12-2007

Identifying the Processes of Teacher Application and Adoption of a Novel Instructional Strategy

Jennifer Kathryn Richards
University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a dissertation written by Jennifer Kathryn Richards entitled "Identifying the Processes of Teacher Application and Adoption of a Novel Instructional Strategy." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

Gary Skolits, Major Professor

We have read this dissertation and recommend its acceptance:

Janie Burney, F. Ann Draughon, Russell French

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

To the Graduate Council:

I am submitting herewith a dissertation written by Jennifer Kathryn Richards entitled "Identifying the Processes of Teacher Application and Adoption of a Novel Instructional Strategy." I have examined the final paper copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

_____
Gary Skolits, Major Professor

We have read this dissertation
And recommend its acceptance:

_____
Janie Burney

_____
F. Ann Draughon

_____
Russell French

Accepted for the Council:

_____
Carolyn R. Hodges
Vice Provost &
Dean of Graduate Students

(Original signatures are on file with official student records.)

Identifying the Processes of Teacher Application and Adoption of a Novel Instructional Strategy

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Jennifer Kathryn Richards
December, 2007

Dedication

This dissertation is dedicated to Beverly Wilson, who started me on this strange journey, to Harry Richards, IV, who sustained me through its many twists and turns, and to Harry Richards, V, who makes all of life's journeys worthwhile.

Acknowledgements

Funds for the execution of this study were provided by the United States Department of Agriculture's National Integrate Food Safety Initiative (Award Number: TEN02005-02098) and The University of Tennessee's Food Safety Center of Excellence. Additional support from The University of Tennessee's Department of Food Science and Technology and UT Extension was also provided.

I would like to thank committee members Dr. Russ French and Dr. Janie Burney for their valuable input and for helping guide this study to its successful completion. I offer my most sincere appreciation and gratitude to Dr. Ann Draughon for providing me with the means and opportunity to pursue a doctorate degree and being willing to "stretch the box" to consider the idea of bringing meaningful food safety education into the middle school classroom. I owe a deep debt of gratitude to my committee chair, Dr. Gary Skolits for pushing me to excel and never allowing me to "take the easy way out."

From my very earliest memories my parents, Jane Parker and Bill Parker, instilled in me a strong value for education and the belief that I could be successful at anything I chose. These are the greatest gifts any parents could offer their child and I am so fortunate to have been blessed by their love and belief in me.

And finally, I offer my appreciation and thanks to my best friend and partner in life, Harry Richards. Your unconditional support and love sustains and inspires me. I am the luckiest girl in the world because I get to share my life with you.

Abstract

Research on adolescent learning shows that students learn best when they are actively engaged with the content and when metacognitive teaching strategies are employed. Despite these findings, current studies show that most classrooms are still teacher centered and that passive learning strategies are the norm. To help teachers incorporate highly effective instructional strategies into their classrooms countless professional development workshops are offered each; yet most of these workshops fail to effect true change in the classroom behavior of teachers.

The design of this study compares teachers' attempts to employ new instructional strategies within the context of a model curriculum with subsequent attempts to employ those same strategies outside of the model. The purposes of this study were to: (1) investigate how teachers apply new knowledge, attitudes, or behaviors and adopt them as a regular part of their instructional process; (2) identify barriers to instructional change; and (3) examine the impact of a research-based professional development model on teachers' use of a novel instructional strategy.

The results of this study indicate that teachers need to understand the educational theory behind new strategies, see the strategy modeled for them, be provided with opportunities to discuss the strategy as it relates to their classrooms and current instructional practices, and have on-site support when implementing the strategy on their own.

Table of Contents

CHAPTER **PAGE**

LIST OF TABLES

Chapter One
Introduction

Introduction

Research on adolescent learning shows that students learn best when they are actively engaged with the content and when metacognitive teaching strategies are employed (Marzano, 2003; Hattie, 1992; Wenglinksky, 2002). There is a high correlation between levels of student engagement and achievement because when a student becomes engaged in instruction, he/she intrinsically becomes more curious and motivated to achieve his/her own intellectual goals (Jablon & Wilkinson, 2006; Finn & Rock 1997; Marks 2000; Roderick & Engle 2001; Willingham, Pollack, & Lewis 2002). Active engagement also promotes behaviors that support deep and meaningful learning such as concentration, investment, enthusiasm, and effort (Jablon & Wilkinson, 2006). Similarly, academic improvement and the ability to transfer knowledge to new situations using metacognitive strategies have been found across disciplines at all grade levels with a wide range of students (Bransford et al., 2000; White & Frederickson, 1998; Scardamalia, Bereiter, & Steinbach, 1984; Schoenfeld, 1991).

One specific instructional strategy that incorporates both active student engagement and metacognition is RAFT (Role, Audience, Format, Topic). This strategy requires students to synthesize new content knowledge into a product which demonstrates a deep and meaningful understanding of the new concepts in a non-traditional format (Santa, 1988), allows students to connect prior knowledge to new

knowledge, and encourages students to write in a creative format that still provides sufficient structure (Goenke & Puckett, 2006). Teachers introduce students to new content knowledge then provide them with a specific, and often non-traditional, role to assume. Students are then given a specific audience for which to write, a particular format in which to write, and a topic on which to focus their products. An example would be to assume the role of a bacteriologist writing to patients in a doctor's waiting room in the format of a most wanted poster on the topic of "The Top 5 Most Wanted Pathogens: Wanted Dead or Alive." While RAFTs were initially developed as a literacy and writing tool, they have been adapted to other disciplines (Buehl, 2001; Daniels & Zimelman, 2004; and Topping & McManus, 2002). This strategy is only recently gaining recognition as a powerful technique that "deserves a place in any science classroom" (Groenke & Puckett, 2006).

To help teachers incorporate highly effective instructional strategies, such as RAFTS, into their classrooms, countless professional development workshops are offered each year by educational corporations, universities, state governments, and local school systems. Yet most of these workshops fail to effect true change in the classroom behavior of teachers. There are several pitfalls to which ineffective professional development workshops continually fall prey. Most are designed to achieve desired outcomes with little attention paid to the participants' needs or learning styles. Teachers benefit most from workshops that incorporate small group activities that require participants to apply, analyze, synthesize, and evaluate new content or strategies (Galbo, 1998). However, many professional development events are still conducted as large group lectures or seminars.

In addition, designers of professional development opportunities for classroom teachers often do not have a clear plan to help teachers overcome barriers to instructional change. Previous literature suggests that habit, a failure to recognize the need for change, previous unsuccessful attempts at change, and a fear of the unknown are common barriers to change (Zimmerman, 2006; Greenberg & Baron, 2000; Fullan, 2001). In order to help teachers successfully implement new instructional strategies in their classrooms, designers of professional development events must be mindful of these barriers and have a plan to actively combat them.

Another common pitfall of professional development workshops is a failure to provide on-going support after the professional development concludes, what Guskey calls a "one shot" in-service (Guskey, 2000). By supporting teachers after the professional development ends, an environment is created in which teachers feel safe to implement and experiment with new techniques and strategies. Research shows that as many as 95% of teachers will transfer a new skill into use if theories, demonstration, practice, feedback and ongoing coaching are part of the professional development program (Joyce & Showers, 1988). On-going support also holds teachers accountable for implementing new strategies because they know they will be monitored and observed. Despite the benefits of a more comprehensive follow-up method, many professional development activities end when teachers walk out of the training.

Statement of the Problem

Despite the substantive body of literature supporting metacognition and active engagement as the cornerstones of effective classroom instruction, current studies show that most classrooms are still teacher centered and that passive learning strategies are the norm (Marks 2000; McDermott, Mordell, & Stolzfus 2001; Yair 2000; Goodlad 2004). Carnine refers to this as a "research to practice gap" (Carnine, 1995). What causes this disconnect between well grounded educational theory and practical application in the classroom? Many teachers cite unfamiliarity with new techniques, a lack of training, and insufficient support in the classroom when trying out new techniques (Huberman & Miles, 1984). Therefore, there exists a need for further study into the processes that promote internalization of new instructional strategies that result in meaningful changes in teachers' instructional behaviors and ways in which professional development can better support those processes.

Purpose of the Study

As school systems struggle to keep up with increasingly stringent standards for "highly qualified" status and other mandates of the No Child Left Behind Act, the expectations on teachers to raise student achievement by regularly seeking additional professional development training have increased. As a result, there has been an explosion in the number of professional development opportunities offered to classroom teachers over the past decade. However, research shows that most fail to create meaningful changes in teachers' instructional practices (Guskey, 2000). In

addition, little attention has been paid to the direct impact of professional development on student learning outcomes. **The purposes of this study were to: (1) investigate how teachers apply new knowledge, attitudes, or behaviors and adopt them as a regular part of their instructional process; (2) identify barriers to instructional change; and (3) examine the impact of a research-based professional development model on teachers' use of a novel instructional strategy.** To accomplish this goal, this study focused on the implementation of the RAFT strategy, as used in the *Food Safety in the Classroom* curriculum.

Importance of the Study

To design effective professional development, educators need to thoroughly understand how teachers internalize new instructional strategies, what barriers to change exist, and the intrinsic and extrinsic motivations that lead teachers to seek out new methods of instruction. The design of this study compared teachers' attempts to employ a new instructional strategy within the context of a model curriculum with subsequent attempts to employ that same strategy outside of the model. The results provide important insights into identifying how teachers acquire and apply new instructional strategies, barriers to implementing new strategies, and what levels of training and support are necessary for teachers to feel comfortable implementing new strategies. Designers of professional development activities can use the insight from this study to more effectively plan and design future professional development opportunities.

Context of the Study

This study drew upon research conducted as part of a larger project funded by the USDA's National Integrated Food Safety Initiative (Award Number: TEN2005-02098). *Food Safety in the Classroom* evaluated the effectiveness of an integrated food safety curriculum written for seventh grade students in Tennessee and North Carolina. The curriculum is an interdisciplinary food safety unit for seventh grade students that is correlated with state standards for math, science, social studies, and language arts in Tennessee and North Carolina. Twenty-three teachers participated in the USDA study, which included a two-day training workshop designed to raise teachers' background knowledge of food microbiology and food safety while also familiarizing them with new and innovative instructional strategies, such as RAFT.

Each participating teacher attended a two-day workshop (9 a.m. to 4 p.m.) with their teammates. Teachers were compensated at a rate of $100 per day for their participation. The delivery method of the workshop was a combination of modeling of lessons and instructional strategies and a seminar style discussion. The tone of the workshops was informal, and teachers were encouraged to ask questions and discuss ideas with their teammates. Each workshop followed a set agenda designed to move efficiently through the food safety curriculum covering new content material and instructional strategies in depth.

Research Questions

For professional development opportunities to be of value to participants, in is important to understand how teachers internalize new instructional strategies and what impact the use of these strategies have on student outcomes. This study employed both quantitative and qualitative means to explore these issues. The research questions around which this study was designed are:

1. To what extent do teachers apply a specific instructional strategy taught in the professional development workshops (the RAFT strategy) in the context of the model food safety curriculum?

2. To what extent do teachers apply the RAFT instructional strategy in contexts outside of the model food safety curriculum?

3. What intrinsic and extrinsic motivation factors affected teachers' adoption of the RAFT instructional strategy outside of the model food safety curriculum?

4. What is the relationship between teachers' fidelity of implementing the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum and student assessment outcomes?

5. What are the barriers to effecting change in teachers' use of the RAFT instructional strategy?

Assumptions

This study was conducted under the following assumptions:

1. The teachers were open and honest in their responses to interview questions.
2. Interview responses were not biased by the researcher through question selection, personal experiences, or content knowledge.
3. Observational data used were valid and reliable.

4. The researcher's role in the *Food Safety in the Classroom* project did not influence or bias data collection for this study.

Limitations

This was an exploratory study with a small sample size. Therefore, the generalizability of the data from this research is limited to the participants of this study. The pilot test sites, from which the participants in this study were selected, were chosen based on previous working relationships with the principal investigators and the University of Tennessee, and therefore, constitute a volunteer population. The six participants in the study were selected solely on the basis that they taught the science component of the *Food Safety in the Classroom* curriculum and they were volunteers, thus they may or may not be representative of the larger population. In addition, the findings of this study were based, in part, on self-reports. Finally, the researcher of this study was directly involved in the direction and execution of the larger USDA project. While the assumption is that the researcher's multiple roles did not bias the current study, it is a limitation worth noting.

Study Methodology

This is an exploratory study that employs mixed methods within an instrumental case study framework. Robert Stake (2000) defines this type of case

study as “examined mainly to provide insight into an issue or to redraw a generalization” (p. 437). The participants were trained to use a novel instructional strategy and were provided with on-site support during the initial implementation of that strategy. Data collected includes observations of the strategy implementation, semi-structured interviews with each of the participants approximately 6-8 months after the implementation, and pre- and posttest assessments of the participating teachers’ students.

Definition of Terms

Professional Development: An activity targeted at classroom teachers that is designed to introduce new content knowledge and instructional strategies or provide training that leads to improved student achievement.

Instructional strategies: Methods for delivering curricular content and teaching new skills and concepts to students.

Active engagement: The process of encouraging students to interact with new content instead of passively observing. Active interaction with the curriculum allows for a better understanding of the material and elicits links to previous knowledge and experience (Dewey, 1916).

Metacognition: Metacognition is broadly defined as thinking about thinking. It is the process of monitoring and managing one’s own thinking (Perkins, 1995).

Academic Improvement: Increases in student knowledge, concepts, or skill as measured by objective standardized tests.

Internalization: The process through which teachers acquire new knowledge, attitudes, or behaviors and apply them as a regular part of their instructional process.

Student Outcomes: The clearly define measures of student learning. Student outcomes are usually measured by the mastery of behavioral objectives.

Fidelity of Implementation: The degree to which a program is implemented as intended by the program designers (Dusenbury, L., et. al.,2004).

Organization of the Study

This dissertation contains five chapters. Chapter one, the introduction, establishes the need for the study, its purpose, importance, and context. In addition, chapter one includes research questions, assumptions, limitation, and definition of terms. Chapter two consists of a review of pertinent literature on the gap between research and practice, barriers to instructional change, effective professional development models, and effective types of curricula. Chapter three details the methods by which this study was completed and includes participants, instruments, and methods of data analysis. Chapter four reports results and presents analysis of the data. Finally, chapter five discusses the results of this study, conclusions drawn from the data, and suggests areas for further research.

Chapter II
Review of the Literature

Introduction

A review of the literature supports the need for further study into the processes by which teachers adopt and implement new instructional strategies. This chapter presents the review of pertinent literature addressing the issues of the research to practice gap, barriers to instructional change, professional development models that over come instructional change barriers, effective types of curricula and instruction, and the RAFT strategy as a means of effective instruction.

Gap between Research and Practice

Throughout the history of formal educational movements, a gap between research and practice has existed. Although numerous studies have shown that a strong collaborative effort between researcher and classroom teachers results in the use of instructional strategies that improve student learning (Baker & Smith, 1999; Bos, Mather, Narr, & Babur, 1999; Boudah, Logan, & Greenwood, 2001; Englert & Tarrant, 1995; McCutchen & Berninger, 1999;Schumm & Vaughn, 1995), there still exists a significant "research to practice gap" (Carnine, 1995). Bondy (2004) suggests that this gap exists because there is a fundamental separation of research based knowledge and practical based knowledge. This separation is attributed the fact that practitioners often fail to see the immediate relevance of empirical research

and there are few effective mechanisms for disseminating empirical research (Chafouleas & Riley-Tillman, 2005).

Overcoming the gap has long been a focus of researchers and educational philosophers. Bondy (2004) and Chafouleas & Riley-Tillman (2005) suggested that a new world-view of educational research is necessary in which research and practice are not seen as mutually exclusive, but rather as different perspectives on the same continuum. In accepting this view, researchers and practitioners share responsibility for building positive bridges to connect the two perspectives (Chafouleas & Riley-Tillman, 2005). Practitioners must be forthcoming with meaningful problems while research focus more intently on questions practitioners want answered (Chafouleas & Riley-Tillman, 2005; Cook et al., 2003). Rosenfield (2000) describes this process as creating "useable knowledge" that practitioners can apply in real-world context. In addition, researchers must work to increase the relevancy and improve the transmission of research findings (Carnine, 1997).

Barriers to Instructional Change

In addition to the research to practice gap, effective instructional change is often hampered by specific barriers to change. Habit is perhaps the most pervasive barrier to instructional change (Greenberg & Baron, 2000). For most teachers, it is simply easier and more comfortable to continue with teaching strategies and that are tried and true resulting in an avoidance of new or innovative methods. Gess-Newsome et. al (2003), who conducted an in-depth case analysis of three college

level science teachers who were attempting to reform their instructional practices, describe these habits as a "personal practical theory" of teaching in which the teacher's experiences and philosophies dictate an image of how teaching and learning in their classrooms should look (p. 758). In addition, habit often leads to a failure to recognize a need for instructional change (Greenberg & Baron, 2000).

In a qualitative case study which included teachers from two middle schools currently in the second year of a large-scale school improvement project, Johnson (2006) found that feeling an obligation to "transmit content knowledge in order to prepare students for the next grade" was an entrenched teaching value that prevents teachers from adopting new instructional strategies (Johnson, 2006, p. 152). The intense focus on accountability through state and national achievement tests has resulted in teachers feeling pressure to focus only on "what works" and leave many apprehensive about testing out new strategies (Johnson, 2006).

Closely associated with habit is the fear of doing unfamiliar things. Most teachers have clearly established patterns of behavior in the classroom. Deviating from those patterns to implement innovative teaching strategies often results in a fear response that many teachers will not work to overcome (Fullan, 2001; Greenberg & Baron, 2000). In addition, the push to incorporate instructional changes can be perceived as a threat to the teacher's expertise and his/her ability to engage students in meaningful learning (Fullan, 2001; Greeberg & Baron, 2000).

A school environment in which teachers perceive as "unsafe" for change can also deter efforts to embrace new instructional strategies and may actually trigger a defensive response leading to entrenchment in old and out-dated methods of

instruction (Goleman, Boyatzis, & McKee, 2002). This perception of an environment that is unsafe for change may stem from previously unsuccessful attempts to change individual or school-wide instructional practices or from a lack of resources such as equipment, curricular materials, and consumables (Anderson & Helms, 2001; Greenberg & Baron, 2000).

