RESEARCH IN THE SCHOOLS
2009, Vol. 16, No. 2, 41-59

Sustaining Instructional Change: The Impact of Professional Development on Teacher Adoption of a New Instructional Strategy

Jennifer Richards and Gary Skolits
University of Tennessee, Knoxville

Adolescents learn best when actively engaged with the content; yet, many teachers rely on passive learning strategies in their classrooms. This study investigated teacher (n = 6) use and adoption of an active learning instructional strategy (Role, Audience, Format, Topic). The study purposes were to: (a) determine how and to what extent teachers apply a new instructional strategy; (b) identify barriers to instructional change; and (c) examine the impact of research-based professional development training on teachers' sustained use of an instructional strategy. Findings suggest that for these six teachers to use a strategy, they must understand the educational theory behind it, observe the strategy modeled, relate the strategy to current instructional practices, and receive on-site support during initial implementation.

A gap between instructional research findings and classroom practice has existed throughout the history of formal public education (Carnine, 1995). Although numerous studies have shown that a strong collaborative effort between researchers and classroom teachers results in the use of effective 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), a significant *research-to-practice gap* continues to persist (Carnine, 1995; Gravini, 2008; Robertson & Bond, 2005). Examples of this gap are reflected in the findings of recent studies suggesting that many classrooms are still teacher-centered and that passive learning strategies remain the norm (Goodlad, 2004; Marks 2000; McDermott, Mordell, & Stoltzfus, 2001; Yair, 2000). Teacher-centered classrooms continue despite a substantive and growing body of instructional literature supporting the efficacy of student metacognition and active engagement as two cornerstones of improved student learning outcomes (Bransford, Brown, & Cocking, 2000; Finn & Rock 1997; Marks 2000; Roderick & Engle 2001; Scardamalia, Bereiter, & Steinbach, 1984; Schoenfeld, 1983, 1984, 1991; Taylor, Pearson, Peterson, & Rodriguez, 2003; Weiss & Pasley, 2004; White & Fredericksen, 1998; Willingham, Pollack, & Lewis, 2002). Although there are many potential causes of this disconnect between well-grounded educational theory and practical application in the classroom, teachers have traditionally cited unfamiliarity with instructional strategies promoting student engagement, inadequate training regarding these strategies, and insufficient support in the classroom when they seek to implement these new strategies (Huberman & Miles, 1984; Williams & Coles, 2007).

To help teachers incorporate highly effective instructional strategies into their classrooms, countless professional development workshops are offered each year by educational corporations, universities, state governments, and local school systems. In fact, the No Child Left Behind legislation of 2001 requires states to provide teachers access to high quality professional development (No Child Left Behind Act of 2001, 2008). Yet, most of these workshops fail to affect true sustainable change in the classroom behavior of teachers (Corcoran, 1995; Darling-Hammond, 1995; Guskey, 2000; Hiebert, 1999; Lieberman, 1996; Little, 1993; Sparks & Loucks-Horsley, 1989). Therefore, there is a need for investigation of the processes that promote and constrain teachers' internalization of new

Correspondence for this article should be addressed to Jennifer Richards, University of Tennessee, Knoxville, 2605 River Drive, Knoxville, TN 37996; email: jennifer.richards@utk.edu

instructional strategies as well as the ways in which professional development can be enhanced to promote sustained instructional improvement.

Gap Between Research and Practice

The *research-to-practice gap* is a long-standing issue and concern in education that has been extensively researched. Bondy and Brownell (2004) suggested that the research-to-practice gap still exists because there is a fundamental separation between research-based knowledge and practical-based knowledge. This separation is attributed to the fact that practitioners often fail to see the immediate relevance of empirical research as well as the lack of effective mechanisms for disseminating empirical research (Chafouleas & Riley-Tillman, 2005). Bondy and Brownell (2004) and Chafouleas and Riley-Tillman (2005) argued that a new worldview 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. Practitioners must be forthcoming with meaningful problems, whereas researchers should focus more intently on questions that practitioners want answered (Chafouleas & Riley-Tillman, 2005; Cook, Landrum, Tankersley, & Kauffman, 2003), thereby leading to useable knowledge that practitioners can apply in real-world context (Rosenfield, 2000). Moreover, researchers need to increase the relevancy of their works to practitioners and improve the dissemination of research findings in a manner that reaches teacher audiences (Carnine, 1997). For example, teachers report that using research information to improve instructional practice is intimidating due to a lack of time to identify needed resources for applying new methods, a lack of access to research materials and references, and a lack of confidence in their abilities to understand research (Williams & Coles, 2007). In order for any research-based professional development to be truly effective, designers must be able to communicate empirical research findings to practitioners in ways that are meaningful and directly applicable to day-to-day classroom instruction.

