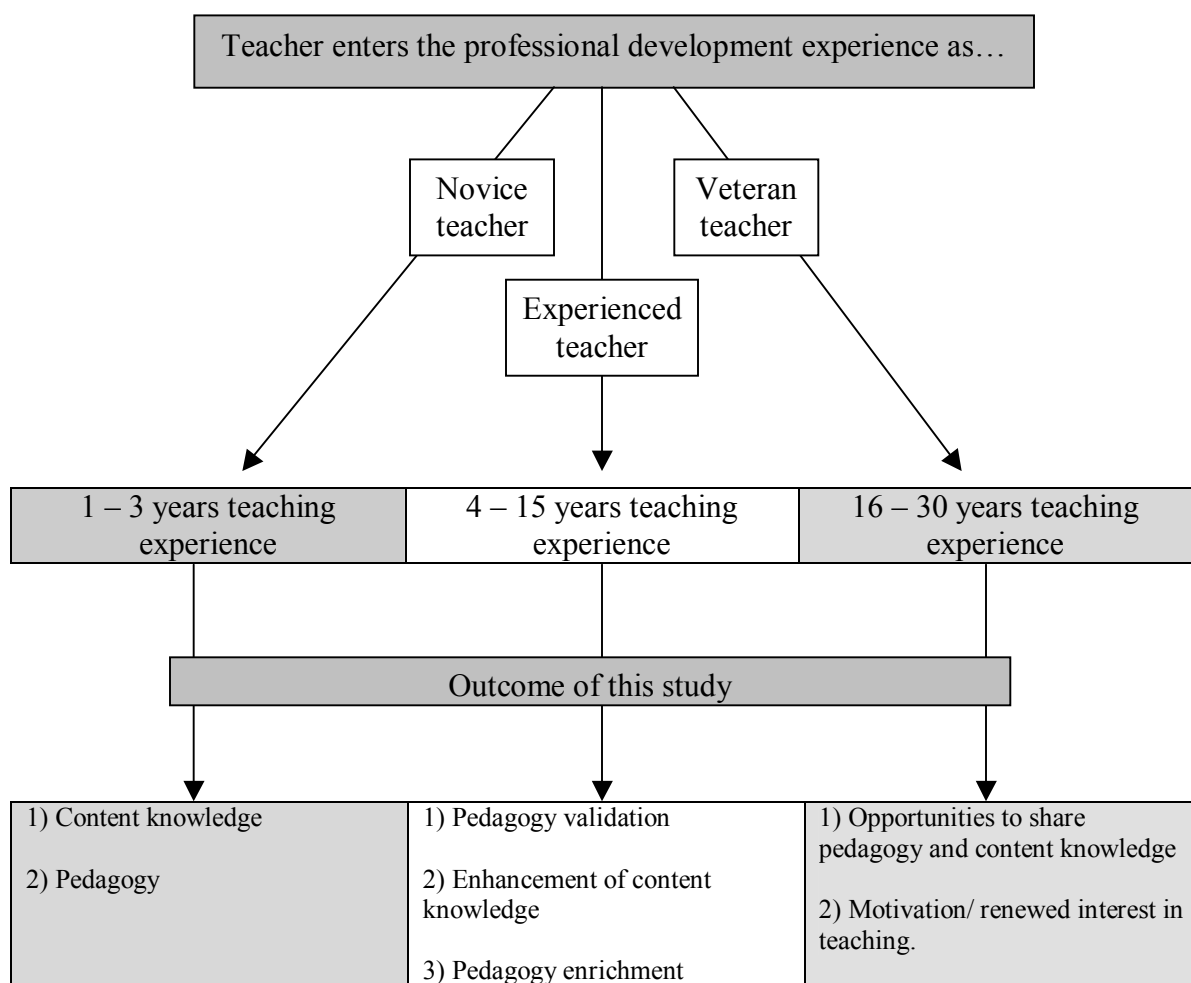


Figure 11. The Professional Development Continuum. The continuum illustrates the impact teaching experience has on the anticipated outcomes of a professional development experience for science teachers.

traditional or alternative teacher certification program there is a good chance that their scientific content knowledge is limited to three or four science related courses. Having teachers participate in professional development courses that provide them experiences where they learn scientific concepts in the same manner that their students learn will be beneficial in helping the teachers gain a better understanding of the content while also developing their pedagogical content knowledge (NRC, 1996). Future professional

development courses should incorporate learning opportunities that allow teachers to learn content through experience.