Similarly, lack of administrative support at the local or district level is a significant barrier to instructional change (Johnson, 2006). For example, Kincaid et. al (2007) surveyed 26 school implementing School Wide Positive Behavior Support (SWPBS) initiatives to determine what barriers to systemic instructional change existed. Their data was divided into two subgroups: schools implementing SWPBS with high degrees of fidelity and those implementing with low degrees of fidelity. The authors found that lack of system support was a barrier commonly reported by both high- and low fidelity schools and was the barrier that generated the most statements by both groups.

A recent study which included the survey of 400 teachers with follow-up interviews of 28 randomly chosen survey participants in the United Kingdom found that the major barriers to using research information in their instructional practices were lack of time to identify resources and a lack of access to resources (Williams et. al, 2007). In addition, the researchers noted that confidence in their abilities to find and understand research were also significant barriers.

Professional Development that Overcomes Barriers to Change

Research consistently shows that several objectives must be met to overcome these barriers to instructional change. First, the new strategies can not propose to radically alter the existing classroom procedures and routine, rather they must be incremental and adhere to a "reality principle" of what can be realistically changed in any given classroom (Gersten et al., 1997). In addition, the professional development event at which new strategies are introduced must incorporate hands-on, experiential learning opportunities that are embedded in authentic contexts in which teachers can thoroughly connect with the new strategies (Kinnucan-Welch et. al, 2006; Cook et. al, 2003; and Loucks-Horsley et al., 1998). These learning opportunities should include demonstrations of the new strategies and allow teachers to interact in small groups to apply, analyze, and synthesize novel instructional strategies in ways that will be meaningful to them (Kinnucan-Welch et. al, 2006; Galbo, 1998; Speck, 1996; and Dempwolf, 1993). Joyce and Showers (1988) found that, under the conditions suggested above, up to 90% of teachers will transfer the new skill or strategy into daily practice. Astor-Jack et. al (2007) found in interviews with 8 professional development providers from institutes of higher education and informal science institutions that modeling instructional strategies, providing theoretical and pedagogical background, and allowing time for teacher reflection were critical to effective professional development.

Several studies have also found that teachers need multiple opportunities to interact with the new strategies and to practice them in the context of their own

classrooms (Gess-Newson, 2001; Sindelar & Brownell, 2001; and Loucks-Horsley, 1998). In fact, the quantity of time a teacher spends in professional development of new skills and strategies is strongly correlated to their use of those skills and strategies in their regular instructional practice (Supovitz & Turner, 2000; Supovitz et al., 2000; and Cohen & Hill, 1998). For example, using survey data collected from teachers participating in the Local Systemic Change initiative Supovitz & Turner (2000) found that only after 80 hours of professional development did use of new instructional practices deviate above the norm.

Once the new instructional strategies have been learned and practiced, on-going support is essential to ensure change in the classroom behavior of a teacher (Cook et al., 2003; Boudah et al., 2001; Fuchs & Fuchs, 2001; Gersten & Dimino, 2001; Guskey, 2000; Abbot et al., 1999; and Gersten, et al., 1997). On-going support must be collaborative and provide systematic feedback (Cook et al., 2003). This feedback is critical in allowing adult learners to transfer the new skill into daily practice (Galbo, 1998; Speck, 1996). Follow-up support also permits a teacher to practice the new strategy within the authentic context of their classroom (Stichter, 2006; Goleman et. al, 2002; Depaepe et. al, 1996). Marshall et al (2001) conducted interviews with district and school level administrators and classroom teachers in 18 school districts. Their results indicated that professional development had little to no impact unless there was strong follow-up support. A plan to help teachers deal with problems that arise in initial implementations and recognize early successes is also crucial to effecting meaningful change in instructional change (Fuchs & Fuchs, 2001; Grimes & Tilly, 1996).

Effective Curricula and Instructional Strategies

Interdisciplinary Curricula

Interest in integrating the curriculum can be found as early as the writings of Herbert Spencer in the 1800s and traced through various reform movements of the 1930s and 1940s. The progressivists added their own touch to the movement for an interdisciplinary curriculum by advocating student-centered approaches to education that were integrative in nature (Vars, 1972).

As integrated curricula have become more commonplace, it general assumes one of three forms (Vars, 1991). First is a total staff approach where the entire school is focused on one theme. Teams of teachers work together to coordinate lessons and activities across disciplines as students complete an in-depth study of the theme. Schools may focus on one theme for an extended period of time or choose many themes through the course of the school year. The second form is an interdisciplinary team approach where teachers of different disciplines work together with one group of students and coordinate unit plans and projects to incorporate concepts and knowledge from each of the subject areas. Finally the third approach is a self-contained class in which one teacher teaches several subjects in an extended block of time. The degree to which the lessons are integrated is dependant upon the individual teacher (Vars, 1991).

Curriculum that is integrated provides a framework for incorporating skills and concepts from all core subject areas to produce a more meaningful understanding of a given concept and show real-life relationships between concepts. Traditional

curricula and testing emphasizes and rewards students who are "book smart." However, research in cognition and psychology clearly demonstrates a wide array of "intelligences" (Gardner, 1987). Interdisciplinary curricula allow students with strengths in non-traditional areas, such as spatial reasoning or music, to be as successful in the classroom as students who perform well in traditional instructional settings. This is more reflecting of today's workplace where a vast range of expertise and intellectual skills are necessary.

Today's workforce requires that students become life-long learners. Rapid advances in technology mean that to stay competitive and productive on the job, employees must be willing to regularly update their skills and learn new technology. Integrated and project-based curricula provide students with learning experiences that prepare them to become life-long learners and critical thinkers (Brown & Campione, 1994). Project-based curricula simulate real-life experiences and modes of thinking, thus training students to tackle problems by connecting concepts from a variety of disciplines, as they would in everyday life. "The adolescent begins to realize that in real life we encounter problems and situations, gather data from all of our resources, and generate solutions" (Jacobs, 1989). Evidence from previous studies suggests that these skills are instrumental in creating life-long learners and future employees who are able to adapt to changing work environments due to the real-life complexity presented to students in integrated curricula (Van Til, 1976).

Integrative curriculum develops higher order thinking skills and encourages motivation to learn because it is based on authentic, real-life issues that directly apply to students' daily lives (Vars, 2001; Caine & Caine, 1991). This type of curriculum is

student-centered and subject-centered, allowing students to learn as they would in the real world (Everett, 1992). Several recent studies have shown that students are highly motivated to work on authentic tasks, even when the workload is higher and traditional means of extrinsic motivation are absent. (Blumenfeld et al., 1991, Brown & Campione, 1994).

Research consistently shows that students who learn through integrated curricula perform as well, and often better than, students who learn through more traditional methods (Vars, 1996). This conclusion is supported by numerous research studies focused on psychological, sociological, and philosophical theories. For example, in their work published in 1951, Faunce and Bossing determined that students studying an integrative curriculum are more highly motivated because the curriculum is driven by their needs, problems, wants, and aspirations. Likewise, Caine & Caine asserted that students perform better in integrated curricula programs because the curriculum is more compatible with the way the brain works (Caine & Caine, 1991). In a study of 128 third grade students assigned to either a control group (literature instruction only) or an experimental group (literature and science instruction), the students in the experimental condition scored significantly higher on recall of facts and vocabulary (Morrow et al, 1995). In short, when students study the same concept through a variety of disciplines they connect what they learn to a broader range of knowledge and see a greater relevance in what they are learning (Clark, 1997; Alexander & George, 1981; Clark & Clark, 1987, 1992; George & Oldaker, 1985; & MacIver, 1990).

Evidence from various studies also suggests that there are a number of professional benefits to teachers who participate in an integrated curriculum effort. Murata (2002) conducted an action research case study on 4 teams of teachers over the course of 4 years. She found that feelings of teacher isolation are often negated due to the sense of community that is established among teachers who work together on an interdisciplinary team (Murata, 2002). Teachers who work on these teams report a greater sense of empowerment and feeling energized both professionally and personally. Students on integrated teams also report feeling more invested in their classes due to the strong sense of community established (Murata, 2002).

Critics of integrated curricula point out that this type of study often sacrifices breadth for depth. Students may learn about a few concepts in-depth, but other important concepts are glossed over or not studied at all. Additionally, many scholars argue that before true learning can occur across the curriculum, fundamentals in each separate discipline must be firmly grasped. Perhaps the biggest opposition to integrated curricula, however, is the current emphasis placed on standardized testing and accountability. Most of the proficiency tests administered are based on conventional subject areas and the pressure for students to perform well on these tests leads many to view integrated curriculum as a luxury (Vars, 2001).

Active Engagement

Over the past 20 years, definitions for intelligence and theories about how knowledge is acquired have changed dramatically (Cognition and Technology Group at Vanderbilt [CTGV], 1996). In the past, the process of learning has been viewed as

a largely passive experience in which knowledge is received from others and stored for future use. Research into the operation of the human brain has shed light on the functional process of learning however, and led to paradigms that reflect a more active model of knowledge acquisition. In this model, knowledge is constructed through interacting with the physical world, acknowledging and appreciating the social context of learning environments, and reorganizing existing mental structures (CTGV, 1996).

Theoretically, active student engagement strategies are used to encourage students to interact with new content instead of passively observing. Active interaction with the curriculum encourages students to become engaged, thus allowing for a better understanding of the material and eliciting links to previous knowledge and experience (Dewey, 1916). Active student engagement is a foundational core concept of all of the major frameworks for classroom instructional strategies designed to improve student achievement. Typically, classrooms that use active engagement have hands-on lessons that require students to use multiple learning skills and higher order thinking to construct meaning and knowledge (Jablon & Wilkinson, 2006). The teacher in this type of setting acts as a facilitator for the development and construction of knowledge (Doolittle & Camp, 1999; Becker & Maunsaiyat, 2004). By contrast, traditional methods such as lecture and memorization are passive models whereby students receive information and relay it back to the teacher during formal assessment. Despite recent shifts in theoretical paradigms, many classrooms still feature passive instructional strategies. Therefore, to improve

student achievement on a large scale, it is necessary to replace models of passive instruction with those of active student engagement.

Active student engagement strategies are rooted in cognitive learning theories such as constructivism and experiential learning. Constructivism holds that knowledge is not "out there" to be acquired; rather it must be constructed through the merging of each individual's own personal experiences with new concepts and skills (Dewey, 1916; Bruner, 1960; Piaget, 1970). Experiential learning is that which is useful and relevant to life outside of school (Rogers & Freiberg, 1994). It reflects the needs and interests of the learner because there is direct personal involvement on behalf of the student, and learning is primarily initiated and evaluated by the learner. Because the knowledge gained is relevant to the student's daily life, the learning that occurs is long lasting and has significant impact on the student (Open Learning Technology Corporation Limited, 1996). In addition, engaged learners are intrinsically curious and motivated to achieve their own learning goals as demonstrated by greater concentration, enthusiasm, and effort (Jablon & Wilkinson, 2006).

Seven of the nine instructional strategies identified as effective by Marzano (2003) promote active student engagement:

- identifying similarities and differences (effect size 1.61);
- summarizing and note taking (effect size 1.00);
- homework and practice (.77 effect size);
- nonlinguistic representations (effect size .75);
- cooperative learning (effect size .73);

- generating and testing hypotheses (effect size .61); and
- questions, cues, and advance organizers (effect size .59).

Similarly, all eight of the strategies identified by John Hattie (1992) as related to student learning are also designed to actively engage students. There is some discrepancy in the effect sizes reported by these two studies; however, this is primarily due to the scale and contextual variables of each study and not to significant variations in the impact found between the strategy and student learning (Marzano, 2003).

A third prominent voice in effective instructional strategies is Harold Wenglinsky (2002). Much of his work is a result of analysis of qualitative studies on effective instruction. In drawing a link between strong student academic performance and instructional strategies, active student engagement is a key component. He cites literature supporting the use of higher-order thinking skills, individualization, collaboration, and authentic assessment. Each of these is a strong example of a strategy that requires active engagement with content by students. Wenglinksy argues that a significant reason that schools matter is because they "provide a platform for active, as opposed to passive, teachers." He further draws this distinction by contrasting an eighth grade science lesson in which the passive teacher leaves students to perform as well as they can on the own with lessons taught at one single level of understanding versus an active teacher who presses all students to improve by presenting various levels of abstraction with methods tailored to the knowledge and skill levels of each student (Wenglinksy, 2002). Using the results of the 1996 NAEP assessment, Wenglinsky (2000, 2002) studied the link between

student academic performance and instructional strategies using active student engagement—specifically, hands-on-learning—as a key component. Wenglinsky (2000) found that "students whose teachers conducted hands-on learning activities outperformed their peers by more than 70% of a grade level in math and 40% of a grade level in science" (p. 7).

Although it has become widely accepted in the field of education that active student engagement is associated with higher achievement and greater academic performance for students, few methodologically rigorous studies examine the direct link between active student engagement and achievement. There are several likely reasons for this gap in the literature. First, researchers and education leaders have a difficult time defining active engagement. It is most easily defined by what it is not: passive learning. Also, it is easier to design rigorous research experiments that focus on discreet examples of active engagement. As a result, most studies choose to investigate the link between specific strategies (e.g., cooperative learning, discovery learning, and guided inquiry) that incorporate active student engagement instead of the overall impact of student engagement. It is important to note, however, that those studies that have investigated the link between active student engagement and achievement show there is high correlation between the two (Weiss & Pasley, 2004; Taylor, et. al, 2003; Willingham, Pollack, & Lewis 2002; Roderick & Engle 2001; Marks 2000; and Finn & Rock 1997).

Taylor, Pearson, Peterson, and Rodriguez (2003) illustrate how active student engagement is related to improving student achievement in reading. In this study, nine students were randomly selected from each of 88 different classrooms (grades 1-

5) in nine high-poverty schools, constituting a stratified random sample of classrooms. A pretest was administered to all 792 participants to establish a baseline of literacy measures for their appropriate grade level. The classrooms were periodically observed over the course of one school year and each was categorized as an active or passive learning environment, based on criteria established by the researchers. A posttest was then administered. Hierarchical linear modeling found a significant positive correlation between active learning environments and growth in reading comprehension, whereas the correlation was negative in passive learning environments. The results of the statistical analysis led the authors to conclude that active student engagement was of paramount importance to improving student achievement in reading.

Greene and Miller (1996) found positive links between meaningful engagement and the achievement of college students. This study included 108 educational psychology students. Data were gathered from the administration of a midterm examination and a motivation and strategy use survey. The results of this study were consistent with existing literature in that perceived ability and student learning goals were significantly and positively correlated to meaningful cognitive engagement. Also, the researchers found that perceived ability and student learning goals had a significant, positive relationship with student achievement. They concluded that “attempts to teach strategies that promote meaningful cognitive engagement will have a stronger impact when students have confidence in their ability to learn and a learning goal orientation.”

Few quantitative studies focused specifically on active student engagement because it is difficult to isolate the impact of active engagement from other variables affecting the classroom. This is why most studies, instead, evaluate specific microstrategies that incorporate active engagement. However, it is possible to garner an increased understanding of active student engagement through rigorous qualitative research. Qualitative research further provides important insights into how an active classroom setting energizes students and promotes investment in their learning.

One such study (Weiss & Pasley, 2004) examined, among other variables, the impact of active engagement in science and mathematics classes. Systematic stratified sampling was used to select 40 middle schools from those participating in the 2000 National Survey of Science and Mathematics Education. One feeder elementary and high school for each middle school was randomly selected to participate as well. Two mathematics and two science teachers from each participating school were randomly selected for classroom observations. Observation protocols were developed to focus on the quality of the mathematics and science content, the quality of implementation. From these ratings, coupled with data gathered through teacher interviews, the researchers analyzed the components of very ineffective lessons and very effective lessons. They concluded that effective mathematics and science instruction invited "students to interact purposefully with the content" and included "various strategies to involve students and build on their previous knowledge."

Metacognition

Metacognition is broadly defined as thinking about thinking. Perkins (1997) applies a more precise definition, the monitoring and management of one's thinking. This definition adds the concept of active assessment of one's personal thinking process. Other definitions of metacognition build upon this expanded concept and include more specific components of the skills involved with metacognitive thinking. Metacognition can be defined as gaining knowledge and control of factors that affect learning such as knowledge of self, the task at hand, and strategies to be employed (Baker & Brown, 1984; Palincsar & Brown, 1981); or the ability to predict one's performance on various tasks and monitor current levels of mastery and understanding (Bransford, et al, 2000; Brown, 1975; Flavell, 1979). The effort to define metacognition in these terms belies its central importance to the educational process. These authors are suggesting that being aware of one's self and the thinking processes one goes through while completing the tasks at hand leads to better understanding of concepts and the ability to attain and transfer new knowledge in the future.

There is a large body of research that supports the incorporation of metacognitive skills in educational settings and its positive impacts on student achievement. For several decades this concept has been a favorite among professionals in the fields of education and cognitive psychology. Academic improvement and the ability to transfer knowledge to new situations using metacognitive strategies have been found across disciplines at all grade levels with a wide range of students (Brandford, et al. 2000; White & Frederickson, 1998;

Scardamalia et al., 1984; and Schoenfeld, 1983, 1984, 1991). Studies that suggest no significant impact are those that have been conducted with either small samples sizes or in contexts that may not be generalizable to a wider population of students (Higgins, 2000; Kuyper, et al., 2000). Therefore, the general consensus among educational professionals is that teaching metacognitive skills is an effective way to improve student achievement.

Despite this level of support, teaching strategies that incorporate metacognition are not common practice in many classrooms across this country. The reason for this is primarily two-fold. First, metacognition is not an instinctive process; therefore, deliberate efforts must be made by teachers and students to call attention to it when it is occurring. Doing so can be difficult because the process often occurs as an "internal dialogue," meaning that there are not tangible verbal cues to aid in awareness (Bransford, et al. 2000; Wolf & Brush, 2000). Secondly, the most successful strategies for teaching metacognition require the complete reorganization of a student's thinking process, which involves much more than simply pointing out when metacognition is occurring (Perkins & Grotzer, 1997). This level of teacher engagement can be intimidating for educators who struggle with their own metacognitive processes and are overwhelmed with the pressures of meeting high-stakes accountability goals. Nevertheless, the apparent benefits of incorporating metacognitive strategies would be well worth the time and effort required to teach them to educators and students.