Barriers to Instructional Change

In addition to the research-to-practice gap, implementation of instructional improvement 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 or fear of new methods (Fullan, 2001; Greenberg & Baron, 2000). Gess-Newsome, Southerland, Johnston, and Woodbury (2003) described these habits as a "personal practical theory" of teaching in which the teachers' experiences and philosophies dictate an image of how teaching and learning in their classrooms should look (p. 758). This idea is similar to the construct of teachers' practical knowledge examined by Aikenhead (1984) and Duffee and Aikenhead (1992). Moreover, attempts to mandate instructional changes can be perceived as a threat to a teacher's expertise and his/her ability to engage students in meaningful learning (Fullan, 2001; Greenberg & Baron, 2000).

A school environment that teachers perceive as *unsafe* for change can also deter efforts to embrace new instructional strategies and might actually trigger a defensive response leading to further entrenchment of out-dated and ineffective methods of instruction (Goleman, Boyatzis, & McKee, 2002). Similarly, lack of administrative support at the local or district level can be a significant barrier to instructional change (Johnson, 2006). In fact, the intense focus on accountability through state and national achievement tests has resulted in teachers feeling pressure to focus only on *what works* and thus become apprehensive about experimenting with new strategies (Johnson, 2006). 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 prevented teachers from adopting new instructional strategies (p. 152).

Elements of Professional Development that Can Overcome Barriers to Change

Research consistently shows that multiple professional development objectives must be achieved to overcome these barriers to instructional change. Birman, Desimone, Porter, and Garet (2000) found that effective professional development could be achieved in the traditional form of workshops or more innovative reform-based activities as long as it included the appropriate duration, subject-matter content, active learning, and coherence. Effective professional development introducing new strategies must incorporate hands-on, experiential learning opportunities that are embedded in authentic contexts in which teachers can thoroughly connect with the new strategies (Cook et al., 2003; Kinnucan-Welch, Rosemary, & Grogan, 2006; Loucks-Horsley, Hewson, Love, & Stiles, 1998). In fact, both Borko (2004) and Desimone, Porter, Garet, Kwang, and Birman (2002) found that professional development that engaged teachers in processes of active learning were highly effective. These active learning experiences allow teachers to develop a deeper understanding of both the content and strategies

introduced through professional development (Birman et al., 2000; Desimone et al., 2002).

Effective professional development opportunities should also include the modeling of the new strategies and allow teachers to interact in small groups to apply, to analyze, and to synthesize novel instructional strategies in ways that will be meaningful to them (Borko, 2004; Dempwolf, 1993; Desimone et al., 2002; Galbo, 1998; Kinnucan-Welch et al., 2006; Speck, 1996). This collaborative group participation is critical as it allows teachers to make meaning out of their professional development experience based on their particular classroom contexts (Birman et al., 2000). Joyce and Showers (1988) reported that, under the conditions suggested earlier, up to 90% of teachers will transfer the new skill or strategy into daily practice. They argued that the combination of modeling new strategies and allowing for problem-solving with colleagues allows teachers to process new strategies or content on a more meaningful level, thereby leading to greater transfer of knowledge to practice (Joyce & Showers, 1988). Astor-Jack, McCallie, and Balcerzak (2007) also documented that modeling instructional strategies, providing theoretical and pedagogical background, and allowing time for teacher reflection were critical to effective professional development. Concomitant with a focus on modeling and active participation, Birman et al. (2000) noted that incorporating significant instruction on subject-matter content was equally important.

Teachers need multiple opportunities to interact with the new strategies and to practice them in the context of their own classrooms (Gess-Newsome, 2001; Loucks-Horsley et al., 1998; Sindelar & Brownell, 2001). Moreover, they also need on-going instructional support (Abbot, Walton, Tapia, & Greenwood, 1999; Boudah et al., 2001; Cook et al., 2003; Fuchs & Fuchs, 2001; Gersten & Dimino, 2001; Gersten, Vaughn, Deshler, & Schiller, 1997; Guskey, 2000). In fact, the quantity of time a teacher spends in professional development addressing new skills and strategies is strongly related to their use of those skills and strategies in their regular instructional practice (Birman et al., 2000; Cohen & Hill, 1998; Supovitz & Turner, 2000; Supovitz, Mayer, & Kahle, 2000). This on-going support must be collaborative and provide systematic feedback (Cook et al., 2003). Feedback is especially critical in allowing adult learners to transfer new skills into daily practice (Galbo, 1998; Speck, 1996). On-going follow-up support also permits a teacher to practice the new strategy within the authentic context of their classrooms (DePaepe, Shores, Jack, & Denny, 1996; Goleman et al., 2002; Stichter, Lewis, Richter, Johnson, & Bradley, 2006). Marshall, Pritchard, and Gunderson (2001) concluded that professional development typically had little to no impact unless there was strong follow-up support. A plan to help teachers deal with problems that arise during initial implementations and recognize early successes is also crucial to effecting meaningful change in instructional practice (Fuchs & Fuchs, 2001; Grimes & Tilly, 1996). For example, new strategies cannot propose to alter radically the existing classroom procedures and routines; 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).