In light of what I have learned as a result of this study, I have provided specific suggestions for the improvement of professional development courses for science educators.

1. Provide science teachers with experiential learning opportunities that enrich their conceptual understanding of scientific concepts.
2. Provide teachers with resources that allow for successful implementation of the concepts they are presented with in the professional development course.
3. Conduct pre-assessments and design or fine tune professional development course to meet the needs of the individuals in the course.
4. Move away from science related professional development experiences that are strictly lecture format with limited hands-on learning opportunities.
5. Create an environment where the teachers feel free to ask questions without fear of being scrutinized for their lack of scientific understanding.
6. Provide teachers with an opportunity for information exchange among themselves related to teaching practice and successful teaching strategies.

The integration of these components will enrich the professional development experiences for science educators. Throughout this study all of the program participants made reference to the above aspects of the Rivers to Reef course and the impact they had on their professional development experience.

Direction for Future Studies

This study provided the education community with insights on the impact of a professional development course that integrated the experiential learning model on the professional growth and teaching practice of its participants. The information obtained was beneficial, but the results of this study suggest several future studies are further needed to enhance the existing research literature related to professional development.

One such study would involve a further examination of the impact of a course like the Rivers to Reef course on groups of teachers with similar levels of teaching experience. This study included a novice teacher, an experienced teacher, and a veteran teacher. A future study may be designed with a group of novice teachers to see if the results from the professional development experience yielded results that are similar to Sherri's results. If the results found that novice teachers make significant gains related to their understanding of scientific concepts, this type of professional development design may be integrated into the professional development or certification renewal plans at the state or local level.

Another study that needs to be examined is a comparative analysis of a course that uses the experiential learning model compared to a traditional professional development course. This investigation would serve to see if gains related to content knowledge or professional growth are related to the design (experiential learning versus traditional) of the professional development course. This would require the development of two courses with the same content and other relevant information for participants, yet the design of the two courses would need to be markedly different, one traditional lecture format and the other a course with an experiential learning model. There is some existing literature

describing similar studies, but I feel a further examination of this area would provide greater insights into the best practices for science related professional development.

Marcie discussed in her interviews that her scientific conceptual understanding of a recent professional development course was greatly enhanced by her participation in the Rivers to Reef course the year before. Marcie was disappointed that her colleagues missed out on the Rivers to Reef experience but to ensure other teachers do not miss out on this learning opportunity, she has recommended that the Rivers to Reef course be taught as a prerequisite for the other Ossabaw Island course. I think the examination of the benefits related to the two courses being taught as a series needs further investigation.

It would also be important to conduct a longitudinal study that examines the impact the Rivers to Reef program would have on the teaching practice and professional growth of middle school teachers if it were followed by another professional development course that used the experiential learning model. In her final interview, Marcie indicated how much more enriching the Ossabaw Island experience was for her based on her having experienced the Rivers to Reef program. She indicated that it had a major impact on her confidence in relation to teaching the new content of physical science and having the two courses in consecutive summers provided her with a much broader understanding of the aquatic ecosystem overall. She felt she was at a significant advantage having participated in the Rivers to Reef program.

Summary

In conclusion, the results of this study support the belief that Kolb's experiential learning model format had a positive impact on the professional growth and teaching practice of the study participants and their future education-related endeavors. Overall,

the teachers viewed the Rivers to Reef course as an educative professional development experience. All of the study participants noted personal and professional growth related to an increased understanding of science content. The increase in understanding of content knowledge varied among the participants, but they all acknowledge a growth in this area. The National Science Education Standards (1996) emphasize that providing teachers with a greater understanding of the content they teach will aid in increasing student achievement. Along with an increase in content knowledge, the Rivers to Reef experience provided the study participants with greater insights into their personal learning styles, an increase in their self-efficacy, and a positive view about professional development courses. The Rivers to Reef experience yielded positive results from the perspective of the study participants and supports many of the goals established by the National Science Education Standards for professional development.

The impact on the teaching practice of the study participants was positive as well. All of the study participants stated that they infused more hands-on learning opportunities into their classroom curriculum particularly when they taught their students aquatic related topics. Beyond the hands-on learning opportunities, they individually noted an increase in the desire for experiential learning opportunities and an integration of more real-world experiences to increase relevancy for their students.