Marzano drew the conclusion, based on his meta-analysis of research on instruction, that metacognitive thinking was the primary vehicle for student learning

(Marzano, 1998). The results of his study suggested an average effect size of 0.72 for strategies that incorporate metacognition, which yields an average achievement gain of 26 percentile points. This staggering level of impact would strongly suggest that metacognition be a centerpiece of any instructional setting. Marzano identifies three specific processes necessary for teaching metacognitive skills. Understanding these processes is the key to developing instructional strategies that will help students become aware of how they think. The three processes are goal specification, process specification and monitoring, and disposition monitoring (Marzano, 1998).

Goal specification is the practice of providing students with specific learning objectives prior to the lesson. Arming students with learning objectives before the lesson begins allows them to create a road map so they can accurately monitor their own progress toward the desired educational outcomes. Process specification and monitoring involves teacher-student interaction whereby feedback is provided on the strategies students use to complete specific tasks or achieve established goals. This allows students to recognize weakness in their selection and implementation of specific strategies and make immediate adjustments to better strategies so that they do not waste time being ineffective. Disposition monitoring requires that teachers allow for an appropriate amount of wait time for students to consider a thinking plan for a given task and to engage students by overtly reminding them to activate specific thinking behaviors. This allows teachers to reinforce effecting thinking strategies that are not instinctive for students. Underscoring the importance of applying these processes and the significant impact that metacognition can have on improving

student achievement; eight of the nine instructional strategies contained in Marzano's cornerstone handbook involve some degree of metacognition (Marzano, 2003).

Cardelle-Elawar (1995) focused on the effects of metacognitive strategies on 489 low-achieving mathematics students in grades three through eight in a primarily Hispanic setting. The strength of the study design is that students in each of the grade-level classes were randomly assigned to 12 treatment groups and 6 control groups. The experimental groups received mathematics instruction based on the Mayer model, which teaches students how to apply metacognitive strategies to problem solving. The Mayer model involves teaching problem solving through self-questioning and monitoring of the processes required for solving mathematical problems (Mayer, 1985, 1987). The control groups received mathematics instruction in a more traditional format. Teachers for each experimental group received training on implementing the Mayer model and were given support throughout the treatment. Unannounced observations by the researchers, as well as follow-up interviews, were conducted to ensure internal reliability and validity. Both groups were pretested and posttested in mathematics. The results showed a statistically significant improvement in the mathematical achievement of students receiving metacognitive strategies for problem solving.

A similar study conducted in South Africa examined the effects of metacognitive strategies on the mathematics achievement and attitude of seventh-grade students. In this study, 40 low-achieving students from one school were randomly assigned to an experimental or a control group. Both groups were given pretests to determine levels of metacognitive awareness and attitudes toward

mathematics. Students in the experimental group learned metacognitive approaches to solving mathematics problems, while those in the control group were taught using traditional methods. For example, on individual written assignments, students in the control group had their work assessed by the teacher and returned without further comments. By contrast, students in the experimental group had their assignments assessed and errors identified. These students were then interviewed by the researcher to determine their thought processes while solving the problem and were then given specific strategies to help correct their mistakes. Posttest scores revealed that the mathematics achievement of the experimental group was significantly higher than that of the control group. Experimental group students also scored higher on tests of general ability, metacognitive awareness, and attitude toward mathematics (Maqsud, 1998).

A strong example of the type of rigorous research that can be conducted and provide conclusive results was performed recently in Israel (Mevarech & Kramarki, 2003). The strength of this design was that 122 eighth grade students were randomly assigned to mathematics classrooms and those intact classes randomly assigned to treatment and control groups. The treatment groups receiving metacognitive strategies performed better than those in the control groups. In fact, a follow-up posttest one year after the study was completed demonstrated that students in the treatment group continued to perform higher on achievement tests than those in the control group. Other experimentally designed studies involving metacognition report very similar results (Bangert-Drownes, et al, 2004; Chiang, 1998; Haller, et al., 1988; Oladunni, 1998; Glaubman *et.* al, 1997; and McInerney, et. al, 1997).

Research into the impact of metacognition strongly suggests that the effects are persistent regardless of student age, achievement level, nationality, or ethnicity. These skills are transferable to other learning situations and are retained over a long period of time (Mevarech & Kramarki, 2003; Cardelle-Elawar,1995; Maqsud, 1998; Oladunni, 1998; and Glaubman *et. al*, 1997). Therefore, metacognitive skills should be a standard component of classroom instruction.

RAFT as an Example of Active Engagement and Metacognition

One specific instructional strategy that incorporates both active student engagement and metacognition is RAFT (Role, Audience, Format, Topic). This strategy requires students to synthesize new content knowledge into a product which demonstrates a deep and meaningful understanding of the new concepts in a non-traditional format (Santa, 1988), allows students to connect prior knowledge to new knowledge, and encourages students to write in a creative format that still provides sufficient structure (Goenke & Puckett, 2006). Teachers introduce students to new content knowledge then provide them with a specific, and often non-traditional, role to assume. Students are then given a specific audience for which to write, a particular format in which to write, and a topic on which to focus their products. While RAFTS were initially developed as a literacy and writing tool, they have been adapted to other disciplines (Buehl, 2001; Daniels & Zimelman, 2004; and Topping & McManus, 2002). This strategy is only recently gaining recognition as a powerful

technique that “deserves a place in any science classroom” (Groenke & Puckett, 2006).

Measuring Fidelity of Implementation for Educational Interventions

When studying the effectiveness of training to teachers to use novel instructional strategies, such as the RAFT, it is important to consider how closely aligned teacher implementation of the strategy is with the original design of the strategy. Fidelity of implementation is the degree to which a program is implemented as intended by the program designers (Dusenbury, et. al.,2004). Accurately measuring fidelity is important to establishing the validity of research conducted on program effectiveness and helps determine whether or not a pilot test was a true measure of the programs performance in real-world conditions (Sanchez, et. al., 2007; Dumas, et. al., 2001; and Owen, 2000). The assumption is that high degrees of implementation fidelity are desirable, while lower degrees of fidelity may reduce the effectiveness of a given program or intervention (Chen, 2005). Chen (2005) also addresses the issue of “diffusion” and “reinvention.” He argues that some modification from the original intent of the program designers is necessary to ensure long-term change because programs have to fit into the real-world application, therefore, some degree of lower fidelity may be desirable. However, deviating too far for the original design is likely to dilute the program’s effectiveness (Chen, 2005).

Summary

There still exists a significant gap between research based effective instructional practices and practical classroom application of these strategies. To overcome this gap, researchers must be mindful of barriers to instructional change. Several significant barriers to change are identified as habit, fear of change, and a lack of an environment supportive of change. As indicated in the literature, to overcome these barriers professional development training should include opportunities for authentic, experiential learning that provides opportunities for sustained practice in a supportive, collaborative environment. This includes providing teachers with opportunities to understand the theory of new strategies, see the strategies modeled, practice the new strategy, and have on-site instructional support with initial implementations of the strategy.

The literature also suggests that adopting effective instructional strategies, such as interdisciplinary curricula and strategies that incorporate active engagement of students and teach metacognition, will lead to greater gains in student achievement. However, a review of the literature failed to reveal the ideal design of professional development that will allow teachers to adopt new strategies and regularly apply them in their classroom instruction (Astor-Jack et al, 2007). The present study seeks to further explore a model professional development design based on several theories to overcome instructional barriers.

Chapter Three
Methodology

Introduction

This study employed mixed methods within an instrumental case study framework. Robert Stake (2000) defines this type of case study as "examined mainly to provide insight into an issue or to redraw a generalization" (p. 437). The purposes of this study were to: (1) investigate how teachers apply new knowledge, attitudes, or behaviors and adopt them as a regular part of their instructional process; (2) identify barriers to instructional change; and (3) examine the impact of a research-based professional development model on teachers' use of a novel instructional strategy. As such, an exploratory case study provided the most appropriate methodology. The research questions which guided this study were:

1. To what extent do teachers apply a specific instructional strategy taught in the professional development workshops (the RAFT strategy) in the context of the model food safety curriculum?

2. To what extent do teachers apply the RAFT instructional strategy in contexts outside of the model food safety curriculum?

3. What intrinsic and extrinsic motivation factors affected teachers' adoption of the RAFT instructional strategy outside of the model food safety curriculum?

4. What is the relationship between teachers' fidelity of implementing the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum and student assessment outcomes?

5. What are the barriers to effecting change in teachers' use of the RAFT instructional strategy?

Design of the Study

The study participants were selected in March 2006. For each of the participants in this study, the RAFT strategy was novel. Only two of the teachers had previously heard of the strategy, but none of the teachers had ever received training in it, nor had any attempted to use the strategy in their classroom. Between May and August 2006, each participant received training in the theory and application of the Role, Audience, Format, Topic (RAFT) strategy through a hands-on professional development workshop. During the workshop the theory behind the RAFT strategy was explained and the classroom application of the strategy was modeled.

The teachers were asked to implement the RAFT strategy as part of the classroom implementation of the *Food Safety in the Classroom* unit in the fall semester of the 2006-2007 school year. The researcher was on-site for each of these implementations to conduct observations and to provide support and guidance when necessary. Each teacher's students were pre-tested immediately prior to the beginning of the unit, post-tested immediately after the unit. The study teachers participated in a semi-structured interview 6-8 months after the implementation of the RAFT in the *Food Safety in the Classroom* curriculum to determine what role the strategy has played in his/her classroom instructional practice since the implementation and to identify barriers to use of the new strategy.

The teachers' classroom student assessment data used to triangulate results from interviews for this project were collected from the students in the study participants' 7th grade science classrooms. Participation required signed parental

consent and student assent forms, also approved by UT IRB. Since classroom students were already assigned to each teacher, randomized selection was not possible. A flow chart of the overall study design with specific tasks is contained in Figure 1.

Context of the Study

The present study was embedded in a larger research project funded by the USDA's National Integrated Food Safety Initiative (Award Number: TEN2005-02098). *Food Safety in the Classroom* evaluated the effectiveness of an integrated food safety curriculum written for seventh grade students in Tennessee and North Carolina. The curriculum is an interdisciplinary food safety unit for seventh grade students that is correlated with state standards for math, science, social studies, and language arts in Tennessee and North Carolina. The instructional unit is designed to take approximately 6-8 class periods of instruction and occurs in all four core subject areas simultaneously. The RAFT instructional strategy investigated in the present study was part of the science component of the *Food Safety in the Classroom* unit. Execution of the RAFT strategy, as designed, takes approximately one class period.

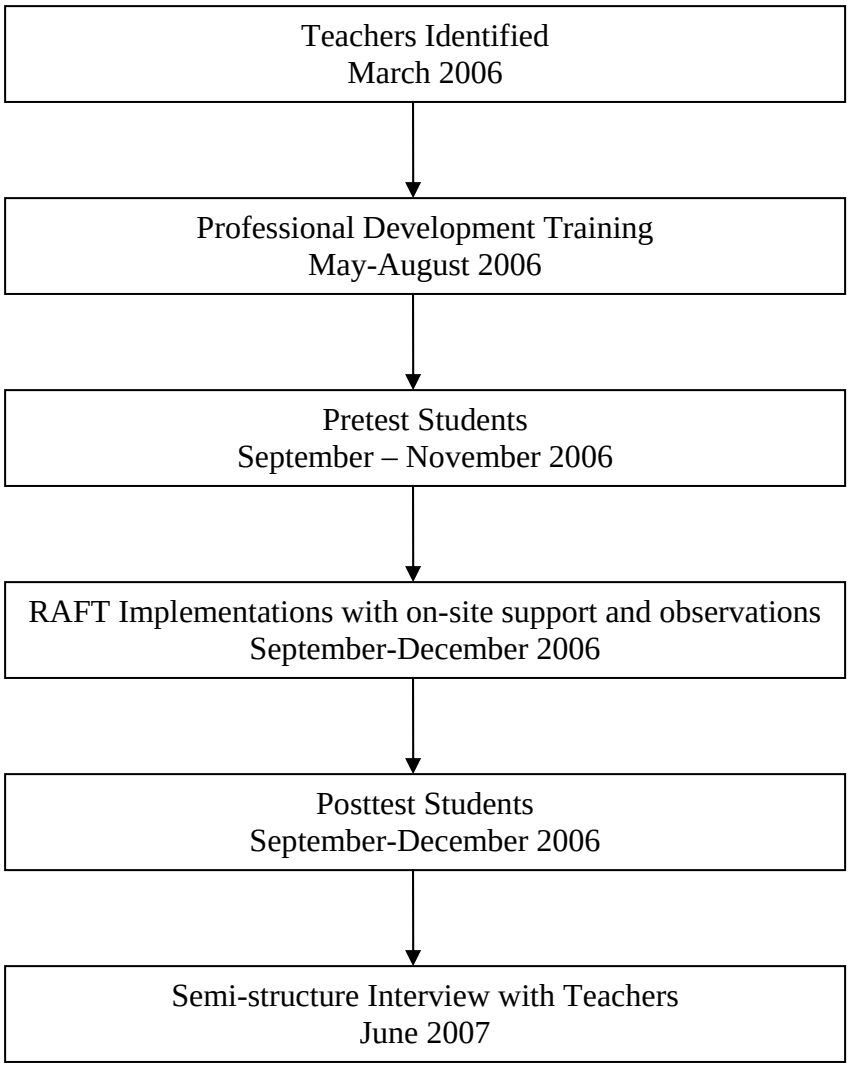

Figure 1 is a flow chart that shows the design of the study and the time at which each task was conducted.

Participants

The participants in the present study were volunteers recruited from the population of teacher participants in the pilot test of the larger USDA National Integrated Food Safety project because they matched the selection criteria of teaching seventh grade science. Each of the six teachers signed informed consent letters approved by the University of Tennessee's Internal Review Board (UT IRB) for research involving human subjects.

The population of teachers from the USDA project selected for inclusion in this study consisted of two males and four females from five schools. These teachers varied in experience as measured by years of teaching (0-1 years: 1; 2-5 years: 1; 6-10 years: 2, and >10 years: 2). Collectively, they represented two suburban schools, two rural schools, and one urban school. Of these schools, three were performing at or above state standards in math and four were performing at or above the state standards in reading. Three of the schools had greater than 50% of students classified as "economically disadvantaged" (See Table 1).

Delivery of Professional Development

The professional development training received by each of the participants of in the present study was conducted as part of the larger USDA project and was designed to reflect current literature on effective teacher professional development.

Table 1 shows the sex, years of experience in teaching, school location, percentage of students performing at or above state standards for math and reading, and the % of students who are considered economically disadvantage as determined by their Free and Reduced Lunch status for each of the teachers in this study.

Teacher	Sex	Years Experience	School Location	Math*	Reading*	Economically Disadvantaged Students
1	M	6-10	Urban	95.8%	92.8%	54.5%
2	F	>10	Rural	94.5%	100%	76.3%
3	F	>10	Rural	100%	92.3%	77.7%
4	F	0-1	Suburban	54%	83%	38.6%
5	F	6-10	Suburban	48.3%	80.6%	37.4%
6	M	2-5	Suburban	48.3%	80.6%	37.4%

Each teacher received training at his/her own school to allow teachers to be in their own classrooms and to promote a feeling of familiarity and comfort. This design also allowed for small groups for each training event (group sizes ranged from 2-8 teachers). In addition, the delivery method of the workshop was a combination of modeling of the RAFT, hands-on participation in activities, and a seminar style discussion. The tone of the workshops was informal and teachers were encouraged to ask questions and discuss ideas with their teammates. This method of delivery was designed to allow teachers an opportunity to apply, analyze, synthesize, and evaluate the new content knowledge, as well as, novel instructional strategies (Galbo, 1998).

Each training event took approximately two days and occurred over the summer of 2006. There was a set agenda designed to move efficiently through the food safety curriculum covering new content material and instructional strategies in

depth and to ensure consistency in training. Teachers were compensated at a rate of $100 per day for their participation in these workshops.

In summary, the professional development model employed in this study included:

1. Small group training held on-site at each school
2. Delivery of instructional theory behind RAFT strategy
3. Teacher Hands-on participation in completing RAFT activities
4. Seminar style discussion of the strategy, ways to implement it, and possible classroom roadblocks
5. Informal discussions with the research to determine teachers' level of comfort and address concerns or implementation issues
6. Providing adequate supplies of materials necessary to implement the RAFT
7. On-site instructional support during the initial implementation of the RAFT strategy

Instruments and Data Collection

Three instruments were used to collect data for this study: an observation protocol, a semi-structure interview, and a student assessment (See Table 2). This section describes each of these instruments in detail.

Table 2 shows the instruments designed to collect the data to answer each research question.