Measuring Fidelity of Implementation for Educational Interventions

When studying the effectiveness of professional development on teacher adoption of more effective instructional strategies, it is necessary to monitor teacher implementation fidelity to the prescribed instructional design (Dusenbury, Brannigan, Falco, & Lake, 2004). Accurately measuring fidelity is needed to determine whether or not the implementation was a true measure of the strategy's performance in real-world conditions (Dumas, Lynch, & Laughlin, 2001; Orwin, 2000; Sanchez et al., 2007). The prevailing assumption is that high degrees of implementation fidelity are desirable, whereas lower degrees of fidelity can be expected to reduce the effectiveness of a given strategy (Chen, 2005). Chen (2005) argued that some modification from the original design of any intervention might be necessary to ensure long-term adoption because strategies have to fit into the real-world application; therefore, some degree of lower fidelity might be desirable. However, deviating too far for the original design is likely to dilute the strategy's effectiveness (Chen, 2005).

Despite the growing calls for greater scientific rigor in educational research that would include the empirical assessment of fidelity and the use of fidelity assessment results to understand better project outcomes (U.S. Department of Education, 2003), very few empirical studies of fidelity appear in the literature (see the review prepared by O'Donnell, 2008). Most of the few empirical fidelity studies appearing in the literature reported a positive relationship between fidelity and expected outcomes (Fuchs & Fuchs, 2001; Penual & Means, 2004; Ysseldyke et al., 2003), but few studies documented a desired fidelity range, especially from the perspective of outcomes (Vaughn et al., 2006).

The RAFT as a Model of an Effective Instructional Strategy

This study focused on teacher professional development addressing one specific instructional

strategy that incorporates both active student engagement and metacognition: the RAFT (Role, Audience, Format, Topic) strategy. The RAFT requires students to synthesize new content knowledge into a product that demonstrates a deep and meaningful understanding of new concepts in a non-traditional format (Santa, 1988), allows students to connect prior knowledge to new knowledge, and encourages them to write in a creative format that still provides sufficient structure (Groenke & Puckett, 2006). Teachers using the RAFT strategy introduce students to new content knowledge and then provide them with a specific role to assume—typically this role requires a unique perspective (students become a bacterium or a cloud). Students are then assigned a designated audience and particular format in which to write, and a specific topic on which to focus their products. An example would be for a student to assume the role of a bacteriologist writing to patients in a doctor's waiting room in the format of a most wanted poster for the "The Top 5 Most Wanted Pathogens: Wanted Dead or Alive." Although RAFTs were initially developed as a literacy and writing tool, they have been adapted to other disciplines (Buehl, 2001; Daniels & Zemelman, 2004; Topping & McManus, 2002). This strategy is only recently gaining recognition as a powerful technique for the teaching of science that "deserves a place in any science classroom" (Groenke & Puckett, 2006, p. 27). For this research study, the RAFT was selected as a highly effective research-based instructional strategy that is appropriate for studying teachers' adoption of instructional innovations.

Conclusions and Deficiencies in the Literature

In summary, there still exists a significant gap between research-based effective instructional practices and the practical classroom application of these strategies. To overcome this gap, researchers must be mindful of barriers to instructional change and actively provide teachers with strategies to overcome barriers. The literature is clear on the critical elements necessary for successful professional development: providing authentic, experiential learning with opportunities for sustained practice in a supportive, collaborative environment. However, a review of the literature failed to reveal an ideal design of professional development that will allow teachers to adopt new strategies and adopt them in their classroom instruction (Astor-Jack et al., 2007).