This research study also shed light on several additional factors. One of the most significant involved the impact of the Rivers to Reef course in relation to the number of years teaching experience of the program participant. The data informed me that the impact of a professional development course that integrates Kolb's experiential learning model on the professional growth and teaching practice of middle school science teachers

could be greatly influenced by the teaching experience of the participant. This study involved three teachers with significant variations in their number of years of teaching experience. The novice teacher, the experienced teacher, and the veteran teacher each acquired differing, yet relevant information that was pertinent to their individual professional growth needs. The data that emerged from each of the participants led to the generation of the professional development continuum that suggests an expected outcome based on the career phase of a teacher. The professional development continuum and several other components that emerged from this research data are worthy of further examination. These results support much of the existing research literature related to successful professional development practices. The study also exposed a number of research questions that are in need of further examination as we search for professional develop opportunities that will enrich the learning environment for middle school science teachers and students.

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APPENDIXES

Appendix A

Rivers to Reef Educator's Workshop_Application Form

Rivers to Reef Educator's Workshop

APPLICATION FORM

Instructions

1. Respond to all questions in 12-point font. All pages must be single-sided. Attach separate sheets as needed.
2. Submit one original plus two copies of the application postmarked no later than (May 20, 2006) to Kim Morris Zarneke.

Name: _____

Title/position: _____

Subject Areas or Areas of Specialty: _____

School/Organization Name: _____

School Address: _____

City: _____ State: _____ Zip Code: _____ County: _____

Gender _____ Number of Years Teaching _____

Date of Birth _____ What grade level do you teach? _____

Have you participated in previous professional development courses? _____ If yes, how many? _____

School Phone: _____ Fax: _____ Web Site: _____

Is your school in the Ocmulgee River or Altamaha River Watersheds? (Circle one.)	YES	NO
--	-----	----

If you are not sure, visit EPA's Surf Your Watershed Web site and find out by entering the zip code for your school. The Web site address is http://cfpub.epa.gov/surf/locate/index.cfm .
--

I am available to participate in the Rivers to Reef Educator's Workshop, (June 2006).

Be advised that the activities during this workshop will be outdoors and include, but are not limited to, walking, rowing, climbing, and lifting (up to 25 lbs.). In order to participate in this workshop you should be able to perform these activities without assistance. Diabetes, asthma, and any allergies to plants, insects, or shellfish should be carefully considered before participating in

Appendix B

Individual Interview One Questions

- 1) How did you become interested in teaching?
- 2) How did you become interested in teaching science?
- 3) Which factors had the greatest influence on you becoming a science teacher?
- 4) How would you describe yourself in your early years of teaching?
- 5) How would you describe your first science related professional development experiences and the impact they had on your teaching?

Appendix C

Individual Interview Two Questions

- 1) Tell me about your Rivers to Reef experience.
- 2) How would you describe the Rivers to Reef program as a professional growth experience?
- 3) Describe the impact your participation in the Rivers to Reef program has had on how you teach?
- 4) Have you incorporated any aspects of the Rivers to Reef program into your classroom curriculum? If so, please provide some examples of how this was accomplished.
- 5) Do you feel the Rivers to Reef program has had an impact on your effectiveness as a science teacher?
- 6) Describe the experiential learning model. Do you use components of this model in teaching science? Please explain.

Appendix D

Individual Interview Three Questions

- 1) Since our last meeting, have you integrated any components of the experiential learning model into your classroom curriculum? If so please describe how this was accomplished.
- 2) How do you see professional development programs like the Rivers to Reef program impacting your future methods for teaching science?
- 3) What role do you feel professional development programs like the Rivers to Reef program could play in teaching curriculum standards?
- 4) How would you design a lesson for your students using an experiential learning format?
- 5) What are some ways you could use the Rivers to Reef experience in planning your curriculum for next year?
- 6) What role do you see programs like Rivers to Reef playing in helping teachers effectively teach science?

Appendix E

Participant Consent Form

Georgia State University
Department of Middle - Secondary Education and Instructional Technology
Informed Consent

Title: Investigating the Experience: A Case Study Of A
Science Professional Development Program Based
On Kolb's Experiential Learning Model

Principal Investigator: Lisa Martin-Hansen, Ph.D.
Professor, Middle-Secondary Education and
Instructional Technology
Georgia State University

Student Principal Investigator: Brian Davis, M.Ed.
Doctoral Candidate, Middle-Secondary Education and
Instructional Technology
Georgia State University

I. Purpose:

You are invited to participate in a research study. The purpose of the study is to investigate the Rivers to Reef program as a professional development experience and its impact on the teaching practice of science educators. You are invited to participate because you are a middle school teacher and you were a participant in the 2006 Rivers to Reef professional development experience. A total of three participants will be recruited for this study. Participation will require a maximum of five hours of your time over the span of a four month period.

