THE DIFFERENTIAL EFFECTS OF TWO VERSIONS OF MIDDLE-SCHOOL INQUIRY-BASED SCIENCE PROGRAM PROFESSIONAL DEVELOPMENT INSTITUTES ON TEACHERS' SELF-EFFICACY AS INQUIRY-BASED SCIENCE TEACHERS

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI'I IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF EDUCATION

IN

EDUCATIONAL PSYCHOLOGY

MAY 2005

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ACKNOWLEDGMENTS

I would like to acknowledge several people for their interest and support as I journeyed through the process of the research and writing of this study. To Paul Brandon, my committee chairman, thanks for the opportunity to work with you on the FAST study and for your constant interest in my progress. To Tyra Shimabuku, thanks for providing your time and experience in helping me develop and facilitate my focus groups. To Mary Gray, Tom Scarlett and Drs. Donald Young, Frank Pottenger, and Tom Speitel: Thanks for your continuous feedback and for sharing your valuable time and knowledge in the pilot testing of my instruments. Thanks to the science teachers who participated in my focus groups. To my Mom and Dad, Linda and Rick Lawton, thanks for your encouragement, love, and guidance. To my wife Summer, none of this would have been possible without your loving support; I am forever indebted to you for putting your dreams on hold so I can accomplish mine.

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CHAPTER 1
INTRODUCTION

Research has been increasingly concerned with teacher self-efficacy and how it relates to the design of professional development for science teachers (Cole, Ryan, & Ramey, 2003; Crowther & Cannon, 2002; Gerber, Brovey, & Price, 2001; Porter, 2002; Saam, Boone, & Chase, 2001). Self-efficacy is a person's beliefs or expectations about his or her capacity to accomplish certain tasks successfully or demonstrate certain behaviors (Bandura, 1977; 1986). The National Science Education Standards (NSES, 1995) state that quality professional development programs should be fully aware of the developmental nature of teachers' professional growth, including attending to the needs of teachers who have varying degrees of experience, competence, and proficiency. With the recognition that professional development programs are a means of affecting school change, there is an increased demand to show that professional development programs are producing intended results (Guskey, 1994), including improvements in self-efficacy. The purpose of this study is to investigate the extent to which two versions of a middle-school science professional development program positively affect middle-school science teachers' self-efficacy to implement inquiry-based science.

The Foundational Approaches in Science Teaching Program

Foundational Approaches in Science Teaching (FAST) is a three-year middle-school inquiry-based science program that has been used by more than 6,000 teachers in 30 states and 10 foreign countries (Curriculum Research & Development Group, 2003). The FAST program uses a constructivist approach to teaching science. It was designed to provide

students with investigative experiences and inquiry skills, as well as application of the physical, biological, and earth sciences (Young & Pottenger, 1992). "The goal of the FAST program is to develop scientifically literate students who have both the background necessary for understanding environmental concerns in our technological society and the foundational tools for further study in science" (Young & Pottenger, 1992, p. 3).

All middle-school science teachers planning to teach FAST must participate in a professional development institute. Curriculum Research & Development Group (CRDG) will not sell books to teachers who have not participated in a FAST institute. An institute is conducted for each of the three years of FAST (FAST 1, FAST 2, and FAST 3). The institutes are designed to prepare participants to successfully teach the program by developing their (a) knowledge of the program's philosophy and objectives, (b) ability to use a variety of instructional strategies, (c) understanding of content of physical, biological, and earth sciences that is necessary to teach the course, and (d) excitement and enthusiasm for teaching science (Brandon, 2002). In the FAST institutes, teachers participate in inquiry investigations that model the varieties of teaching behaviors and provide for reflective discussions of learning, teaching, and assessing. A support program is also provided, including newsletters, e-mail, Web site, and toll-free number phone support (Curriculum Research & Development Group, 2003).

Extension of a Larger Study

CRDG is currently conducting the first phase of a National Science Foundation (NSF) study. The purpose of the Phase-I study is to prepare for a second phase in which (if funded) CRDG will examine whether improvements in professional development and long-term

support enhance program implementation and thereby increase the likelihood that FAST can be scaled up. The Phase-I study consists of two components. First, CRDG has prepared a new 5-day FAST-1introductory teacher institute and an expanded and improved version of long-term support consisting of a multimedia DVD and a two-semester online course. Second, CRDG is developing and validating instrumentation for Phase-II.

The present study is intended to supplement Phase-I of the project and provide CRDG with valuable preliminary information about the differential effects of the traditional 10-day institute and the new 5-day institute. The findings of this study will be examined in light of their implication for the broader study.