Purpose of Study and Research Questions

The overall goal of this study was to explore issues regarding six teachers' adoption of a new instructional strategy and investigate the potential of a specific professional development model to help them overcome barriers to instructional change. The study employed a sequential explanatory strategy of mixed methods research within an instrumental case study framework (Creswell, 2009). Robert Stake (2000) defined an instrumental case study as "examined mainly to provide insight into an issue or to redraw a generalization" (p. 437). Quantitative data were collected first through an observation protocol through which a fidelity score was calculated. Semi-structured interviews then were used to collect qualitative data to explain further data resulting from the quantitative method (Creswell, 2009). The purposes of this study were to: (a) investigate how and to what extent six teachers apply a new instructional strategy introduced through research-based professional development (Role, Audience, Format, Topic, the RAFT); (b) identify barriers to sustained instructional change; and (c) examine the impact of a research-based professional development opportunity on these teachers' use of a novel instructional strategy (the RAFT). Three research questions guided this study: (a) To what extent do six teachers apply a specific instructional strategy taught in the professional development workshops (the RAFT strategy) in the context of the model food safety curriculum?; (b) To what extent do these teachers apply the RAFT instructional strategy in contexts outside of the model food safety curriculum?; and (c) What are the barriers to effecting change in these teachers' use of the RAFT instructional strategy?

Educational Significance

To design effective professional development, educators need to understand how teachers internalize new instructional strategies and what barriers to change exist during a professional development intervention as well as subsequent to the intervention when they lack the external support and guidance. To help promote this understanding, this study is unique in that it compared teachers' attempts to employ a new instructional strategy within the context of a model curriculum intervention with subsequent attempts to employ that same strategy outside of the intervention. Designers of professional development activities can use the insights from this study to plan and to design more effectively future professional development opportunities for teachers.

Method

Context of the Study

The professional development literature provided the theoretical framework for this study. Building on the literature regarding effective professional development, a model instructional innovation was designed and delivered to teachers as part of a larger research project funded by the United States Department of Agriculture's (USDA's) National Integrated Food Safety Initiative. This larger study designed and pilot tested a food safety curriculum that was interdisciplinary in nature and correlated directly to state standards for math, science, social studies, and language arts at the seventh-grade level in Tennessee and North Carolina. The pilot test involved 23 teachers and 233 students at five middle schools (Richards, Skolits, Burney, Pedigo, & Draughon, 2008). Designed to take approximately 1 week of classroom instructional time, this unit contains lessons to be taught in all four core subject areas simultaneously. The RAFT instructional strategy investigated in the present study was incorporated into the science component of the food safety curriculum. Execution of the RAFT instructional strategy required approximately one class period.

Teacher Participants and the Professional Development Intervention

The 6 participants in this study (four female, two male) constituted a purposive sample recruited from the population of teacher participants in the pilot test of the National Integrated Food Safety project (NIFSI). These 6 teachers were recruited because they each taught the science component of the food safety curriculum in the project NIFSE pilot test. These participants represented three suburban schools, two rural schools, and one urban school. Five taught only science whereas one also taught math and social studies. Two of the participants had more than 10 years classroom experience, two had between 6 to 10 years, and two had less than five years experience.

The participant professional development training on the RAFT strategy in the NIFSI project was designed to reflect and model current literature on effective teacher professional development (see Table 1). Each teacher received approximately 12 hours of training at her/his own school to allow them to be in her/his own classrooms during training and to promote a feeling of familiarity and comfort. This design also allowed for small group interaction for each training event (group sizes ranged from 2-8 teachers). In addition, the delivery method of the workshop offered a combination of modeling of the RAFT, hands-on participation in activities, and a seminar style discussion. This delivery method allowed 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 2 days and occurred over the summer of 2006. A predetermined agenda was set for the 12 hours of training to move efficiently and consistently through the food safety curriculum covering new content material and instructional strategies in depth.

Implementation of the RAFT strategy

After each participant was trained to use the RAFT strategy, he or she established a classroom implementation date during the upcoming 2006-2007 school year. Researchers were on-site for the implementation of the RAFT to provide additional instructional support. Teachers completed a semi-structured interview within 6 weeks of implementation. Approximately 4 to 6 months after the implementation, researchers conducted an additional semi-structured interview with each participant to delve more deeply into issues that emerged from the first interview and to determine if they had attempted to use the RAFT strategy again outside the context of the food safety curriculum.

Instruments and Data Collection

The present study drew upon observational data collected based upon a classroom implementation protocol developed by project staff (Skolits & Richards, 2009) (Appendix A). The present study used data from the science observations only. For the science observation, a total of 10 different activities comprised the week-long instructional unit (the RAFT strategy was the fifth activity in the unit). Each activity was subdivided into specific instructional events (i.e., introducing the activity, providing student directions, executing the learning activity, concluding the activity, and debriefing students to ensure student learning occurred). The researcher made note of the following details: each teacher modifications of the activity; specific details of how the activities were introduced, conducted, and concluded; the teacher's apparent comfort level with instructional strategies and teaching techniques; and any significant teacher or student comments.