Research Question	Instrument for Data Collection
Research Question 1: To what extent do teachers apply a specific instructional strategy taught in the professional development workshops (the RAFT strategy) in the context of the model food safety curriculum?	Observations Semi-structured Interview
Research Question 2: To what extent do teachers apply the RAFT instructional strategy in contexts outside of the model food safety curriculum?	Semi-structured Interview
Research Question 3: What intrinsic and extrinsic motivation factors affected teachers' adoption of the RAFT instructional strategy outside of the model food safety curriculum?	Semi-structure Interview
Research Question 4: What is the relationship between teachers' fidelity of implementing the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum and student assessment outcomes?	Semi-structure Interview Student Assessments
Research Question 5: What are the barriers to effecting change in teachers' use of the RAFT instructional strategy?	Semi-structured Interview

Instruments and Data Collection

Observations

The present study draws upon observational data collected in the larger USDA project based upon an observation protocol developed by project staff based on existing models of observational protocols (See Appendix D). A separate protocol was developed for each component of the *Food Safety in the Classroom* curriculum (math, science, social studies, and language arts). The present study used data from the science observations only. For the science observation, each activity included in the week-long unit was divided into individual steps (i.e. introduction, student directions, execution of various steps, conclusion, and debriefing). Using this protocol, the researcher checked "yes" or "no" to indicate whether the teacher completed each step of the activity. In addition, the researcher made note of how lessons and activities were introduced, conducted, and concluded and reflected on the teacher's apparent comfort level with instructional strategies and teaching techniques. Any teacher modification of activities was recorded, as well as, significant teacher or student comments. The start and stop time of each activity was also documented. The observational data for the larger USDA project were analyzed by the calculating a fidelity of implementation score to indicate how closely the teacher followed the protocol for implementing the lessons and activities in the *Food Safety in the Classroom* curriculum. Each activity within the science component was allotted a maximum of 5 possible points. Points were awarded based on the ration of "yes" to "no" checks given by the observers. Comments recorded by the observer were also

taken into account. In some situations the "letter" of the activity was followed (i.e. teacher followed all prescribed steps) but the "spirit" was not (i.e. teacher did not facilitate discussion of critical or higher order thinking questions). Points were deducted from activities where this was the case. Points were also deducted if the activity was performed out of sequence. The points awarded were divided by the total possible points to produce a total percentage for the science component. Fidelity scores were calculated by the researcher of the present study and an independent rater. The two raters had a greater than 80% inter-rater reliability and discrepancies in their scoring were resolved to determine a final fidelity of implementation score.

Only the fidelity scores given to the RAFT activity are discussed in the present study. Analysis of these observations and the resulting fidelity of implementation scores support an understanding of how teachers internalized new content and instructional strategies in their classrooms. As such, the data resulting from the observations of the six participating teachers in the present study was used to answer **Research Question #1** (See Table 2).

Student Assessments:

Student assessment data analyzed for the present study was collected as part of the larger USDA project from an instrument designed to measure food safety knowledge and content specific science knowledge (See Appendix E). Questions for the assessment were written based on the learning outcomes established for the *Food Safety in the Classroom* curriculum. These learning outcomes were developed by the curriculum designer, as well as food safety and microbiology experts, including the

Food Safety Task Force of Tennessee and the University of Tennessee's Food Safety Center of Excellence. This instrument was then evaluated by an external evaluation team, as well as, an independent testing expert.

The instrument was field tested for reliability and validity by a group of seventh grade students at a non-pilot test school prior to its use in this study. The first administration of the field tests took place on Friday, August 18, 2006 and the second administration was conducted on Monday, August 28, 2006. There were no significant differences ($p<.05$) between the responses of two administrations of the field test. A Chronbach alpha was completed to ensure reliability ($\alpha=.874$). Through item analysis, several test items were flagged as having ambiguous or misleading language. These questions were reworded.

Students in the larger USDA project were administered the student assessment one to three days prior to the execution of the curriculum and then immediately after the implementation. The assessment was divided into five components: science, language arts, math, social studies, and behaviors. Student assessment data were scored by the UT Institute of Evaluation and Assessment, itemized by student and question. Each component of the assessment was sub-totaled and then added together to achieve a total score. Individual student assessment scores were considered outliers and removed from the data set under the following conditions: the entire assessment was not finished, or observations were offline giving too few or too many answers on the answer form.

Only the science component sub-totals from the student assessment data were used in the present study. This data was used to answer **Research Question #4** by

providing validation to teachers' perceptions of how the strategy may have impacted student learning outcomes.

Semi-structured Interviews

A semi-structured interview protocol was developed by the researcher specifically for this study. The questions included were guided by the research questions for the study. The protocol was evaluated by an independent expert in interviewing for quality of question construction and bias. Each study teacher was interviewed using the semi-structured protocol to determine how the teachers apply new knowledge, attitudes, and behaviors and adopt them as a regular part of the instructional process. Specifically, the interview focused on the acquisition and implementation of a novel instructional strategy: the RAFT strategy. Each interview took between 15 and 30 minutes to complete. The interview questions were:

1. Describe your experience using the RAFT strategy in the context of the Food Safety (FS) in the Classroom curriculum.

2. What impact did your training last summer have on your ability to implement the RAFT strategy during the FS curriculum?

3. How did on-site support and observations impact your ability to implement the RAFT strategy during the FS curriculum?

4. To what extent have you used the RAFT strategy in a context outside the FS curriculum? Describe your experience with the strategy.

5. If you have not used RAFT, explain why you've chosen not to use the strategy.

6. Do you feel you need more training in implementing the RAFT strategy effectively?

7. Have you noticed changes in student learning outcomes as a result of the RAFT strategy (either in the context of the FS curriculum or outside the context)?

8. Have there been improvements in any of the following since you began using the raft strategy?

- Student learning and/or achievement

- Student engagement in the classroom

9. If yes, what evidence of these improvements do you have?

10. What persuades you to use a new instructional strategy?

Interview questions #1, was designed to answer research question 1**.** Research question 2 was addressed through interview questions #4, 5, and 6. Interview questions # 7, 8, and 9 address research question 4 and interview questions #2, 3, and 10 addresses research questions 3 and 5 (See Table 3).

Analysis of Data

Data collected from the three instruments used in this study were analyzed in terms of the study questions. Specific analysis techniques for each instrument are described in this section.

Observations

Only the fidelity of implementation scores for the RAFT activity were used from the observational data collected for the larger USDA project. This data was

Table 3 shows which interview questions were used to gather data for each research question.

Research Question	Semi-structured Interview Questions
Research Question 1: To what extent do teachers apply a specific instructional strategy taught in the professional development workshops (the RAFT strategy) in the context of the model food safety curriculum?	1. Describe your experience using the RAFT strategy in the context of the Food Safety in the Classroom curriculum.
Research Question 2: To what extent do teachers apply the RAFT instructional strategy in contexts outside of the model food safety curriculum?	4. To what extent have you used the RAFT strategy in a context outside the FS curriculum? Describe your experience with the strategy. 5. If you have not used RAFT, explain why you've chosen not to use the strategy. 6. Do you feel you need more training in implementing the RAFT strategy effectively?
Research Question 3: What intrinsic and extrinsic motivation factors affected teachers' adoption of the RAFT instructional strategy outside of the model food safety curriculum?	2. What impact did your training last summer have on your ability to implement the RAFT strategy during the FS curriculum? 3. How did on-site support and observations impact your ability to implement the RAFT strategy during the FS curriculum? 10. What persuades you to use a new instructional strategy?
Research Question 4: What is the relationship between teachers' fidelity of implementing the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum and student assessment outcomes?	7. Have you noticed changes in student learning outcomes as a result of the RAFT strategy (either in the context of the FS curriculum or outside the context)? 8. Have there been improvements in any of the following since you began using the raft strategy? - Student learning and/or achievement - Student engagement in the classroom 9. If yes, what evidence of these improvements do you have?
Research Question 5: What are the barriers to effecting change in teachers' use of the RAFT instructional strategy?	2. What impact did your training last summer have on your ability to implement the RAFT strategy during the FS curriculum? 3. How did on-site support and observations impact your ability to implement the RAFT strategy during the FS curriculum?

used as a reference of how closely the teachers following the RAFT protocol when comparing effect sizes for the RAFT and total student knowledge gain. It allowed the researcher to identify and explain trends in the data in terms of how effectively participating teachers used the RAFT strategy in their classrooms and the possible impact the strategy had on student knowledge gain.

Student Assessments

Student assessment data for the present study were analyzed by determining the total gain in student knowledge on the 10 assessment items for the science component by calculating the difference between student pre and post test scores. Using SPSS 15.0, paired sample t-tests were calculated to determine if the difference between pre and post test scores for each teacher were significant. The pre and post test means and standard deviations were also used to calculate effect size for each teacher. The total gains and effect sizes were then compared with the RAFT fidelity of implementation scores given to each teacher to determine what relationship, if any, existed between fidelity and gains in student knowledge.

Semi-Structured Interviews

Teachers' responses to the semi-structured interview questions were analyzed in terms of the study questions and themes identified. The categorization of data into themes permitted synthesis of teacher responses to provide a more holistic view of how the study teachers employed the RAFT strategy both in and out of the context of

the *Food Safety in the Classroom* curriculum. In addition, teacher responses provided a rich description of experiences using the RAFT strategy in their classrooms, as well as barriers they faced, and how those barriers were addressed and overcome. Teacher responses were triangulated with fidelity scores and student assessment outcomes to verify teachers' perceived experiences.

Chapter Four
Results

Introduction

The purpose of this research was to investigate the data regarding how teachers apply new knowledge, attitudes, or behaviors and adopt them as a regular part of their instructional process and to identify barriers to instructional change. Data were collected from semi-structured interviews with the six participating teachers, from fidelity scores reflecting observations conducted while teachers implemented the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum, and from student assessment outcomes within pre-, post, and follow-up timeframes. This chapter discusses the results of the study and is organized by research questions. Each question will be addressed individually with data sources and results detailed.

Research Question 1

To what extent do teachers apply a specific instructional strategy taught in the professional development workshops (the RAFT strategy) in the context of the model food safety curriculum?

Implementation Fidelity

The data to answer this question resulted from the fidelity of implementation scores calculated from the observations recorded during teachers' implementations of the *Food Safety in the Classroom* curriculum and responses from the semi-structured

teacher interview. Among the six study participants, implementation of the RAFT strategy occurred along a spectrum, ranging from one teacher who closely followed the letter and spirit of the activity to another teacher who did not use the activity within the model food safety curriculum at all (See Table 4). The others fell somewhere in between these two extremes. On a scale of 1-5, teachers averaged an implementation fidelity score of 3.58. Overall, the teachers applied the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum effectively. The teachers who used the strategy reported that they found the RAFT to be easy to implement and effective at engaging their students in higher levels of thinking while promoting cooperative team work among students.

Teacher 1 received a total of 5 points (out of 5 possible) for fidelity of implementation of the RAFT strategy. This teacher implemented the strategy in the proscribed sequence of the curriculum, which was designed to be used after a PowerPoint presentation on bacteria so that it would allow students an opportunity to apply and synthesize new knowledge. During implementation, teacher 1 thoroughly described the activity and gave clear and concise directions. Students were allowed to choose their own groups of three to four and then each group selected a product to create. No two groups were allowed to choose the same product, however. The teacher provided students with examples of products and circulated among students to answer questions and prompt them, when necessary. Teacher 1 also provided students with ample time and supplies to complete the project in class and then asked that they take home the product for any final polishing and editing. The next day,

Table 4 shows teachers' fidelity of implementation score and significant teacher quotes relating to major themes in response to the semi-structured interview question, "Describe your experience using the RAFT strategy in the context of the Food Safety in the Classroom curriculum."

Teacher	Fidelity Score*	Ease of Implementation	Meaningful Engagement	Response of Students
1	5	It went well; kids enjoyed it and learned from it.	They were able to relay or give information they had learned and they came up with unique projects.	The kids said they enjoyed, they laughed and cut up with it, and they were comfortable with it overall.
2	4	It was easy to implement.	They had to use knowledge from the class to do project.	Even with my lower level class, a couple of cheerleaders did the rap song and loved it! It allowed them to get into it more.
3	0	I did not use it.	———	———
4	4.5	It was a good activity, but because of time constraints we weren't able to spend as much time on it as we should have.	———	The students enjoyed it.
5	4	———	They had to think more about details and they gained a new perspective.	They responded to it well.
6	4	It was a well designed break from lab work..	In the context of doing different things, it was something they could take and turn around and reemphasize by presentation.	Students liked it a lot.

* 5=high implementation fidelity, 0=no implementation fidelity.

students were asked to present their final products. The teacher established a safe, comfortable environment in which students were excited to make their presentations.

Teacher 2 received a total of 4 points for fidelity of implementing the RAFT strategy. One fidelity point was deducted because, even though the teacher implemented the strategy at the proscribed time in the curriculum, she assigned students to complete the products a week later. The teacher altered the activity in this manner because she felt her students would need the longer period of time to complete high-quality products. This is a significant deviation from the protocol of the strategy because the activity was designed, in part, to immediately reinforce student learning of new concepts and allow them a mechanism to transfer new knowledge to long-term retention. By allowing students a full week to complete and present their products, the immediate reinforcement of knowledge was lost. Beyond this variation, however, the teacher implemented the activity as it was designed. Some class time was allotted to allow groups to work together. Students worked in pairs and selected their own products. All students selected either the most wanted poster or the rap song. The teacher provided students with all necessary materials and supplies and was available to answer student questions.

Teacher 3 did not implement the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum, and therefore received a fidelity score of 0 for the activity. The decision not to use the RAFT was a joint one between the teacher and researcher. Teacher 3's students had gotten very deeply interested in a laboratory exercise that preceded the RAFT and spent approximately 40 minutes discussing their ideas, hypotheses, and alternative experiments that would test other variables. Both

the research and the teacher felt that the higher order and critical thinking skills required to participate in these discussions were too valuable to cut short. As a result, there was not sufficient time to complete the RAFT activity.

Teacher 4 received a total of 4.5 points for the fidelity of implementation score on the RAFT strategy. Teacher 4 followed both the letter and spirit of the activity and completed it in the appropriate sequence; however insufficient time was allotted to allow all student groups to complete the presentation of their products to the class. Students were allowed to choose their own groups and their products. Again, most groups chose either the most wanted poster or the rap song with every product completed by at least one group. Sufficient time and materials were provided to students and the teacher was available to answer questions and provide suggestions to students who needed extra help. The students began the activity in one class period and then made their presentations the following day.

Teacher 5 received a total of 4 points for fidelity of implementation on the RAFT strategy. One point was deducted because the activity was completed out of sequence. The teacher used the RAFT as a review activity at the end of the lesson instead of as an application and synthesis activity in the middle of the lesson. With the exception of sequencing, however, the teacher used the strategy as prescribed. Students were allowed to choose their own groups of three or four and then select their own products. Students chose a variety of products, with the rap song and most wanted poster being the most popular choices. The teacher was available to address student questions and concerns and provided students with ample materials and time

to complete their products. Students began working on their products at the beginning of the class and presented them at the end of class.

Teacher 6 received 4 points for fidelity of implementation of the RAFT strategy. One point was deducted because, while the teacher introduced the activity and allowed students class time to work on their products at the appropriate point in the lesson, he did not require students to complete and present their products until several days later. The teacher randomly assigned students to groups of three or four and then allowed each group to choose their own products. All of the groups chose either the rap song or the most wanted poster, with the exception of one group who chose the autobiographical poem. The teacher provided students with all the necessary materials and supplies and was available during the class time allotted to answer questions. Some students complained of having to try to get together outside of class to complete their products.

Teacher Semi-structured Interviews

In the semi-structure interview, each teacher was asked questions related to his/her experience using the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum. Several prominent themes emerged from their responses. Of the five teachers who used the strategy, all commented that they felt their students learned from the activity. When asked what they meant by "learned," they responded that the RAFT "helped [students] remember the information better," it required them to "relay new information in a unique way," and it made students consider the new knowledge from a "new perspective." Along the same lines, four of the teachers

discussed how the structure of the RAFT strategy required their students to engage new concepts on a deeper level. As one teacher stated, that students "had to use their knowledge from the [lesson] to complete the product [and] had to think about bacteria in a new way, think more about the details and gain a new perspective." One teacher reflected on the ability of the strategy to force students to synthesize, as opposed to simply regurgitate, new information. He reported that the products were something "they could take, turn around, and reemphasize by presentation."

The importance of presenting student products to the class was another common theme resulting from the teacher responses. One teacher commented that "presentation skills are necessary and students don't get many opportunities. This gave them a chance to present and they like it a lot." While making the presentations was time consuming (one teacher did not have enough time to allow all of the groups to present), the teachers felt that student presentations helped make the activity enjoyable. One teacher reported that her students "enjoyed performing for the other students."

The teachers reported that the strategy was successful in their classrooms in the context of the *Food Safety in the Classroom* curriculum because it was easy to implement, allowed students to focus on personal learning styles, and was fun (See Table 1). Each of the teachers who used the RAFT strategy in the context of *Food Safety in the Classroom* felt that the implementation went well in their classes. They expressed that it was "easy to implement" and that it provided a "well designed break from lab work." Each of these teachers also mentioned the ability of students to

choose their own products based on personal interests and learning styles as being important to the success of the activity.

When asked to describe their experience using the RAFT in the context of the *Food Safety in the Curriculum*, each of the teachers who used the strategy commented that it was an activity that their students enjoyed. The teachers reported that the students had fun working in groups to create their products and that this was an activity the kids could "really get into." In addition, several of the teachers remarked that the design of the activity (allowing students to work in small groups and be creative) created an atmosphere where students felt comfortable presenting their work to the rest of the class and that this level of comfort contributed greatly to the effectiveness of the strategy. One teacher said, "The kids said they enjoyed it, they laughed and cut up with it, and they were comfortable with [the RAFT] overall." Another teacher commented, "I think [the RAFT] zeros in on what they were comfortable with."

In the semi-structured interview, teachers were also asked what impact their professional development training had on their ability to implement the RAFT strategy. All of the teachers responded that the RAFT strategy was new to them and that the training gave them an opportunity to learn how to implement it. Several commented that the hands-on nature of the professional development gave them an opportunity to "experience it and understand what [it] was like" and helped them "reteach it later because I had done it myself." One teacher said, "Because I knew, it went more smoothly and I could explain exactly what they would be doing." Two of the teachers reported using the products that the teachers created in their training as

examples for students to follow; “I showed our examples from the training to the class and that let them see what I expected from them.” Because the professional development modeled the implementation of the RAFT strategy and allowed teachers to participate in a hands-on manner, the teachers reported feeling greater levels of comfort when implementing the strategy on their own.

As a means of providing on-going support and follow-up, the researcher observed each of the participating teachers when they implemented the RAFT strategy during the *Food Safety in the Classroom* curriculum implementation. In the semi-structured interview, teachers were asked what impact the on-site support had on their implementation of the strategy. Four of the five who implemented the strategy reported that the researcher’s presence had a positive impact on their ability to effectively use the strategy. They also reported that having the researcher there to answer questions and help problem solve improved their use of the strategy. One teacher said, “If you hadn’t been here to answer my questions, I don’t feel like I would have felt as comfortable. It’s like you were my reference and then I could help students go more in-depth with the content.” Another commented, “I was nervous because it was new to me and you were here to provide reinforcement to me. I would still have used the RAFT even if you had not been here to observe, but I may not have been as comfortable.” Only one teacher felt that having on-site support during their implementation of the RAFT strategy was not necessary. She said, “I don’t think having [the researcher] around was crucial at that point. It went fairly well on its own. It was not quite as hands-on and didn’t need as much support.”