II. Procedures:

If you decide to participate, you will be asked to take part in three individual interviews. Each interview will take place at your school and should last approximately sixty to ninety minutes. The interviews will be scheduled at times that are conducive to your scheduling needs and minimize any inconvenience to you. Interviews will be scheduled in the following months: March, April and May. Approximately, four weeks will elapse between each interview. Along with

the interviews, samples of student work, your classroom curriculum and photographs of your classroom and/ or student work relevant to this study may be collected. All of the individual interviews will be conducted by Brian Davis, the Student Principal Investigator for this research study.

III. Risks:

In this study, you will not have any more risks than you would in a normal day of life.

IV. Benefits:

Participation in this study may not benefit you personally. Overall, we have to gain information about the effectiveness of professional development courses and their impact on the teaching practice of science educators. Your participation in this study will enrich the research literature related to professional development courses for science educators and aid in professional development designers in the development of the most beneficial professional development programs.

V. Voluntary Participation and Withdrawal:

Participation in research is voluntary. You have the right not to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. Participation in this study will not affect your school district employment, certification status or the obtainment of professional learning units and there are no foreseeable risks associated with your participation in this study. You may skip questions or stop participating at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

VI. Confidentiality:

We will keep your records private to the extent allowed by law. Your personal identity, that is your name, address, and other identifiers, will remain anonymous for the purpose of this research study. We will use a combination of numbers and letters to generate a coding system rather than your name on study records. The Principal Investigator, the Student Principal Investigator, Georgia Aquarium officials, and Georgia State University officials associated with the Institutional Review Board will have access to the initial data obtained during this research study. However, only the Principal Investigator and the Student Principal Investigator will be aware of your identity. You will be identified to the other above mentioned entities (The Georgia Aquarium officials and the Institutional Review Board officials at Georgia State University) using the coding scheme established for the purposes of this study. Your individual identity will not be revealed to the officials of the Georgia Aquarium or the Institutional Review

Board of Georgia State University. All information obtained including photographs and audio tapes will be stored in a locked cabinet within the department of Middle – Secondary Education and Instructional Technology at Georgia State University for a period of one year before being destroyed. However, interview transcripts will be housed at Georgia State University for a period not to exceed five years for future research study purposes. The coding key will remain in the possession of the Student Principal Investigator and it will remain secure on a password protected computer system. Your name and other facts that might point to you will not appear when we present this study or publish its results. The findings will be summarized and reported in group form. You will not be identified personally.

VII. Contact Persons:

Call Lisa Martin-Hansen, Ph.D. or Brian Davis M.Ed. at 678-925-9586 or bdavis4@student.gsu.edu if you have questions about this study. If you have questions or concerns about your rights as a participant in this research study, you may contact Susan Vogtner in the Office of Research Integrity at 404-463-0674 or svogtner1@gsu.edu.

VIII. Copy of Consent Form to Subject:

We will give you a copy of this consent form to keep.
If you are willing to volunteer for this research, please sign below.

Participant

Date

Principal Investigator or Researcher Obtaining Consent

Date

March 2007

Dear Rivers to Reef Participant,

Under the supervision of my Doctoral Chairperson, Dr. Martin-Hansen, Georgia State University, I am conducting a research study on the effect a professional development course that uses an experiential learning model has on the teaching practice of science educators.

In order to conduct this study I am collecting data from the 2006 Rivers to Reef participants and I would like to invite you to participate in this research study. As a participant you will be asked to take part in three individual interviews. The interviews will be conducted at your school during times that are most conducive to your scheduling needs.

You may refuse to participate in this study without penalty or loss of benefits to which you are otherwise entitled. Participation in this study will not affect your school district employment, certification status or the obtainment of professional learning units and there are no foreseeable risks associated with your participation in this study. However, your participation in this study can play a role in enriching the existing professional development research literature and improving future professional development experiences for science teachers.

If you have any additional questions about the research study and the role of the participants in this study please feel free to contact me at bdavis4@student.gsu.edu via e-mail or at 678-925-9586. If you are interested in participating in this research study please contact me at the e-mail address or phone number listed above. You will also need to read, sign and date the attached consent form and return it to me in the self addressed envelope that has been provided. Thank you for taking the time to read this letter and I look forward to hearing from you soon.