A semi-structured interview protocol was developed for this study and evaluated by an independent interviewing expert for quality of question construction and bias. Each study teacher was interviewed using this 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 (see Appendix B).

Table 1
Summary of Professional Development Model Employed in Study

Professional Development Component	Research Literature Foundation
Small group training held on-site at each school	Galbo, 1998; Kinnucan-Welch, Rosemary, & Grogan, 2006
Delivery of instructional theory behind curriculum	Gersten, Vaughn, Deshler, & Schiller, 1997
Hands-on participation in completing curricular activities	Astor-Jack, McCallie, & Balcerzak, 2007; Birman, Desimone, Porter, & Garet, 2000; Borko, 2004; Cook, Landrum, Tankersley, & Kauffman, 2003; Desimone, Porter, Garet, Kwang, & Birman, 2002; Kinnucan-Welch et al., 2006; Loucks-Horsley, Hewson, Love, & Stiles, 1998
Seminar style discussion of instructional strategies, ways to implement them, and possible classroom roadblocks	Astor-Jack et al., 2007; Birman et al., 2000; Desimone et al., 2002; Galbo, 1998; Kinnucan-Welch et al., 2006
Informal discussions with the researchers to determine teachers' level of comfort and address concerns or implementation issues	Astor-Jack et al., 2007; Birman et al., 2000; Desimone et al., 2002
On-site instructional support during the initial implementation of the curriculum	Astor-Jack et al., 2007; Boudah, Logan, & Greenwood, 2001; Cook et al., 2003; Fuchs & Fuchs, 2001; Gersten & Dimino, 2001; Guskey, 2000; Kinnucan-Welch et al., 2006; Stichter, Lewis, Richter, Johnson, & Bradley, 2006

Table 2
Teacher Implementation Fidelity and Subsequent Use of RAFT Strategy

Teacher	Fidelity Score*	RAFT use Outside of Model Curriculum	*n* (students)
1	5	No	76
2	4	Yes	29
3	0	Yes	10
4	4.5	Yes	50
5	4	Yes	28
6	4	Yes	59

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

Analysis of Data

The observational data were analyzed by 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 curriculum (Skolits & Richards, 2009). Each activity within the science component was allotted a maximum of 5 possible points based on the ratio of activity elements completed by the teacher. 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. 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 jointly resolved to determine a final fidelity of implementation score. These data were used as a reference of how closely the teachers following the RAFT protocol when researchers compared 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.

Teachers' responses to the semi-structured interview questions were organized and prepared for data analysis using constant comparison analysis (Glaser & Strauss, 1967). First the actual transcripts of the interviews were presented to the participants approximately 1 week after the interview for member-checking. The researcher then read through each of the interview transcripts and made notes on the general sense of responses to each question. The participants' responses were then grouped by interview question to allow the researcher to look for emergent themes or codes. For each interview question, the researcher generated a list of topics and then grouped common topics into codes. Upon rereading the interviews, new codes were added as needed. Using the rich descriptions provided by participants, the codes were then organized into the themes and the themes used to generate interpretations of the data. Teacher responses were then compared to their fidelity scores and student assessment outcomes to verify teachers' perceived experiences. 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 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.

Results

To what extent do participating teachers subsequently apply a specific, novel instructional strategy (the RAFT strategy) from a model curriculum as taught in professional development workshops?

Among the 6 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 2). The others fell somewhere in between these two extremes. On a scale of 1 to 5 (1 = low fidelity, 5 = high fidelity), teachers had a mean implementation fidelity score of 3.58 (±1.8). All but one of the teachers applied the RAFT strategy in the context of the food safety curriculum effectively. One teacher chose not to implement the RAFT, but elected to remain in the study.

In the semi-structured interview, each teacher was asked to describe his/her experience using the RAFT strategy in the context of the food safety curriculum. Three prominent themes emerged from their responses: ease of implementation, impact of the strategy on student engagement, and the impact of the strategy on student learning. 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. Of the five teachers who used the strategy, all commented that they thought their students learned from the activity, responding that the RAFT "helped [students] remember the information better," 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, 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 simple regurgitation of new information. He reported that

the products were something "they could take, turn around, and reemphasize by presentation."