Research Question 2

To what extent do teachers apply the RAFT instructional strategy in contexts outside of the model food safety curriculum?

While the majority of study participants implemented the RAFT strategy effectively in the context of the *Food Safety in the Classroom* curriculum implementation, it was important to know what role, if any, the strategy had played in their classroom practices since the implementation. The hypothesis was that subsequent use of the RAFT in the context of other, teacher-designed units would indicate a propensity to add the strategy to their regular instructional repertoire.

Responses from the semi-structured teacher interview comprise the data for research question two. Teachers were asked if they had used the RAFT strategy in a context outside of the *Food Safety in the Classroom* curriculum implementation. If they had, they were asked to describe their experience with it. If they had not, they were asked why they had chosen not to use the strategy again.

At the time of the semi-structured interviews, five of the six teachers had used the RAFT strategy again in some context outside of the *Food Safety in the Classroom* curriculum (See Table 5). All six stated their intent to use the strategy in other units the following school year with two of them giving specific details on how they planned to use the strategy in the future. When asked why they would continue to use the strategy in the future, the most common responses were ease of implementation, enjoyment of the kids, and effectiveness in allowing students to apply and synthesize information.

Table 5 shows teacher fidelity scores and whether each teacher had used the RAFT strategy outside the context of the Food Safety in the Classroom curriculum.

Teacher	Fidelity Score	RAFT use since FSIC
1	5	No
2	4	Yes
3	0	Yes
4	4.5	Yes
5	4	Yes
6	4	Yes

Teacher 1 had not used the strategy again; however, he was making plans to include the strategy in a weather unit the next school year. When asked why he had chosen not to use the strategy he replied, "I kind of just followed the same curriculum I've been teaching the last few years. It's not that it is something I wouldn't use, I've just been using comfortable stuff." The teacher also reported that he liked the strategy and was looking forward to using it the following school year.

Teacher 2 had used the RAFT strategy again in the context of a diversity unit with her 8th grade students. In this unit she had students use their newly acquired knowledge to create either a poster or a song that communicated specific messages to their audiences. The teacher commented that her students enjoyed the RAFT and that she felt very comfortable using the strategy again.

In the context of the *Food Safety in the Classroom* curriculum, teacher 3 did not use the RAFT strategy. However, at the time of the interview, she had used a modified version of the strategy in the context of another unit. Students were

completing an environmental unit in which there was a heavy focus on genetic engineering. The teacher assigned groups of students to different roles and required them to observe and analyze information from the perspective of their roles. For example, students were to assume the roles of scientists, consumers, or parents. Then they completed research on genetic engineering and presented their findings from the view point of their assigned roles. The teacher felt this was an effective way to approach the controversial topic because, "it allowed students to consider the pros, cons, benefits, and harm of genetic engineering" from multiple perspectives.

Teacher 4 had also used the RAFT strategy again. She incorporated it into a unit on the dangers of smoking. Students were assigned to one of four groups: A lung with emphysema writing a suicide letter to the person to whom it belonged; a child with chronic bronchitis, allergies, and asthma writing a letter of complaint to their parents asking them to stop smoking; an ashtray writing an eviction notice to a cigarette butt in a hospital waiting room; and the surgeon general writing a brochure to convince people to stop smoking. The teacher reported that the activity was easy to implement in this context and that the student enjoyed the opportunity to approach the topic of smoking from different perspectives.

Teacher 5 had used the basic concept of the RAFT strategy again in a unit on the human body which focused on the heart and circulatory system. Students were asked to assume the role of fat found in food and to explain how they coated and affected arteries. Even though the teacher modified they strategy by providing students with only one option, it still required students to assume an alternate

perspective and creatively communication new knowledge and concepts to their audience.

Teacher 6 also used the strategy in a unit on the human body; however his RAFT focused on the digestive system. As with teacher 5, he designed the activity to include only one role and product option for students. Students were to assume the role of food passing through the digestive system and write postcard to the teacher describing their journey through various parts of the digestive system. The teacher reported that the activity was so well received by his students that the teacher had already developed other RAFT options to include in the unit the following school year. The new options included: advertisers writing a jingle for cardiologist to explain how the number of heartbeats per minute increases with exercise and dieticians creating a poster to explain the importance of nutrition and picking the right foods. The teacher also said that he is planning to create another RAFT to use in a unit on weather next year.

Research literature on professional development suggests that the quality of professional development training has a significant impact on the ability of teachers to overcome instructional barriers to change (Johnson, 2006; Fullan, 2001; Greenberg & Baron, 2000). As such, it was important to address the study participants' perception of the training their received on the RAFT strategy. Four of the six teachers felt that the training they had received on implementing the RAFT strategy was sufficient to allow them to feel comfortable using the strategy in their classroom. The other two teachers felt they would benefit from more training. One of these said that he understood how to implement the strategy and was comfortable using it in his

classroom, but was "more or less a nuts and bolts type of person. I need someone to say, 'That's way too straight forward, it will bore the students to tears. Let's come up with some wild and zany roles or audiences.'" The other teacher who indicated that she would benefit from more training said, "I don't think I've perfected it to the point of being the best. I could always improve and understand different ways to incorporate the strategy."

The researcher hypothesized that one informal way of assessing true adoption of a new instructional strategy would be to determine whether the teacher has shared or discussed the strategy with other teachers. When asked if they had shared the RAFT strategy with other teachers, only one study participant indicated that she had. Two commented that they had discussed the strategy with other teachers, but that those teachers were already familiar with the strategy. The other three teachers had not discussed or shared the activity.

Research Question 3

What intrinsic and extrinsic motivation factors affected teachers' adoption of the RAFT instructional strategy outside of the model food safety curriculum?

Data for research question 3 resulted from teachers' responses to the semi-structured interview. Teachers were asked to explain what encouraged them to use a new instructional strategy in their classrooms. For ease of analysis, their responses were categorized as either intrinsic or extrinsic motivational factors (See Tables 6 and 7). Intrinsic motivation is that which comes from within; the desire to engage in an

Table 6 shows teacher Quotes Supporting Intrinsic Motivation Factors Affecting Adoption of New Instructional Strategies.

Teacher	Comfort Level	Improve Student Learning	Desire to Try New Things
1	If I'm comfortable presenting it to the kids, I'll use it. If I don't feel comfortable, then I'll find another way to get the information across.		Other teachers' success with a strategy also persuades me to use it.
2		If I try a strategy and I feel like it helped them remember information longer, I'll keep it. If not, I'll scrap it and do something else.	
3		My decisions on which new strategies to use are based on knowing my students and the way they think and trying to develop teaching strategies that cause them to think more critically or outside the box.	I like to try new things. By trying new things you find out what works and what doesn't.
4	I guess I'd say ease of use.	Whether or not I think it fits in with what we cover in class.	
5			Seeing that it got me excited and I learned from it….firsthand experience.
6		If I can see this is a good strategy or have them do the things they like to do and it is curriculum oriented , then I'll lean in that direction.	

Table 7 shows teacher Quotes Supporting Extrinsic Motivational Factors Affecting Adoption of New Instructional Strategies.

Teacher	Successful Use	Positive Response from Students	Time and Resources Required
1	Other teachers' success with a strategy also persuades me to use it.		
2		How the kids respond to it. Different strategies work well with different kids, so it depends on kids.	
3		I feel like these students need new and different ways to view thing and absorb information because traditional methods don't seem to be as effective.	
4			Whether its hands on or not and how much extra support you need. If it requires a lot of extra stuff I may not be in as big a hurry to try it.
5	Either seeing it work before in a class or experiencing it myself.		
6	Basically I'm a results oriented person. If you can see that this will work and especially when you implement it, then I'll keep doing it.	Seeing students having fun pushes you closer to saying, "Yeah, I'll use this."	

activity for its own sake (APA, 2007). By contrast, extrinsic motivation is the "desire or push to perform a certain behavior based on the potential external rewards that may be received as a result" (AllPsych, 2007). The motivational factors, both intrinsic and extrinsic, cited by the teachers of this study are supported by findings of others' research as reported in current literature on the topic (Chaney, 2004; Yamagata-Lynch & Haudenschild, 2006).

One major theme arising from intrinsic motivational factors to use a new instructional strategy was that teachers want to provide students with refined instructional strategies that improve student learning. Several teachers commented that different strategies work well with different kids and that they were constantly on the look out for strategies that would appeal to "their kids." One teacher said, "My decisions on which new strategies to use are based on knowing my students and the way they think and trying to develop teaching strategies that cause them to think more critically or outside the box." Additionally, teachers reported that if the strategy was successful at engaging students and allowing them an opportunity to enjoy what they were learning; then students were more likely to demonstrate increased learning. One teacher reported, "I bet that those students who made up the song to the tune of 'Frosty the Snowman' will remember the information better. It helps students retain information and connect to prior learning." Similarly, another teacher commented, "They had fun so, I know that it tied together all the information for them."

A second common intrinsic motivational factor was the teacher's personal level of comfort with that strategy. Included in this theme of comfort are the issues of ease of implementation and the relationship of the strategy to the teacher's own

personal styles of learning and teaching. Strategies that are easy to incorporate into the teacher's own established style of teaching appear more likely to be incorporated into the regular classroom routine. One teacher commented, "If I'm comfortable presenting it to the kids, I'll use it. If I don't feel comfortable then I'll find another way to get the information across."

The final intrinsic motivational factor that emerged from teachers' interview responses was the teacher's desire to try out new things in his/her classroom that he/she personally found exciting and interesting. Several teachers communicated that they did not want to be bored in the classroom while teaching and trying out new instructional strategies provided the variety necessary to maintain their energy and interest levels. "I like to try new things," commented one teacher. Recent literature on teachers' motivational factors supports these findings (Chaney, 2004; Yamagata-Lynch & Haudenschild, 2006).

One commonly identified extrinsic motivational factor to adopting a new instructional strategy cited by teachers in this study was the successful use of the strategy by the teacher or others. Seeing a highly effective strategy implemented motivated teachers to try it out in their classrooms. All six teachers responded that the opportunity to see a strategy "work" would persuade them to use it. One teacher said, "I like to see it actually working in a classroom. Seeing students learning and having fun pushes you closer to saying, 'Yeah, I'll use this.'"

A second extrinsic motivational factor to implementing a new instructional strategy reported by teachers was a positive response from the students. This type of positive response varied from teacher to teacher. One teacher focused on how likely

the strategy was to help students learn and retain information; “If I try a strategy and I feel like it helped [the students] remember information longer, I’ll keep it. If not, I’ll scrap it and do something else.” While another teacher felt that students enjoying the activity while meeting curricular standards was important; “If I can see this is a good strategy [that] has them doing things they like to do and it is curriculum oriented, then I’ll lean in that direction.” On the whole, the teachers in this study felt that the ability of a strategy to engage students, thus eliciting a positive response, was an important extrinsic motivational factor.

A third extrinsic motivational factor that influence the use of a new instructional strategy to emerge from the interview data included the amount of time and other resources required to implement the strategy. One teacher said that she considers “whether it is hands-on or not and how much extra support you need. If [the strategy] requires a lot of extra stuff I may not be in as big a hurry to try it.” With the extra emphasis on accountability and state mandated testing, teachers also considered how closely the strategy was aligned with the state mandated curriculum. As an illustration, when one teacher was asked what persuaded her to use a new instructional strategy, she responded that it depended on “whether or not I think it fits in with what we cover in class.” The existing literature on teachers’ motivation to use new instructional strategies is supported by the findings of this study (Chaney, 2004; Yamagata-Lynch & Haudenschild, 2006).

Research Question 4

What is the relationship between teachers' fidelity of implementing the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum and student assessment outcomes?

The data for research question four results from student assessments given immediately before (pretest) and after (posttest) the implementation of the *Food Safety in the Classroom* curriculum, fidelity of implementation scores derived from classroom observations conducted by the researcher as the teachers taught RAFT strategy, and from teacher responses to the semi-structured interview (See Chapter 3 for methods).

There was a strong relationship between teachers' use of the RAFT strategy and student learning outcomes. At the time of the semi-structured interview, teachers were not aware of their students' assessment outcomes. Therefore, their responses regarding any changes they had noticed in student learning outcomes were based on teachers' perceptions only. When asked if they had noticed changes in student learning outcomes as a result of the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum or in other contexts five of the six participating teachers reported that they did perceived positive changes as a result of the RAFT. Two reported this was specifically because the students had fun with the activity. As one teacher said, "Most of the time when students are doing something that is work but that is fun and they can socialize working with other kids, they are learning."

Another teacher focused on the ability of the RAFT to allow students to acquire a "broader perspective of the situation rather than being isolated to one

particular viewpoint or set of information" as the key to long term retention of information. In addition, another teacher said that the strategy allowed her students to retain information better by allowing them an opportunity to "connect to prior learning" and make connections that ensured retention and transfer of new knowledge. Only one of the participants in this study who implemented the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum did not notice positive changes in student learning outcomes as a result of the RAFT strategy. She responded that she "couldn't tell that [the RAFT] made more of a difference than anything else."

Teachers' perceptions of increased student learning with the RAFT strategy were supported by quantitative data. The total student knowledge gain was statistically significant for all teachers who used the RAFT in the context of the *Food Safety in the Classroom* curriculum. The students of teacher 3, who did not use the RAFT in the model curriculum, did not demonstrate a significant gain in knowledge. Also, in classrooms where the fidelity of implementation of the RAFT strategy was high, the average student knowledge gains were greater (See Table 8). Effect sizes were also greater with higher levels of implementation fidelity. While teacher 3 represents in terms of fidelity of implementation score and number of students, it is interesting to note, that she had the lowest student knowledge gain, as well as, smallest effect size. The quantitative data from this study seems to suggest a trend between high fidelity of implementation of the RAFT strategy and greater positive impact on student knowledge gain.

Table 8 shows the total student knowledge gain (with significance noted), teacher fidelity of implementation, the effect size of the RAFT's impact on student knowledge gain, and the total number of students per teacher.

Teacher	Total Gain[a, b]	Fidelity	Effect Size	n (students)
1	2.71*	5	0.7581	76
2	1.93*	4	0.5093	29
3	1.6	0	0.4245	10
4	3.19*	4.5	0.7494	50
5	2.29*	4	0.6415	28
6	2.08*	4	0.4888	59

[a]Total gain was determined by calculating the difference in students' pre and post assessments
[b]A total of 10 points were possible
* denotes statistical significance

Research Question 5

What are the barriers to effecting change in teachers' use of the RAFT instructional strategy?

Data for research question 5 results from responses to the semi-structured interview as well as from observations of RAFT implementation during the *Food Safety in the Classroom* curriculum. These data suggest that the amount of time required to implement the RAFT strategy and teachers' level of comfort with the new strategy are the two largest barriers to effecting change in teachers' use of the RAFT strategy. These findings are supported by the current literature on barriers to instructional change in the classroom (See Summary in Chapter 2).

The RAFT instructional strategy can be a time consuming one. Providing thorough instructions and explanations of each role, audience, topic, and format, allowing students adequate time to construct their products, and then providing each

group an opportunity to present their product to the class generally takes at least one class period and often two. In this study the issue of time was a factor. One teacher chose not to use the strategy at all to provide more time for students to devote to hands-on lab activities. Another teacher used the strategy, but did not have enough time to allow students to present their products to the class. In this class, students simply handed their products into the teacher at the end of the class period. Two of the teachers addressed concerns about the length of time required to implement the RAFT strategy by having students complete their products as homework and present the next class period. The remaining two teachers reported that the intrinsic value of the activity was worth the time required to devote two full class periods to the activity.

Teachers' comfort level with the new strategy was another common barrier to implementing the RAFT strategy. For all six participants, the RAFT strategy was completely novel in that they had never used the strategy or received training on it prior to this study. As such, there was anxiety about using a strategy that operating in cooperative learning groups and required students to demonstrate a significant level of creativity in applying and synthesizing new knowledge. Several teachers were concerned about adjusting to the role of "facilitator" in this activity as opposed to the more comfortable role as "transmitter or knowledge."

In this study the barriers of time required to implement and level of comfort with the RAFT strategy were largely overcome through extensive, hands-on training and the presence of the researcher in the teachers' classrooms during their first attempt to use the strategy. All of the teachers reported that the training they received

on implementing the RAFT strategy as a part of the *Food Safety in the Classroom* professional development prepared them to use the strategy in their classrooms and addressed their areas of concern so as to allow them to feel comfortable with the strategy. In fact, one teacher who used the strategy in the context of the *Food Safety in the Classroom* curriculum confided that "If I hadn't had the training, I wouldn't have done it. The training was hands-on; you took us through the activity step-by-step. By taking us through it, that helped me reteach it later because I had done it myself." Another commented, "It was good that I experienced it because then I could relate to where the students might be and I knew how to explain what I wanted from them." The training also helped teachers prepare to address time factor issues within their classrooms. As one teacher commented, "You can plan, but if you haven't done it you don't know exactly how it will go. Because I knew, it went more smoothly."

In addition, the researcher's presence in the classroom while the teachers implemented the RAFT strategy for the first time also helped combat the barrier of level of comfort. The teachers felt that having a resource in the room who could address questions and concerns while helping trouble-shoot allowed them to feel more comfortable with the novel strategy. One teacher said, "If I perceive myself as going in the wrong direction or for clarity purposes, then you being here gives me more confidence." Another commented, "In case we forgot or were hazy, you being here gave us a chance to clarify."

There were barriers to implementing the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum, such as comfort level with the strategy and the time required to implement it effectively. There is some evidence that open

dialogue between the researcher and the participants and effective professional development that included theory, modeling, and on-site support allowed the teachers in this study to overcome these barriers and implement the strategy successfully.