Sincerely,

Brian Davis, M.Ed.
Georgia State University
College of Education
Middle-Secondary Education and Instructional Technology Department

Appendix F

IRB Approval Form

Protocol H07335

Title: INVESTIGATING THE EXPERIENCE: A CASE STUDY OF A SCIENCE PROFESSIONAL DEVELOPMENT PROGRAM BASED ON KOLBS EXPERIENTIAL LEARNING MODEL

Principal Investigator: Lisa Michelle Martin-Hansen

Current Status: Approved

Admin Assigned: Susan Vogtner

Last Activity: 03/12/2007 - Approval Dates Changed

Committee Assigned: COMMITTEE 1

Original Approval Start: 03/12/2007

Review Type: Expedited Review

Current Approval Period: 03/12/2007 - 03/11/2008

Protocol Summary

Protocol Description:

Professional development for educators has been defined as the process or processes by which teachers achieve higher levels of professional competence and expand their understanding of self, role, context and career (Duke and Stiggins, 1990). Currently, there is limited research literature that examines the effect a professional development course that uses the experiential learning model has on the teaching practice of its participants. The purpose of this interpretive case study is to investigate how three middle school science teachers who participated in the Rivers to Reef professional development course interpreted the learning experience and integrated the experience into their teaching practice. The questions guiding this research are

- 1) What is the relationship between a professional development course that uses an experiential learning model and the science teaching practice of its participants?
- 2) How do the Rivers to Reef participants reflect on and describe the course as a professional growth experience?

The creation of the professional development course and the framework for the study were established using David Kolbs' (1975) experiential learning theory and the reflection process model designed by David Boud (1985). The participants in the study are three experienced science teachers from schools that represent varied settings and socioeconomic levels in the southeastern United States. Data will be collected using artifact analysis and a phenomenological based series of three interviews designed by Dolbere and Schuman (Seidman, 1998). The data will be analyzed for the identification of common themes related to changes in science

	teaching practice. The purpose of this study is to gain a greater understanding of how a professional development course based on the experiential learning model is being integrated into the teaching practice of three middle school science teachers.
Protocol Department:	Middle Sec Educ & Instruc Tech – 145000000
Research Personnel:	2 personnel
Researcher Certifications:	2 researchers have active "CITI Training: On-line Training for the Protection of Human Research Subjects" certifications
	certification details
Amendments:	None
Renewals:	None
SAE's/Adverse Event's:	None
Protocol Deviations:	0 Protocol Deviations created » Report Protocol Deviation
Research Funding:	None
Research Locations:	None
Research Subjects:	3 subjects, Both genders
Vulnerable Populations:	None
Drugs:	None
Investigational Devices:	None
Radiation:	None
Key Words:	Professional development, teachers, experiential learning, David Kolb
Documents:	4 documents

Appendix G

Georgia Aquarium Approval Letter



Letter of Support

December 5, 2006

Brian Davis
Georgia State University
College of Education
30 Pryor Street
Georgia State University
Atlanta, GA 30303-3083

Dear Brian,

I am writing to inform you that we have reviewed the information that you submitted and we are granting you permission to use the professional development data that we have obtained for your doctoral research study, *Understanding the Experience: A Case Study of a Professional Development Program Based on Kolb's Experiential Learning Model*.

We believe that your study will help our institution in obtaining a greater understanding of our professional development programs from the perspective of the teachers. You will need to work closely with the members of our education department to acquire any information you need related to our professional development programs. This permission is extended to the use of data that we have collected as a result of interviews, surveys, and other documents used during our professional development programs. However, this permission does not obligate any teacher who has participated in our programs to take part in your research study. You will need to seek the consent of individual teachers independent of this request.

The integrity of this institution is paramount. After your research data is collected and compiled you will be required to submit your findings to the Executive Director's Office or the Vice President of Research prior to using the name of this institution in the published version of your dissertation. At that time the Executive Directors Office or our Vice President of Research will grant you with permission to use the name of the institution or inform you if a pseudonym would be more appropriate.

Please feel free to contact me if you have any additional questions. Good luck with your study and we are eager to examine the results of your research in the near future.

Sincerely,

A handwritten signature in black ink, appearing to read 'J. Swanagan'.

Jeffery S. Swanagan
President and Executive Director

/JSS