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 professional development training gave them an opportunity to learn how to implement it. The teachers cited the modeling of the RAFT strategy in the professional development and the opportunity to participate in a hands-on manner and critical factors to their subsequent use of the strategy. 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 "re-teach 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 they 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." These comments indicate that the professional development model employed in this study provided effective means to overcome at least some of the initial barriers to instructional change.

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 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 use the strategy effectively. 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 teacher 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 thought 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."

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

Although all but one of study participants implemented the RAFT strategy effectively in the context of the food safety curriculum implementation, the researchers wanted to know what role, if any, the strategy had played in the participants' broader classroom practices since the implementation. The hypothesis was that subsequent use of the RAFT in the context of other, teacher-designed units would demonstrate a propensity to add the strategy to their regular instructional repertoire.

Teachers were asked if they had used the RAFT strategy in a context outside of the food safety curriculum implementation. Five of the six teachers, including the teacher who had not initially used the strategy, reported they had used the RAFT strategy again in some context outside of the food safety curriculum (See Table 2). For example, Teacher 4 had 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.

All six teachers stated their intent to use the strategy in other units the following school year. Two participants gave 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 of the strategy in allowing students to apply and to synthesize information.

Research literature on professional development suggests that the quality of training has a significant impact on the ability of teachers to overcome instructional barriers to change (Fullan, 2001; Greenberg & Baron, 2000; Johnson, 2006). As such, it was important to address the study participants' perceptions of the training they received on the RAFT strategy to assess what impact the professional development had in helping them overcome barriers to change. Four of the six teachers believed that the training they received was sufficient to allow them to feel comfortable using the RAFT strategy again in their classrooms. The other two teachers thought they would benefit from more training. One of these who thought more training would be beneficial 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 researchers 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. Sharing the strategy with other teachers might indicate a strong comfort level with the strategy and a belief that the strategy was an effective instructional tool worthy of sharing with peers. However, 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.

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

The data from this study suggest that the amount of time required to implement the RAFT strategy and teachers' level of comfort with the new strategy are the two most challenging barriers to effecting change in teachers' use of the RAFT strategy. However, according to the study participants, on-site instructional support and effective professional development that included theory, modeling, and on-site support allowed the teachers to overcome these barriers and implement the strategy successfully. These findings support the current literature on barriers to instructional change in the classroom.

The RAFT instructional strategy can be time consuming. Providing thorough instructions and explanations of each role, audience, topic, and format, allowing students adequate time to construct their products, and then providing each student group an opportunity to present their products to the class generally takes at least one class period and often two. In this study, time was a factor that influenced the participants' fidelity of implementation. In the context of the model curriculum, one teacher chose not to use the strategy at all to provide more time for students to devote to hands-on laboratory 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 in their products to 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 during 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 6 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 operated 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 prepared them to use the strategy in their classrooms and addressed their areas of concern, enabling them to feel comfortable with the strategy. In fact, one teacher who used the strategy 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 re-teach 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 researchers' 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 thought 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."

Discussion

The design of this study closely followed recommendations of previous research to create a professional development environment conducive to teacher instructional change (Astor-Jack et al., 2007; Birman et al., 2000; Galbo, 1998; Guskey, 2000; Kinnucan-Welch et al., 2006). 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 was effective. Five of the six participants successfully implemented the strategy in the context of the food safety curriculum and five had also used the strategy again in other contexts.

This research-based 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. For example, one teacher said that "seeing [a strategy] work or experiencing it myself" was a significant factor in motivating him to attempt a new strategy. As active participants in creating RAFT products of their own during the professional development, teachers were able to see first-hand how successful the strategy could be in allowing students to apply and to 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, thereby 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.

It is important to recognize that, regardless of how effective an instructional strategy might 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. One explanation relates to the level of comfort teachers experienced with the strategy. Having the confidence to modify the RAFT to meet their instructional needs and the learning needs, styles, and preferences of their students suggests an inherent level of comfort with RAFT. Thus, increased implementation fidelity does not necessarily translate into continued use of the strategy. This is consistent with Chen's (2005) assertion that some reinvention of a program or strategy might 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 was effective and as the primary justification for continuing to use the strategy. In addition, when asked what factors are relevant to the selection of new strategies, personal level of comfort with the strategy was a common response. Previous research, supported by the results of this study, indicates that elevated levels of comfort with a strategy are critical to adopting that strategy as a regular part of classroom instruction (Cohen & Hill, 1998; Gess-Newsome, 2001; Loucks-Horsley et al., 1998; Sindelar & Brownell, 2001; Supovitz & Turner, 2000; Supovitz et al., 2000). Therefore, evidence exists that significant efforts to allow the teacher to develop a strong sense of comfort with novel instructional strategies through modeling, practice, and instructional support are necessary components of effective professional development.