Chapter Five
Conclusions, Discussion, Implications, and Recommendations

Introduction

It is puzzling that many classrooms continue to be teacher centered and reliant on passive learning strategies (Marks, 2000; McDermott, Mordell, & Stolzfus, 2001; Yair, 2000; and Goodlad, 2004) when there are many highly effective, research proven instructional strategies, such as RAFT, that incorporate active student engagement and metacognitive practices. One explanation for this "research to practice gap" (Carnine, 1995) is the lack of effective professional development. The purposes of this study were to: (1) investigate how teachers apply new knowledge, attitudes, or behaviors and adopt them as a regular part of their instructional process; (2) identify barriers to instructional change; and (3) examine the impact of a research-based professional development model on teachers' use of a novel instructional strategy. This chapter will address conclusions for each research question, provide some discussion of those conclusions, and make recommendations for future research.

Conclusions

Research Question 1: To what extent do teachers apply a specific instructional strategy taught in the professional development workshops (the RAFT strategy) in the context of the model food safety curriculum?

Conclusion – Most of the teachers in this study effectively implemented the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum.

Research Question 2: To what extent do teachers apply the RAFT instructional strategy in contexts outside of the model food safety curriculum?

Conclusion – Most teachers in this study had successfully implemented the RAFT strategy again in contexts outside of the model food safety curriculum.

Conclusion – Teachers in this study who modified their implementation of the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum used the strategy again outside of the model curriculum.

Research Question 3: What intrinsic and extrinsic motivation factors affected teachers' adoption of the RAFT instructional strategy outside of the model food safety curriculum?

Conclusion – Intrinsic motivational factors affecting the adoption of the RAFT strategy by teachers in this study were consistent with research literature and included: 1) teacher comfort level; 2) desire to improve student learning; and 3) desire to improve teaching techniques.

Conclusion – Extrinsic motivational factors affecting the adoption of the RAFT strategy by teachers in this study were consistent with research literature and

included: 1) successful use by other teachers; 2) positive response from students; and 3) time and resources required for implementation.

Research Question 4: What is the relationship between teachers' fidelity of implementing the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum and student assessment outcomes?

Conclusion – Results from this study seem to indicate that there is a strong relationship between high fidelity of implementation of the RAFT strategy and greater gains in student knowledge as measured by student assessment outcomes.

Research Question 5: What are the barriers to affecting change in teachers' use of the RAFT instructional strategy?

Conclusion – The two primary barriers to affecting changes in teachers' use of the RAFT instructional strategy cited by teachers of this study were: 1) the teachers' level of comfort, and 2) the amount of class time require to implement.

Discussion and Implications

Setting the Stage for Change

The design of this study closely followed recommendations of previous research to create an environment conducive to teacher instructional change (Astor-Jack et al., 2007; Kinnucan-Welch et. al, 2006; Guskey, 2000; Galbo, 1998). Participants in this study were trained in the educational theory of the RAFT strategy,

the researcher modeled the strategy, and on-site support was given as teachers implemented the RAFT for the first time. The purpose of this approach was to minimize potential barriers to change and maximize the possibility of teachers using the strategy again in other contexts. The results from this study suggest that this professional development model tended to be effective. Five of the six participants successfully implemented the strategy in the context of the *Food Safety in the Classroom* curriculum and five had also used the strategy again in other contexts.

This approach was likely successful because it allowed the teachers to see the RAFT strategy implemented successfully in their training. Many of the participants cited this as a necessary component to adopting new instructional strategies. As active participants in creating RAFT products of their own, teachers were able to see first-hand how successful the strategy could be in allowing students to apply and synthesize new knowledge. This first-hand experience also allowed teachers to develop a sense of comfort with the strategy. By first understanding the theory and then assuming the role of their students while the researcher executed the RAFT in the workshop, the teachers were able to envision implementation in their classrooms, thus anticipating possible roadblocks and considering ways to adapt the strategy to their personal teaching styles. As such, teachers became comfortable with the strategy and recognized RAFT as a successful strategy worthy of their instructional time.

Embracing Change

A significant finding of this study was that teachers who modified their implementation of the RAFT strategy in the context of the *Food Safety in the Classroom* curriculum implementation used the strategy again outside of the model curriculum. One explanation is the level of comfort teachers felt with the strategy. Having the confidence to modify the RAFT to meet their instructional needs and the learning needs, styles, and preferences of their student suggests an inherent level of comfort with RAFT. This is consistent with Chen's (2005) assertion that some reinvention of a program or strategy may be necessary to sustain long-term changes.

Teachers in this study cited ease of use as one of the primary reasons they perceived that the implementation of the RAFT went well and as justification for continuing to use the strategy. In addition, when asked what factors go into selecting new strategies, personal level of comfort with the strategy was a common response. Previous research, as well as results from this study, indicates that elevated levels of comfort with a strategy are critical to adopting that strategy as a regular part of classroom instruction (Gess-Newson, 2001; Sindelar & Brownell, 2001; Supovitz & Turner, 2000; Supovitz et al., 2000; Cohen & Hill, 1998; and Loucks-Horsley, 1998). Therefore, there is evidence that significant efforts to allow the teacher to develop a strong sense of comfort with novel instructional strategies are necessary.

While the results of this study depicted a strong relationship between implementation fidelity and increased gains in student knowledge, it is also important to recognize that regardless of how effective a strategy may be, a teacher will not use it if they are uncomfortable with the strategy. For example, teacher 1 was the only

teacher to receive a fidelity score of 5 points (the highest score possible). He implemented the strategy precisely as it was modeled and did not deviate from the written instructions. He was also the only teacher who had not used the strategy again in other contexts. Each of the other teachers incorporated a variety of modifications to the strategy ranging from omitting it completely to assigning the products as homework. Thus, increased implementation fidelity does not necessarily translate into continued use of the strategy.

Overcoming Barriers

The two primary barriers that teachers cited as preventing them from using a new instructional strategy were: 1) the teachers' level of comfort, and 2) evidence that the strategy was worthy of their instructional time based on factors such as improved student learning and positive student response to the strategy. As such, it was interesting to note that teachers who had used the RAFT strategy again in contexts outside of the *Food Safety in the Classroom* curriculum described their initial implementation experiences with the RAFT in terms of the ease of implementation, the enjoyment of their students, and increasing student learning. Because their initial experiences with RAFT served to disarm barriers to instructional change they identified as being crucial, the teachers were empowered to implement the strategy again in other contexts.

Previous literature has shown that unless barriers to instructional change are planned for and overcome; teachers will not adopt new instructional strategies (Johnson, 2006; Fullan, 2001; Greenberg & Baron, 2000). The results of this study

support prior research by demonstrating that when teachers were presented with a novel strategy, given the opportunity to participate in the execution of those strategies, and provided with on-going support to trouble-shoot potential roadblocks they were able to overcome barriers to instructional change and adopt new strategies effectively.

Implications

The results of this study support previous research on effective professional development models. It appears that teachers will not adopt new instructional strategies unless professional development provides them with the tools and experiences necessary to overcome barriers to instructional change. Teachers in this study indicated a need to understand the educational theory behind new strategies, see the strategy modeled for them, be provided with opportunities to discuss the strategy as it relates to their classrooms and current instructional practices, and have on-site support when implementing the strategy on their own. This approach allowed the teachers in this study to see the successful implementation of novel strategies and develop a deeper level of comfort to be empowered to modify the strategy to suit their instructional needs as well as the needs and learning styles of their students. Designers of professional developments shouls also make efforts to demonstrate the impact of novel strategies on student learning outcomes.

Recommendations for Future Research

This study was a small, exploratory case-study, therefore limiting generalizations of findings to larger populations. Efforts to replicate this research in the future could benefit from the following recommendations.

1. Future research should include larger populations in more diverse settings educational settings, as well as, different content areas.

It would be interesting to test whether the relationship between modification of the strategy at the time of the initial implementation and use of the strategy in other contexts holds when studied with larger populations. For example, in this study, the participants who modified the activity in the initial implementation were more likely to use the strategy again in other context. It remains unclear whether this is a trend that would appear across a larger population, or simply a phenomenon localized to the study participants. In addition, further research should explore whether this phenomenon is applicable to other instructional strategies.

2. Further examination of the professional development model proposed in this study design is warranted.

To accomplish this, a more rigorous experimental research design should be implemented which includes multiple treatment groups with a variety of professional

development models. One possible example of this type of design would be a treatment group which receives the professional development model explored in this study versus a control group which receives a traditional "one-shot" model. If the treatment group in this designed exhibited the same types of results as in the present study, it would make a stronger case for adopted the model employed within this study.

3. Future studies on the effectiveness of the RAFT strategy at raising student content knowledge should use study designs that measure the impact of this strategy in isolation, rather than as part of a larger, interdisciplinary instructional unit.

In addition, the student assessment scores may have been confounded by the interdisciplinary nature of the *Food Safety in the Classroom* curriculum. This study draws a relationship between fidelity of implementation of the RAFT strategy and total gains in student knowledge as measured by pre- and post- tests of science knowledge. However, it is possible that these scores were influenced by lessons and activities in other subject areas and were not a true reflection of the impact of the RAFT strategy. Also, to draw a true correlation between the two factors, a much larger sample size is needed to ensure the validity of the statistical analysis.

4. An experimental design should be developed to further test the impact of fidelity of implementation on gains in student knowledge.

The results of this study seem to indicate that higher degrees of implementation fidelity result in greater student gains in knowledge. However, the design of this experiment did not provide for control and treatment groups. Future research should consider treatment groups in which fidelity of implementation occurs along a scale from high to low to determine what impact, if any, fidelity has on student knowledge gain.

LIST OF REFERENCES

Abbott, M., Walton, C., Tapia, Y., & Greenwood, C. R. (1999). Research to practice: A "blueprint" for closing the gap in local schools. *Exceptional Children*, 65, 339-352.

Alexander, W., & George, P. (1981). *The Exemplary Middle School*. New York: Holt, Reinhart and Winston.

Anderson, R.D**.,** & Helms, J.V. (2001). The ideal of standards and the reality of schools: Needed research. *Journal of Research in Science Teaching, 38(1),* 3-16.

Baker, L., & Brown, A. L. (1984). Metacognitive skills and reading. In P. D. Pearson, R. Barr, M. L. Kamil, & P. Mosenthal (Eds.), *The Handbook of Reading Research* (pp. 353-394). New York: Longman.

Baker, S., & Smith, S. (1999). Starting off on the right foot: The influence of four principles of professional development in improving literacy instruction in two kindergarten programs. *Learning Disabilities Research and Practice, 14*, 239-253.

Bangert-Drownes, R. L., Hurley, M. M., & Wilkinson, B. (2004). The effects of school-based writing-to-learn interventions on academic achievement: A meta-analysis. *Review of Educational Research*, *7(1)* 29-58.

Blumenfeld, P., Soloway, E., Marx, R., Krajcik, J., Guzdial, M., & Palincsar, A. (1991) Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist*, *26 (3 & 4)*, 369-398.

Bondy, E. & Brownell, M. T. (Winter 2004). Getting beyond the research to practice gap***:*** researching against the grain. *Teacher Education and Special Education 27(1)*, 47-56.

Bos, C. S., Mather, N., Narr, R. E, & Babur, N. (1999). Interactive, collaborative professional development in early literacy instruction: Supporting the balancing act. *Learning Disabilities Research and Practice, 14*, 227-238.

Boudah, D.J., Logan, K.R., & Greenwood, C.R. (2001). The research to practice projects: Lessons learned about changing teacher practice. *Teacher Education and Special Education, 24,* 290-303.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school* (expanded ed.). Washington, DC: National Academy Press.

Brown, A. L. (1975). The development of memory: Knowing, knowing about knowing, and knowing how to know. In H. W. Reese (Ed.), *Advances in child development and behavior* (Vol. 10, pp. 103-152). New York: Academic Press.

Brown, A. L., & Campione, J. C. (1994). Guided discovery in a community of learners. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and classroom practice* (pp. 229-272). Cambridge, MA: MIT Press.

Bruner, J. (1960). *The process of education.* Cambridge, MA: Harvard University Press.

Buehl, D. (2001). *Classroom strategies for interactive learning*. Newark, DE: International Reading Association.

Caine, R. N., & Caine, G. (1991). *Making Connections: Teaching and the human brain*. Alexandria, VA: Association for Supervision and Curriculum Development.

Calabrese, R. L. (2002). *The leadership assignment: Creating change.* Boston: Allyn & Bacon.

Cardelle-Elawar, M. (1995). Effects of metacognitive instruction on low achievers in mathematics problems. *Teaching and Teacher Education, 11(1),* 81-95.

Carnine, D. (1997). Bridging the research-to-practice gap. *Exceptional Children, 63,* 513-521.

Carnine, D. (1995). Trustworthiness, useability, and accessibility of educational research. *Journal of Behavioral Education, 5(3),* 251-258.

Chafouleas, S. M., & Riley-Tillman, T. C. (2005, May). Accepting the gap: An introduction to the special issue on bridging research and practice. *Psychology in the Schools 42(5),* 455-591.

Chaney, S. (2004). Six best and worst incentives for professional development. *The Delta Kappa Gamma Bulletin* 70(2), 10-14.

Chen, H. T. (2005). *Practical program evaluation: Assessing and improving planning, implementation, and effectiveness*. Thousand Oaks, CA. Sage Publications.

Chiang, L. H. (1998). *Enhancing metacognitive skills through learning contracts.* Paper presented at the annual meeting of the Mid-Western Educational Research Association, Chicago, IL.

Clark, S. (1997) Exploring the Possibilities of Interdisciplinary Teaming. *Childhood Education, 73(5),* 267-272.

Clark, S., & Clark, D. (1992). The pontoon transitional design: A missing link in research on interdisciplinary teaming. *Research in Middle Level Education, 15(2),* 57-81.

Clark, S., & Clark, D. (1987, October). Interdisciplinary teaming programs: Organization, rationale, and implementation. *Schools in the middle: A report on trends and practices.* Reston, VA: National Association of Secondary School Principals.

Cochran-Smith, M., & Lytle, S. (1999). Relationships of knowledge and practice: Teacher learning in communities. In A. Iran-Nejar and PD. Pearson (Eds.), *Review of Research in Education (24)* (pp. 249-305). Washington, DC: American Educational Research Association.

Cognition and Technology Group at Vanderbilt (CTGV). (1996). Looking at technology in context: A framework for understanding technology and education research. In D. C. Berliner & R. C. Calfee (Eds.), *The handbook of educational psychology* (pp. 807-840). New York: Macmillan.

Cohen, D.K., & Hill, H.C. (1998). *State policy and classroom performance: Mathematics reform in California.* Washington, DC: Consortium for Policy Research in Education.

Cook, B. G., Landrum, T. J., Tankersley, M., Kauffman, J. M. (2003, November). Bringing research to bear on practice: Effecting evidence-based instruction for students with emotional or behavioral disorders. *Education and Treatment of Children, 26(4),* 345-61.

Daniels, H., and Zemelman,S.. (2004). *Subjects matter: Every teacher's guide to content-area reading*. New York: Heinemann.

Dempwolf, D. H. (1993). The utilization of principles of adult learning in California staff development programs. Doctoral dissertation, University of La Verne.

DePaepe, P.A., Shores, R. E., Jack, S. L. & Denny, R.K. (1996). Effects of task difficulty on disruptive and on-task behavior of students with severe behavior disorders. *Behavioral Disorders, 21,* 216-225.

Denzin, N.K. & Lincoln, Y.S. (Eds.) (2000). *Handbook of qualitative research.* 2nd edition. Thousand Oaks, CA: Sage. p. 822-825.

Dewey, J. (1916) *Democracy and education.* New York: MacMillan.

Duffy, F M. (2002). *Step-up-to-excellence: An innovative approach to managing and rewarding performance in school systems.* Lanham, MD: Scarecrow.

Dusenbury, L., Brannigan, R., Falco, M., & Lake, A. (2004). An exploration of fidelity of implementation in drug abuse prevention among five professional groups. *Journal of Alcohol and Drug Education, 47*(3), 4-19.

Englert, C.S., & Tarrant, KL. (1995). Creating collaborative cultures for educational change. *Remedial and Special Education, 16,* 325-336.

Everett, M. (1992). Developmental Interdisciplinary Schools for the 21st Century. *The Education Digest, 57*, 57-59.

extrinsic (n.d.). Retrieved Februrary 16, 2007 from website: allpsych.com/dictionary/dictionary2.html.

Faunce, R. C., & Bossing, N. L. (1951). *Developing the core curriculum*. Englewood-Cliffs, NJ: Prentice-Hall.

Finn, J.D., & D.A. Rock. (1997). Academic success among students at risk for school failure. *Journal of Applied Psychology, 82 (2),* 221–34.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34*(10), 906-911.

Fuchs, D., & Fuchs, L.S. (2001). One blueprint for bridging the gap: Project Promise: (Practitioners and researchers orchestrating model innovations to strengthen education). *Teacher Education and Special Education, 24,* 304-314.

Fullan, M. (2001). *Leading in a culture of change.* San Francisco: Jossey-Bass.

Galbo, C. (1998). Helping adults learn. *Thrust for Educational Leadership,* 27(7),13-15.

Gardner, Howard (1987). "The Theory of Multiple Intelligences" *Annals of Dyslexia, 37,* 19-35.

George, P., & Oldaker, L. (1985). *Evidence for Middle School*. Columbus, OH: National Middle School Association.

Gess-Newsome, J., et. al. (2003). Educational reform, personal practical theories, and dissatisfaction: The anatomy of change in college science teaching. *American Educational Research Journal* 40(3) p. 731-67.

Gess-Newsome, J. (2001). The professional development of science teachers for science education reform: A review of the research. In. J. R Rhoton & P. Bowers(Eds.), *Professional development planning and design.* (pp. 9 1-100), Arlington, VA: NSTA Press.

Gersten, R., & Dimino, J. (2001). Realities of translating research into classroom practice. *Learning Disabilities Research &Practice, 16,*120-130.

Gersten, R., Vaughn, S., Deshler, D., & Schiller, E. (1997). What we know about using research findings: Implications for improving special education practice. *Journal of Learning Disabilities, 30,* 466-476.

Gersten, R., & Woodward, J. P. (1990). Rethinking the regular education initiative: Focus on the classroom teacher. *Remedial and Special Education, 11,* 7-16.

Glaubman, R., Glaubman, H., & Ofir, L. (1997). Effects of self-directed learning, story comprehension, and self-questioning in kindergarten. *The Journal of Educational Research, 90*(6), 361-374.

Goleman, D., Boyatzis, R., & McKee, A. (2002). *Primal leadership: Realizing the power of emotional intelligence.* Boston: Harvard Business School Publishing.

Goodlad, J.I. (2004). *A place called school: Prospects for the future*. 20th anniversary ed. New York: McGraw-Hill.

Greenberg, J., & Baron, R. A. (2000). *Behavior in organizations* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Greenwood, C. R. (2001). Bridging the gap between research and practice in special education: Issues and implications for teacher preparation [Special issue]. *Teacher Education and Special Education, 24(4),* 273-275.

Grimes J. & Tilly, D.J. (1996). Policy and process: Means to lasting educational change. *School Psychology Review, 25(4),* 465-476.

Groenke, S. L., & Puckett, R. (2006, November). Becoming environmentally literate citizens. *The Science Teacher, 73(11),* 22-27.

Guskey, T. R. (2000). *Evaluating professional development*. Thousand Oaks, CA: Corwin Press.

Haller, E. P., Child, D. A., & Walberg, H. J. (1988). Can comprehension be taught: A quantitative synthesis of "metacognitive" studies. *Educational Researcher, 17*(9), 5-8.

Hattie, J. A. (1992). Measuring the effects of schooling. *Australian Journal of Education*, *36*(1), 5-13.

Heifetz, R. A., & Linsky, M. (2002). *Leadership on the line: Staying alive through the dangers of leading.* Boston: Harvard Business School Press.

Higgins, B. A. (2000). *An analysis of the effects of integrated instruction of metacognitive and study skills upon the self-efficacy and achievement of male and female students.* Unpublished master's thesis, Miami University, Oxford, OH.

Huberman, A.M., & Miles, M.B. (1984). *Innovation up close: How school improvement works*. New York: Plenum Press.

intrinsic. (n.d.). *WordNet® 3.0*. Retrieved September 12, 2007, from Dictionary.com website: http://dictionary.reference.com/browse/intrinsic.

Jablon, J.R. & Wilkinson, M. (2006), "Using Engagement Strategies to Facilitate Children's Learning and Success. [Electronic Version] *Young Children: Beyond the Journal, March 2006.*

Jacobs, H.H. (1989). The growing need for interdisciplinary curriculum content. In *Interdisciplinary Curriculum: Design and Implementation*, Association for Supervision and Curriculum Development, Alexandria, VA., 1989.

Johnson, C. C. (2006, March). Effective professional development and change in practice: Barriers science teachers encounter and implications for reform. *School Science and Mathematics, 106(3),* 150-61.

Joyce, B. and Showers, B. (1988). *Student Achievement through Staff Development*. White Plains, NY: Longman Press.

Kauffman, J. M. (1996). Research to practice issues. *Behavioral Disorders, 22,* 55-60.

Kinnucan-Welch, K., Rosemary, C., & Grogan, P. (2006, February). Accountability by design in uteracy professional development. *The Reading Teacher 59(5),* 426-435.

Komblet, A. (1997). Response to bridging the research-to-practice gap. *Exceptional Children,63,* 523-524.

Kuyper, H., van der Werf, M. P. C., & Lubbers, M. J. (2000). Motivation, meta-cognition, and self-regulation as predictors of long-term educational attainment. *Educational Research and Evaluation 6*(3), 181-205.

Loucks-Horsley, S., Hewson, P., Love, N., & Stiles, K. (1998) *Designing professional development for teachers of mathematics and science.* Thousand Oaks, CA: Corwin Press.

MacIver, D. (1990). Meeting the needs of young adolescents: Advisory groups, interdisciplinary teaching teams, and school transition programs. *Phi Delta Kappan, 71(6),* 458-464.

Maqsud, M. (1998). Effects of metacognitive instruction on mathematics achievement and attitude towards mathematics of low mathematics achievers. *Educational Research, 40*(2), 237-243.

Marks, H.M., (2000). Student engagement in instructional activity: Patterns in the elementary, middle and high school years. *American Educational Research Journal 37 (1),* 153–84.

Marzano, R. J. (2003). *What works in schools: Translating research into action.* Alexandria, VA: Association for Supervision and Curriculum Development.

Marzano, R. J. (1998). *A theory-based meta-analysis of research on instruction*. Aurora, CO: Mid-Continental Regional Educational Laboratory.

McCutchen, D. & Berninger, V. (1999). Those who know, teach well: Helping teachers master literacy-related subject-matter knowledge. *Learning Disabilities Research and Practice, 14,* 215-226.

McDermott, P. A., Mordell, M., & Stoltzfus, J. C. (2001). The organization of student performance in American schools: Discipline, motivation, verbal, learning, nonverbal learning. *Journal of Educational Psychology,* 93, 65-76.

McInerney, V., McInerney, D. M., & Marsh, H. W. (1997). Effects of metacognitive strategy training within a cooperative group learning context on computer achievement and anxiety: An aptitude-treatment interaction study. *Journal of Educational Psychology, 89*(4), 686-695.

Mevarech, Z. R., & Kramarski, B. (2003). The effects of metacognitive training versus worked-out examples on students' mathematical reasoning. *The British Journal of Educational Psychology, 73*(4) 449-471.

Morrow, L. M.; Pressley, M.; and Smith, J. K. (1995). The effect of a literature-based program integrated into literacy and science instruction on achievement, use, and attitudes toward literacy and science, reading. *Research Report No. 37.* Athens, GA: National Reading Research Center.

Murata, R. (2002). What does team teaching mean? A case study of interdisciplinary teaming. *Journal of Educational Research, 15(2),* 67-78.

Oladunni, M. O. (1998). An experimental study on the effectiveness of metacognitive and heuristic problem solving techniques on computational performance of students in mathematics. *International Journal of Mathematical Education in Science and Technology, 29*(6), 867-874.

Open Learning Technology Corporation Limited. (1996). Learning with software: Pedagogies and practices. Retrieved October 17, 2005, from http://www.educationau.edu.au/archives.

Orwin, R.G. (2000). Assessing program fidelity in substance abuse health services research. *Addiction* 95: S309-27.

Palincsar, A. S., & Brown, D. (1981). Enhancing instructional time through attention to metacognition. *Educational Researcher, 10*(2), 14–21.

Perkins, D. N., & Grotzer, T. A. (1997). Teaching intelligence. *American Psychologist, 52*(10), 1125-1133.

Piaget, J. (1970). Piaget's theory. In P. Mussen (Ed.), *Carmichael's manual of child psychology* (Vol. I, pp.703-732). New York: John Wiley.

Roderick, M., & M. Engle. (2001). The grasshopper and the ant: Motivational responses of low-achieving students to high-stakes testing. *Educational Evaluation Policy Analysis* 23 (3): 197–227.

Rogers, C. R., & Freiberg, H. J. (1994). *Freedom to learn* (3rd ed.). Columbus, OH: Merrill/Macmillan.

Rosenfield, S. (2000). Crafting usable knowledge. *American Psychologist, 55,* 1347–1355.

Sanchez, V., Stekler, A., Nitirat, P., Hallfors, D., Cho, H., and Brodish, P. (2007). Fidelity of implementation in a treatment effectiveness trial of Reconnecting Youth. *Health Education Research* 22(1):95-1.

Santa, C. (1988). *Content Reading Including Study Systems*. Dubuque, IA: Kendall/Hunt Publishing.

Scardamalia, M., Bereiter, C. & Steinbach, R. (1984). Teachability of the reflective processes in written composition. *Cognitive Science, 8*(2): 173-190.

Schoenfeld, A. H. (1991). On mathematics as sense-making: An informal attack on the unfortunate divorce of formal and informal mathematics. In J. F. Voss, D. N. Perkins, & J. W. Segal (Eds.), *Informal reasoning and education* (pp. 311-343). Hillsdale, NJ: Lawrence Earlbaum Associates.

Schoenfeld, A. H. (1984). Episodes and executive decisions in mathematical problem solving. In R. Lesh and M. Landau (Eds.), *Acquisition of mathematics concepts and processes* (pp. 345-399). New York: Academic Press.

Schoenfeld, A. H. (1983). *Theoretical and pragmatic issues in the design of mathematical problem solving.* Paper presented at the Annual Meeting of American Educational Research Association, Montreal, .

Schumm, J.S. & Vaughn, S. (1995). Meaningful professional development in accommodating students with disabilities: Lessons learned. *Remedial and Special Eduication,16,* 344-353.

Senge, P., Kleiner, A., Roberts, C., Ross, R., Roth, **G.,** & Smith, B. (1999). *The dance of change.* New York: Random House.

Sindelar, P. T., & Brownell, M. T. (2001). Research to practice dissemination, scale, and context: We can do it, but can we afford it? *Teacher Education and Special Edlucation, 24*,348-355.

Speck, Ma. (1996, Spring). Best practice in professional development for sustained educational change. *ERS Spectrum.*

Stichter, J. P., Lewis, T. J., Richter, M., Johnson, N.W., & Bradley, L. (2006). Assessing antecedent variables: The effects of instructional variables on student outcomes through in-service and peer coaching professional development models. *Education and Treatment of Children 29(4),* 665-692.

Stone, J. E. (1996, April 21). "Developmentalism: An obscure but pervasive restriction on educational improvement." *Educational Policy Analysis Archives*, 4(8), Retrieved on 03/14/07 from http://epaa.asu.edu/epaa/v4n8.html.

Sunal, D. W., Hodges, J., & Sunal, C. S., (2001, May). Teaching science in higher education: faculty professional development and barriers to change. *School Science and Mathematics, 101(5),* 246-57.

Supovitz, J.A., & Turner, H.M. (2000). The effects of professional development on science teaching practices and classroom culture. *Journal of Research in Science Teaching, 37(9),* 963-980.

Supovitz, J.A., Mayer, D.P., & Kahle, J.B. (2000). Promoting inquiry-based instructional practice: The longitudinal impact of professional development in the context of systemic reform. *Educational Policy, 14(3),*331-357.

Taylor, B. M., Pearson, P. D., Peterson, D. S., & Rodriguez, M. C. (2003). Reading growth in high-poverty classrooms: The influence of teacher practices that encourage cognitive engagement in literacy learning. *Elementary School Journal, 104*(1), 3-28.

Topping, D., and McManus, R.A. (2002). *Real reading, real writing: Content-area strategies*. New York: Heinemann.

Van Til, W. (1976). What should be taught and learned through secondary education? In W. Van Til (Ed.), *Issues in Secondary Education.* Seventy-fifth yearbook of the Nation Society for the Study of Education (Part II, pp. 178-213). Chicago: University of Chicago Press.

Vars, G. (2001) Can curriculum integration survive in an era of high-stakes testing? *Middle School Journal, 33(2),* 7-17.

Vars, G. F. (1996). The effects of interdisciplinary curriculum and instruction. In P. S. Hlebowitsh & W. G. Wraga (Eds.), *Annual Review of Research for School Leaders*, (pp. 147-164). Jefferson City, MO: Scholastic.

Vars,G. (1991, October) Integrated curriculum in historical perspective. *Educational Leadership, 9,* 14-15.

Vars, G. (1972). "Curriculum in secondary schools and colleges." In J.R. Squire (Ed.), *A New Look at Progressive Education, 1972 ASCD Yearbook.* Alexandria, VA.: Association for Supervision and Curriculum Development.

Weiss, I., & Pasley, J. (2004). What is high-quality instruction? *Educational Leadership, 61*(5), 24-28.

Wenglinsky, H. (2002, February 13). How schools matter: The link between teacher classroom practices and student academic performance. *Education Policy*

Analysis Archives, *10*(12). Retrieved June 12, 2005, from http://epaa.asu.edu/epaa/v10n12/.

Wenglinsky, H. (2000). *How teaching matters: Bringing the classroom back into discussions of teacher quality.* Washington, DC: Educational Testing Service.

White, B. Y., & Frederiksen, J. R. (1998). Inquiry, modeling, and metacognition: Making science accessible to students. *Cognition and Instruction*, *16*(1), 3-118.

Willingham, W.W., J.M. Pollack, & C. Lewis. 2002. Grades and test scores: Accounting for observed differences. *Journal of Educational Measurement* 39 (1): 1–37.

Wolf, S. E., & Brush, T. (2000). Using the big six information skills as a metacognitive scaffold to solve information based problems. In *Annual Proceedings of Selected Research and Development Papers.* Presented at the 23rd National Convention of the Association for Educational Communications and Technology, Denver, CO: 25-28.

Yair, G. (2000). Reforming motivation: How the structure of instruction affects students' learning experiences. *British Educational Journal* 26 (2), 191–210.

Yamagata-Lynch, L. C., Haudenschild, M. (2006). Using activity theory to identify contradictions and tensions in teacher professional development . Online Submission, Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA, 2006.

Zimmerman, J. (2006, September). Why some teachers resist change and what principals can do about it. *NASSP Bulletin*, 90 (3), 238-49.

APPENDICES

Appendix A

RAFT Used by Study Participants

Role	Audience	Format	Topic
Pathogen expert	A group of concerned fast food workers	How To Manual	"Pathogens for Dummies: What they are and how you can avoid them"
Bacteria	People who love poetry	Autobiographical Poem	"All About Me!"
Helpful bacteria	Teenagers	Rap song	"Can I help U?"
Bacteriologist	Patients in a doctor's waiting room	Most Wanted Poster of foodborne pathogens	"Wanted: Dead or Alive"

Appendix B

Semi-Structured Interview Protocol

1. Describe your experience using the RAFT strategy in the context of the Food Safety (FS) in the Classroom curriculum.

2. What impact did your training last summer have on your ability to implement the RAFT strategy during the FS curriculum?

3. How did on-site support and observations impact your ability to implement the RAFT strategy during the FS curriculum?

4. To what extent have you used the RAFT strategy in a context outside the FS curriculum? Describe your experience with the strategy.

5. If you have not used RAFT, explain why you've chosen not to use the strategy.

6. Do you feel you need more training in implementing the RAFT strategy effectively?

7. Have you noticed changes in student learning outcomes as a result of the RAFT strategy (either in the context of the FS curriculum or outside the context)?

8. Have there been improvements in any of the following since you began using the raft strategy?

- Student learning and/or achievement
- Student engagement in the classroom

9. If yes, what evidence of these improvements do you have?

10. What persuades you to use a new instructional strategy?

Appendix C

Transcripts of Study Participants' Semi-structured Interviews

Teacher 1:

1. Describe your experience using the RAFT strategy in the context of the Food Safety in the Classroom curriculum.

Teacher clarifies activity, "That's the one where the students made raps and poems?" It went well, kids enjoyed it and learned from it. They were able to relay or give information they had learned and they came up with unique projects. Research asks teacher to clarify what he meant by "the kids enjoyed it." Well, the kids said they enjoyed, they laughed and cut up with it, and they were comfortable with it overall. They were not embarrassed about presenting.

2. What impact did your training last summer have on your ability to implement the RAFT strategy during the FS curriculum?

It was a novel strategy. If I hadn't had training, I wouldn't have done it. I'm a more traditional teacher. Instead of doing innovative things, I wouldn't have felt comfortable doing it without training. The training was hands-on, you took us through the activity step-by-step. My group did the pamphlet and drew the bacteria, Duncan's group did the rap. By taking us through it, that helped me reteach it later because I had done it myself. I showed our examples from the training to the class and that let them see what I expected from them. Some students tried to use the examples as a crutch, but I wouldn't let them copy. They had to be original. They did a good job.

3. How did on-site support and observations impact your ability to implement the RAFT strategy during the FS curriculum?

You (Jennifer) were able to answer all of my questions. I could bounce ideas off of you. I was nervous because it was new to me and you were here to to provide reinforcement to me. I would still have used the RAFT even if you had not been here to observe, I may not have been as comfortable, but would have used it.

4. Have you used the RAFT strategy in a context outside the FS curriculum?

I have not, but I have been looking to change some things for next year. I ran across something similar for an idea next year in a weather unit. It will be something I use next year.

5. If not, explain why you've chosen not to use the RAFT strategy.

I kind of just followed the same curriculum I've been teaching the last few years. Its not that it is something I wouldn't use, I've just been using comfortable stuff.

6. Do you feel you need more training in implementing the RAFT strategy effectively?

I feel that the training I've had is sufficient and I would be comfortable doing it again I feel comfortable enough that I could create my own too.

7. Have you noticed changes in student learning outcomes as a result of the RAFT strategy (either in the context of the FS curriculum or outside that context)?

I noticed from changes in their learning from the beginning to the end of the unit. I feel that the RAFT strategy impacted their learning. Anytime they can get up and give information back to class, it reinforces it even more. Plus, they had fun so I know that it tied together all the information for them.

8. Have you shared this strategy with other teachers?

No.

9. What persuades you to use a new strategy?

If I'm comfortable presenting it to the kids, I'll use it. If I don't feel comfortable, then I'll find another way to get the information across. Other teachers' success with a strategy also persuades me to use it.

Teacher 2:

1. Describe your experience using the RAFT strategy in the context of the Food Safety in the Classroom curriculum.

It was easy to implement. I let the kids choose which of the options they were more comfortable with and they grouped up based on that. They enjoyed it. A few of the more outgoing students chose the rap and they enjoyed it. I felt like it helped them remember the information better. The artists in the class chose the most wanted poster, and do I think it zeros in on what they were comfortable with. They had to use knowledge from the class to do project. Even with my lower level class, a couple of cheerleaders did the rap song and loved it! It allowed them to get into it more.

2. What impact did your training last summer have on your ability to implement the RAFT strategy during the FS curriculum?

Just that we had done it ourselves and we knew how to explain better to the kids what they were going to be doing. I was able to give them examples.

3. How did on-site support and observations impact your ability to implement the RAFT strategy during the FS curriculum?

In case we forgot or were hazy, you being here gave us a chance to clarify in cases where we forgot or weren't sure.