The two primary barriers that teachers cited as preventing them from using this new instructional strategy were: (a) the teachers' levels of comfort with the strategy, and (b) 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 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 (Fullan, 2001; Greenberg & Baron, 2000; Johnson, 2006). The results of this study support prior research

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

Limitations

This was an exploratory study with a small sample size (n = 6). 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, therefore, constitute a volunteer population. The 6 participants in the study were selected solely on the basis that they taught the science component of the food safety 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. Although the assumption is that the researcher's multiple roles did not bias the current study, it is a limitation worth noting.

Conclusions and Recommendations for Future Research

Although the results of this exploratory case study are not generalizable to larger populations due to the small sample size, the findings of this study add to the body of literature on effective professional development in that they support and augment previous research on effective professional development models. It appears that teachers in the study 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 study participants 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.

Efforts to replicate this research in the future could benefit from the following recommendations:

1. *Future research should include larger samples in more diverse educational settings, as well as different content areas.* It would be fruitful 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 samples. 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 contexts. 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 as well.

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 that includes multiple treatment groups with a variety of professional development models. One possible example of this type of design would be a treatment group that receives the professional development model explored in this study versus a control group that receives a traditional *one-shot* professional development model. If the treatment group achieved the results in the present study and these results were significantly different for the control group, it would make a stronger case for adopting the professional development model employed within this study.

3. *Future studies on the effectiveness of professional development models on the adoption of novel instructional strategies should use study designs that use strategy in isolation, rather than as part of a larger, interdisciplinary instructional unit.* The decision was made to investigate teachers' adoption of the RAFT strategy in the context of the larger project because the structure of the project allowed for intensive professional development and opportunities for the participants to practice the strategy within the model curriculum with on-site instructional support. However, it is possible that the results of teacher adoption of the RAFT strategy in this study were influenced by it being embedded in the larger interdisciplinary curriculum. It seems highly likely that the participants were more likely to use initially the curriculum in the context of the model curriculum simply because it was part of a larger project. It is unclear, however, to what extent the strategies being embedded in the larger project impacted teachers' subsequent use of the strategy outside the model curriculum. To validate further the findings of this study, the professional development

model and subsequent teacher adoption of a novel strategy should be studied with the selected strategy in isolation.

The lead editors for this article were Anthony J. Onwuegbuzie and John R. Slate.

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.

Aikenhead, G. S. (1984). Teacher decision making: The case of Prairie High. *Journal of Research in Science Teaching, 21*, 167-186.

Astor-Jack, T., McCallie, E., & Balcerzak, P. (2007). Academic and informal science education practitioner views about professional development in science education. *Science Education, 91*, 604-628.

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.

Birman, B. F., Desimone, L., Porter, A. C., & Garet, M. S. (2000). Designing professional development that works. *Educational Leadership, 57*(8), 28-33.

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

Borko**,** H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher, 33*(8), 3-15.

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.

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

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

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

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

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

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). Bringing research to bear on practice: Effecting evidence-based instruction for students with emotional or behavioral disorders. *Education and Treatment of Children, 26*, 345-361.

Corcoran, T. B. (1995). *Transforming professional development for teachers: A guide for state policymakers.* Washington, DC: National Governors Association.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Los Angeles: Sage.

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

Darling-Hammond, L. (1995). Changing conceptions of teaching and teacher development. Teacher Education Quarterly, *22*, 9-26.

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

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.

Desimone, L. M., Porter, A. C., Garet, M. S., Kwang, S. Y., & Birman, B. F. (2002). Effects of professional development on teachers' instruction: Results from a three-year longitudinal study. *Educational Evaluation & Policy Analysis, 24*, 81-112.

Duffee, L., & Aikenhead, G. S. (1992). Curriculum change, student evaluation, and teacher practical knowledge. *Science Education, 76*, 493-506.

Dumas J., Lynch A., & Laughlin J. (2001). Promoting intervention fidelity. Conceptual issues, methods, and preliminary results from the early alliance prevention trial. *American Journal of Preventive Medicine, 20*, 38-47.

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*, 4-19.

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

Finn, J. D., & Rock, D. A. (1997). Academic success among students at risk for school failure. *Journal of Applied Psychology, 82*, 221-234.

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*, 13-15.

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. 91-100). Arlington, VA: NSTA Press.