4. Have you used the RAFT strategy in a context outside the FS curriculum?

I used something similar. I let them do a poster and a song in diversity unit with 8th grade students.

5. If so, describe your experience.

It was about the same. The kids got into it. They had to use content knowledge from the class to be able to do project. But the project was something they enjoyed, it helps them clarify. When they were doing the song, they had to go back to their notes to clarify for themselves before they could complete project. It helped them remember material.

6. If not, explain why you've chosen not to use the RAFT strategy.

Not applicable.

7. Do you feel you need more training in implementing the RAFT strategy effectively?

I don't think so, just doing it this summer and then twice this year.

8. Have you noticed changes in student learning outcomes as a result of the RAFT strategy (either in the context of the FS curriculum or outside the context)?

I think it helps the keep the information longer. They can always go back to it and draw on it, from the poster or song, whatever they did, helps them remember longer.

9. Have you shared this strategy with other teachers?

My husband is a chemistry teacher, I told him about and how it went. I don't know if he used it or not.

10. What persuades you to use a new instructional strategy?

How the kids respond to it. If I try a strategy and I feel like it helped them remember information longer, I'll keep it. If not, I'll scrap it and do something else. Different strategies work well with different kids, so it depends on kids.

Teacher 3:

1. Describe your experience using the RAFT strategy in the context of the FS in the Classroom curriculum.

I did not use it. Jennifer and teacher discussed the decision not to use the strategy in order to allow more time for in-depth discussions on the lab and other activities.

2. What impact did your training last summer have on your ability to implement the RAFT strategy during the FS curriculum?

It introduced me to something I've not used before in that format. It opened up another method for summarizing activities.

3. How did on-site support and observations impact your ability to implement the RAFT strategy during the FS curriculum?

The fact that you were there and were aware of what the kids were doing and how things were progressing gave extra feedback to help determine that it was not necessary to use the RAFT in that case. As the teacher I'm not going to pick up on as much as you would observing what's going on. It gave a second opinion.

4. Have you used the RAFT strategy in a context outside the FS curriculum?

Not in its entirety. I've used similar things, but didn't call it RAFT. This was an environmental unit, on genetic engineering.

5. If so, describe your experience.

Students were given different roles and were required to observe and analyze information from their role. For example, students were either a group of scientists versus the consumers versus mothers or parents. They studied genetic engineering and looked at websites and textbooks. Then groups were assigned roles to gain perspective. Then they presented their perspective on genetic engineering from their view point. It allowed students to consider the pros, cons, benefits, and harm of genetic engineer.

6. If not, explain why you've chosen not to use the RAFT strategy.

Not applicable.

7. Do you feel you need more training to implement the RAFT strategy effectively?

I think I would definitely benefit from more training, I don't think I've perfected it to the point of being the best. I could always improve and understand different ways to incorporate the strategy.

8. Have you noticed changes in student learning outcomes as a result of the RAFT strategy (either in the context of the FS curriculum or outside that context)?

Yes, definitely. Students took a broader perspective of the situation rather than being isolated to one particular viewpoint or set of information. They were exposed to a wide variety of facts and I think it required them to think more critically in order to determine their opinion.

9. Have you shared this strategy with other teachers?

No. I haven't had an opportunity to do so where it was appropriate. Not because I think it's a bad strategy, though.

10. What persuades you to use new strategy?

I like to try new things. The fact that the group of students we have now is living in such a different type of educational system than I grow up in or even did my student teaching in, I feel like these students need new and different ways to view thing and absorb information because traditional methods don't seem to be as effective. By trying new things you find out what works and what doesn't. My decisions on which new strategies to use are based on knowing my students and the way they think and trying to develop teaching strategies that cause them to think more critically or outside the box.

Teacher 4:

1. Describe your experience using the RAFT strategy in the context of the Food Safety in the Classroom curriculum.

It was a good activity, but because of time constraints we weren't able to spend as much time on it as we should have. One class didn't get to do it at all. It was good though and the students enjoyed it. I used some of their posters for a bulletin board. But wet didn't have enough time to present everyone's.

2. What impact did your training last summer have on your ability to implement the RAFT strategy during the FS curriculum?

Very good, I didn't know about it before. When we did that I liked it and tried to use it again. I have used it since for several other things.

3. How did on-site support and observations impact your ability to implement the RAFT strategy during the FS curriculum?

I don't think having folks around was crucial at that point. It went fairly well on its own. It wasn't quite as hands on and didn't need as much support.

4. Have you used the RAFT strategy in a context outside the FS curriculum? If so, describe your experience.

I've used it in other areas. One example was when we studied the dangers of smoking. I broke it up into four things. One was a lung with emphazema writing a suicide letter to the person it lived inside of. The second was a child with chronic bronchitis, allergies, and asthma writing a letter of complaint to their parents to stop smoking. The third was an ashtray writing an eviction notice to cigarette butt at the hospital. And the last one was the surgeon general writing a brochure to convince people to stop smoking.

5. If not, explain why you've chosen not to use the RAFT strategy.

Not applicable.

6. Do you feel you need more training in implementing the RAFT strategy effectively?

I don't think so; it's pretty easy to grasp the idea of.

7. Have you noticed changes in student learning outcomes as a result of the RAFT strategy (either in the context of the FS curriculum or outside that context)?

No more than any other activity. I couldn't tell that it made more of a difference than anything else.

8. Have you shared this strategy with other teachers?

I don't think so, most teachers here were already familiar with it. I haven't met anyone who didn't know some version of it.

9. What persuades you to use a new strategy?

Whether its hands on or not and how much extra support you need. If it requires a lot of extra stuff I may not be in as big a hurry to try it. I guess I'd say ease of use and whether or not I think it fits in with what we cover in class.

Teacher 5:

1. Describe your experience using the RAFT strategy in the context of the Food Safety in the Classroom curriculum.

I think it helped the students. They responded to it well, they had to think of bacteria in different way when they were bacteria. The poem or rap, where they were telling about themselves, they had to think more about details and they gained a new perspective. They also enjoyed performing for other students. I did the RAFT at the end of the Food Safety unit.

2. What impact did your training last summer have on your ability to implement the RAFT strategy during the FS curriculum?

It had a major impact because I experienced doing it myself. You can plan, but if you haven't done it you don't know how it will go. Because I knew, it went more smoothly and I could explain exactly what they would be doing, knew to emphasize they would be presenting from bacteria's point of view and could explain their roles better.

3. How did on-site support and observations impact your ability to implement the RAFT strategy during the FS curriculum?

If you hadn't been here to answer my question, I don't feel like I would have felt as comfortable. It's like you were my reference and then I could help students go more in depth with the content.

4. Have you used the RAFT strategy in a context outside the FS curriculum?

I used it once in the human body when we did the heart and circulatory system. They made a 'healthwise' poster, or they were the fat in food and had to explain how it would coat and affect arteries. It wasn't exactly the same, but they adopted a different point of view.

5. If not, explain why you've chosen not to use the RAFT strategy.

Not Applicable.

6. Do you feel you need more training in implementing the RAFT strategy effectively?

I don't think so.

7. Have you noticed changes in student learning outcomes as a result of the RAFT strategy (either in the context of the FS curriculum or outside that context)?

Definitely, they have a better understanding of the material and they can make more connections so they retain the information better. I bet that those who made up the song to tune of "Frosty, The Snowman" will remember the information better. It helps students retain information and connect to prior learning.

8. Have you shared this strategy with other teachers?

No.

9. What persuades you to use a new strategy?

Either seeing it work before in a class or experiencing it myself and seeing that it got me excited and I learned from it….firsthand experience.

Teacher 6:

1. Describe your experience using the RAFT strategy in the context of the Food Safety in the Classroom curriculum.

I loved it, absolutely loved it. I am trying to think of how to incorporated it over and over again. Students can choose whatever they wanted to do. They generally go for the easy options, but sometimes choose harder ones. Students liked it a lot. In the context of doing different things, it was a well designed break from lab work to something they could take and turn around and reemphasize by presentation. Presentation skills are necessary and students don't get many opportunities. This gave them an chance to present and they liked it a lot.

2. What impact did your training last summer have on your ability to implement the RAFT strategy during the FS curriculum?

I think it was good because I was able to experience it and understand what that was like. Rick and I coming up with a poem was good because its not something I would normally do. A lot of times when I use this strategy I'd like to assign roles to make kids come out of comfort zone. It was good that I experienced it because then I could relate to where the students might be and I knew how to explain it what I wanted from them. It helped put them at ease.

3. How did on-site support and observations impact your ability to implement the RAFT strategy during the FS curriculum?

It was good that, across the board, the support was there because sometimes time goes by and you say I don't remember how to do that, but now that I have support here I can ask questions. If I perceive myself as going in the wrong direction or for clarity purposes, then you being here gives me more confidence in that part of the presentation or curriculum.

4. Have you used the RAFT strategy in a context outside the FS curriculum? If so, describe your experience with it.

One time I gave the student 3x5 cards and told them they were going through the digestive system. I asked them to send me a postcard from their digestive system. Other ideas I've though of are if we're doing human body, and circulatory system, to have students write a jingle for cardiologist about how number of heartbeats per minute increases with exercise. Or with the digestive system, have them create a poster of the importance of nutrition to dieticians and how to pick right foods. I want to try to change it around some, but keep same philosophy. A lot of students wanted to sing or write letters. Those are things I like to implement, weather would be another perspective. I like the way you did it, but I'm straightforward, I need someone to come along and say, "Lets do something goofy". I actually had them do a brochure about smoking and exercise and cardiovascular health. They came up with cool brochures.

5. If not, explain why you've chosen not to use the RAFT strategy.

Not applicable.

6. Do you feel you need more training in implementing the RAFT strategy effectively?

I need someone to come along side and say, "That's way too straightforward, it will bore students to tears, let's come up with wild and zany roles or audiences." I'm more or less a nuts and bolts type of person; I need someone to give me interesting combinations or roles and audiences, and presentations.

7. Have you noticed changes in student learning outcomes as a result of the RAFT strategy (either in the context of the FS curriculum or outside that context)?

I think so. Most of the time when students are doing something that is work, but is fun and they can socialize working with other kids, they're learning. But it's also a relaxed atmosphere rather than copying terms or something. They do better that way.

If they're not remembering it right then, they will recall it in the long term. Kids prefer seeing other kids present rather than seeing me give the information.

8. Have you shared this strategy with other teachers?

I can't remember if I have or not. While we were actually doing it, I was talking to other people, like the media specialist or other teachers, about how the lessons and activities were going. But I don't know specifically if I mentioned this activity or not.

9. What persuades you to use a new strategy?

Basically I'm a results oriented person. If you can see that this will work and especially when you implement it, then I'll keep doing it. If I can see this is a good strategy or have them do the things they like to do and it is curriculum oriented , then I'll lean in that direction. Some workshops give you talk, talk, talk, like we got this result, reading scores went up. You think about that and I need to actually see fine data as opposed to just the conclusion. I like to see it actually working in classroom, seeing students having fun pushes you closer to saying, "Yeah, I'll use this."

Appendix D

Observation Protocol for Science Component of *Food Safety in the Classroom*

Science Observation Checklist
USDA– NIFSI Food Safety Project 2006

Observer: Date:

Instructions:
-Mark an "X" in the "***Yes***" column if the intervention is conducted in complete accordance with the described activity.
-Mark an "X" in the "***No***" column if the intervention is **NOT** conducted in accordance with the described activity.
-Record comments as is appropriate in "***Comments***".
-Record the actual time the class spent on the activity in the "***Time***" column and compute "***Total***".

#	YES	NO	ACTIVITY	TIME
1			Setting the stage - 10 Minutes Displayed on board as students enter the room: "On a scale of 1-10, how clean do you think your hands are right now? (1=dirtiest 10=cleanest). "	
			Make a list of 10 things you have touched since you last washed your hands.	
			Allow students a few minutes to respond in writing, and then discuss answers as a class.	
			Tell students: Today we are going to conduct a lab to learn about bacteria, where it grows, and how you can avoid getting sick from bacteria.	
	Comments:			**TOTAL**
#	YES	NO	ACTIVITY	TIME
2			Bacterial Growth Lab - 35 minutes Follow the procedures of Bacterial Growth Lab sheet (attached).	
			Provide each student with a Lab sheet handout.	
			Students should record their procedures as they set up the experiment.	
			Ask each student (or lab group) to brainstorm a hypothesis for this experiment. Students will observe their Petri plates for two days and record their observations on their lab sheet.	
	Comments:			**TOTAL**
#	YES	NO	ACTIVITY	TIME

3			Bacterial Concept Map - 10 minutes Using a large piece of drawing paper, a blank overhead transparency, or the board, construct a concept map about bacteria with students. Depending on whether they have studied this topic before, student knowledge will vary.	
	Comments:			**TOTAL**
#	*YES*	*NO*	***ACTIVITY***	***TIME***
4			Introduction to Bacteria Presentation - 20 minutes Use the PowerPoint presentation *Introduction to Bacteria* (electronic copy on CD-ROM, see Tab 5).	
			Students should complete the graphic organizer Bacteria Concept Map during the presentation. Be sure to allow time for students to fill in their concept map through out the presentation.	
			Once the lecture is finished and students have completed their concept maps, ask students to respond to lecture review questions.	
	Comments:			**TOTAL**
#	*YES*	*NO*	***ACTIVITY***	***TIME***
5			RAFT Follow up - 35 minutes Display the RAFT chart on the overhead or board.	
			Assign each student (or pairs) one of the roles.	
			Students will then assume the role of their assignment and create the prescribed product.	
			Once the products have been completed, students should present their work to the class.	
	Comments:			**TOTAL**
#	*YES*	*NO*	***ACTIVITY***	***TIME***
6			Lab Follow-up - 40 minutes Aggregate the class data by recording student plate counts by treatment. .	
			Total and average the amount of growth in each treatment	
			Ask students what trends and discrepancies they notice in the data.	
			Have each student construct a simple bar graph to reflect the class aggregate data.	
			Students should then draw a conclusion on the experiment results and answer Questions for Consideration. Allow students to work in lab groups to complete the Generating a Researchable Question exercise. (Examples and possible answers for all lab follow-up activities are included on the Teacher's Copy of the Bacterial Growth Experiment lab sheet). Students should complete the Bacterial Growth Lab Self-Assessment once these activities are completed.	
	Comments:			**TOTAL**

#	YES	NO	ACTIVITY	TIME
7			Microscope Introduction - 25 minutes Remind students of the proper way to carry and handle microscopes.	
			Students should follow the procedures outlined on the *Microscope Lab* handout. Encourage students to be pay close attention to detail when drawing their observations in the data sections. The purpose of this activity is to familiarize students with the microscope before they view bacterial cells in a later lesson.	
	Comments:			**TOTAL**
#	YES	NO	ACTIVITY	TIME
8			Tortilla Cells - 35 minutes Lead students through creating a tortilla cell (See Tortilla Cells handout). The purpose of this activity is to familiarize students with the structure of a bacterial cell while allowing them an opportunity to practice safe food handling.	
			Remind students to wash their hands thoroughly before beginning this activity and before eating.	
	Comments:			**TOTAL**
#	YES	NO	ACTIVITY	TIME
9			Preparing and Staining Slides - 30 minutes Have students follow the preparation and staining procedures found on Preparing and Staining Wet Mount Slides.	
			Remind students that they should not touch the colonies growing on their Petri plates with their fingers…only the loops. Petri plates should be closed immediately after use.	
			Once students have observed their slides, they should answer the questions found on the bottom of the procedure handout.	
	Comments:			**TOTAL**
#	YES	NO	ASSESSMENT ACTIVITY	TIME
10			Ask students to write a brief reflection on the following topic: Imagine you have a sister in 1st grade. In language she can understand, explain to her what bacteria is, how it can make you sick, and how you can avoid getting sick from bacteria. Encourage students to share their responses with the class.	
	Comments:			

Appendix E

Student Science Assessment

Directions: Read each of the following statements or questions below and choose the **BEST** answer from the choices given.

Science

1) Which of the following is NOT true about bacteria?

- O They are microscopic.
- O They are made up of only one cell.
- O They can be found on most surfaces.
- O All bacteria can make you sick.

2) Which of the following is NOT one of the three basic shapes of bacteria?

- O Circular
- O Bacilli
- O Spiral
- O Cocci

3) When bacteria grow they:

- O Grow in size from an infant to an adult.
- O Grow in number, not in size.
- O Eventually get too big and die.
- O Require more and more food to grow larger.

4) How do bacteria get the nutrients they need to survive?

- O Some make their own energy from sunlight.
- O Some scavenge their nutrients from the environment around them.
- O Some attach to other living things.
- O All of these are true.

5) A pathogen is:

- O A bacterium that helps in digestion.
- O A bacterium used to make pepperoni.
- O A bacterium that can make you sick.
- O A bacterium used to make medicines.

6) An example of indirect contact is:

- O Touching the desk and then touching your eyes, mouth, or nose.
- O Getting a kiss on the cheek from Aunt Mildred.
- O Shaking hands with a friend.
- O Hugging your parents.

7) Which of the following is NOT a food made using helpful bacteria?

- O Pickles
- O Eggs
- O Pepperoni
- O Sauerkraut

8) All of the following are pathogens EXCEPT:

- O Salmonella
- O Lactobacillus
- O E. coli
- O Listeria

9) The best way to avoid getting sick from a pathogen is to:

- O Rinse your hands in cold water for 5 seconds.
- O Wash your hands in warm water with soap for 20 seconds.
- O Avoid touching any surface.
- O Wipe your hands on a dish towel.

10) Bacterial cells are different from animal cells in that bacteria cells:

- O Contain DNA.
- O Have a cell wall.
- O Do not have a nucleus.
- O Contain cytoplasm.

VITA

Jennifer Richards was born in Florence, Alabama. She completed a Bachelor of Science in Education from Miami University in 1997. After teaching middle school for five years, she enrolled at The University of Tennessee to pursue of Ph.D. in Education. Jennifer currently directs an educational research project that brings innovative instruction on food safety into middle school classrooms. After completing her degree she hopes to continue directing educational research in the fields of interdisciplinary instruction and professional development.