Gess-Newsome, J., Southerland, S., Johnston, A., & Woodbury, S. (2003). Educational reform, personal practical theories, and dissatisfaction: The anatomy of change in college science teaching. *American Educational Research Journal, 40*, 731-767.

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.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research.* Chicago: Aldine.

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*. New York: McGraw-Hill. (Original work published in 1984)

Gravani, M. N. (2008). Academics and practitioners: Partners in generating knowledge or citizens of two different worlds? *Teaching and Teacher Education, 24*, 649-659.

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

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

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

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

Hiebert, J. (1999). Relationships between research and the NCTM standards. *Journal for Research in Mathematics Education, 30*, 3-19.

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

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

Joyce, B., & Showers, B. (1988). *Student achievement through staff development*. White Plains, NY: Longman Press.

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

Lieberman, A. (Ed.). (1996). Practices that support teacher development: Transforming conceptions of professional learning. In M. W. McLaughlin & I. Oberman (Eds.), Teacher learning: New policies, new practices (pp. 185-201). New York: Teachers College Press.

Little, J. W. (1993). Teachers' professional development in a climate of educational reform. *Educational Evaluation and Policy Analysis, 15*, 129-151.

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

Marks, H. M. (2000). Student engagement in instructional activity: Patterns in the elementary, middle and high school years. *American Educational Research Journal, 37*, 153-184.

Marshall, J., Pritchard, R., & Gunderson, B. (2001). Professional development: What works and what doesn't. *Principal Leadership (High School Ed.), 1*, 64-68.

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.

No Child Left Behind Act of 2001, 20 U.S.C. § 6319 (2008).

O'Donnell, C. L. (2008). Defining, conceptualizing, and measuring fidelity of implementation and its relationship to outcomes in K-12 curriculum intervention research. *Review of Educational Research, 78*, 33-84.

Orwin, R. G. (2000). Assessing program fidelity in substance abuse health services research. *Addiction, 95*(11S3), 309-327.

Penual, R., & Means, B. (2004). Implementation variation and fidelity in an inquiry science program.: Analysis of GLOBE data reporting systems. *Journal of Research in Science Teaching, 41*, 294-315.

Richards, J., Skolits, G., Burney, J., Pedigo, A., & Draughon, F. A. (2008). Validation of an interdisciplinary food safety curriculum targeted at middle school students and correlated to state educational standards. *Journal of Food Science Education*, 7, 54-61.

Robertson, J., & Bond, C. (2005). The research/teaching relation: A view from the 'edge'. *Higher Education, 50*, 509-35.

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*, 197–227.

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

Sanchez, V., Stekler, A., Nitirat, P., Hallfors, D., Cho, H., & Brodish, P. (2007). Fidelity of implementation in a treatment effectiveness trial of Reconnecting Youth. *Health Education Research, 22*, 95-107.

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

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

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

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

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

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 Erlbaum Associates.

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 Education, 24*, 348-355.

Skolits, G., & Richards, J. (2009). *Designing and applying Project Fidelity assessment for a teacher implemented middle school instructional improvement pilot intervention*. Manuscript submitted for publication.

Sparks, D., & Loucks-Horsley, S. (1989). Five models of staff development for teachers. *Journal of Staff Development, 10*, 40-57.

Speck, M. (1996). Best practice in professional development for sustained educational change. *ERS Spectrum*, *14*, 33-41.

Stake, R. E. (2000). Case studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 237-47). Thousand Oaks, CA: Sage.

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*, 665-692.

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*, 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*, 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*, 3-28.

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

U.S. Department of Education. (2003, December). *Identifying and implementing educational practices supported by rigorous evidence: A user-friendly guide.* Washington, DC: Institute for Education Sciences.

Vaughn, S., Cirino, P. T., Linan-Thompson, S., Mathes, P. G., Carlson, C. D., Hagan. E. C., et al. (2006). Effectiveness of a Spanish intervention and an English Intervention for English-language learners at risk for reading problems. *American Educational Research Journal*, *43*, 449-487.

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

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

Williams, D., & Coles, L. (2007) Teachers' approaches to finding and using research evidence: an information literacy perspective. *Educational Research, 49*, 185-206.

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

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

Ysseldyke, J., Spicuzza, R., Kosciolek, S., Teelucksingh, E., Boys, C., & Lemkuil, A. (2003). Using curriculum-based instructional management systems to enhance math achievement in urban schools. *Journal of Education for Students Placed at Risk, 8*, 247-265.

Appendix A

Implementation Observation Checklist Criteria – Science

Implementation Observation Checklist Criteria - Science				
			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 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?