Rationale

This study examines, both qualitatively and quantitatively, (a) the changes in middle-school science teachers' perceptions of their self-efficacy to implement inquiry-based science instruction immediately after attending a 10-day or a 5-day FAST-1 professional development institute and (b) the differences in self-efficacy between teachers attending the two institutes. Several studies examining the extent to which FAST has affected student science achievement have shown significant differences between FAST and non-FAST students in recall, higher-level cognitive processing, and science processing skills (Curriculum Research & Development Group, 2000; Dekkers, 1978; Pauls, Young, & Lapitkova, 1999; Tamir & Yamamoto, 1977; Young, 1982, 1993). However, no research has been conducted on the change in teacher self-efficacy after attending FAST institutes or on the components of the institutes that affect this change. While this study does not address the number of teachers who do not implement the FAST-1 program due to low self-efficacy,

it does examine how teachers' self-efficacy in using stages of inquiry-based science instruction changed immediately after attending the training.

The importance of the study is to provide preliminary findings about the differences between the two versions of professional development. These findings will supplement those collected in the second phase of the NSF study by identifying teachers' perceived ability to use inquiry-based knowledge and to answer the various questions that students may have about science topics, an important aspect of the FAST program. This study will also contribute to the body of knowledge about science educators' professional development by examining the effects of variation in the lengths of professional development workshops.

The examination of the relationship between teachers' self-efficacy and their inquiry-teaching skills has been the focus of several researchers (Enochs & Riggs, 1990; Gibson & Dembo, 1984, Guskey, 1988; Plourde, 2002). Rubeck and Enochs (1991) reported that teachers with high self-efficacy tended to teach in ways characterized by the use of inquiry approaches. Czerniak (1990) also showed that highly efficacious teachers have been found to be more likely to use inquiry and student centered teaching strategies, while teachers with a low sense of efficacy are more likely to use teacher-directed strategies (in Plourde, 2002). With the knowledge that science education is lacking in the areas that will equip and entice teachers to effectively and consistently teach inquiry-based science (Cavicchi & Hughes-McDonnell, 2001; Kahle & Kronebusch, 2003) and by showing that the FAST program achieves this end, others will benefit from a model that attends to multiple aspects of effective teaching practices.

Research Questions

In this study, I examine the self-efficacy to implement inquiry-based science of teachers who participated in a 10-day FAST-1 institute and of teachers who participated in a 5-day FAST-1 institute. The research questions that this study addressed are

1) Is there a change in teacher self-efficacy to implement inquiry-based science instruction after attending the traditional 10-day FAST-1 institute, and what factors influence this change?
2) Is there a change in teacher self-efficacy to implement inquiry-based science instruction after attending the new 5-day FAST-1 institute, and what factors influence this change?
3) Is there a difference in the change in teacher self-efficacy to implement inquiry-based science instruction between the 5-day and 10-day versions of FAST-1 institutes?

Limitations

Limitations to this study include:

1) No attempt was made to control for teacher background and science teaching experience. The participating teachers' educational background, demographic information, and understanding of inquiry science, as it is used in the FAST program, may have varied within or between the 10-day and the 5-day groups.
2) This study examines the teachers after only a brief exposure to the FAST program—namely, their participation in the professional development institutes.
3) The entire analysis and coding of the qualitative data was conducted solely by the researcher, which may affect the reliability of the results.

CHAPTER 2
REVIEW OF LITERATURE

In order to understand the changes in self-efficacy that might occur after the participation in a professional development institute, a review of literature on teacher self-efficacy, factors that influence teacher self-efficacy, and aspects of effective professional development that contribute to teacher change is necessary.

The Construct of Self-Efficacy

Self-efficacy is a construct based in the theoretical framework of Social Cognitive Theory developed by Bandura (1977, 1986). Behavior, for Bandura, is partially based upon two components: self-efficacy and outcome expectancy. Self-efficacy refers to an individual's belief that he or she possesses the requisite skills and abilities to accomplish an identifiable task. Self-efficacy determines the individual's level of persistence to learn a task and influences perceptions of future outcomes. Outcome expectancy refers to an individual's belief that task accomplishment leads to a desired outcome. It is defined as the consequence of an act and not the act itself. Both have separate and distinct impacts on individual behavior, although Bandura (1986) states that self-efficacy typically has a greater effect and that self-efficacy has a direct impact on outcome expectancy. Furthermore, self-efficacy suggests that an individual's expectations primarily influence situations involving motivation, performance, and feelings of frustration associated with repeated failure. Woolfolk-Hoy (2004) states that "one of the things that makes self-efficacy judgments so powerful is the cyclical nature of the process. Greater efficacy leads to greater effort and persistence, which leads to better performance, which in turn leads to greater efficacy. The

reverse is also true. Lower efficacy leads to less effort and giving up easily, which leads to poor outcomes, which then produce decreased efficacy" (p. 11).

According to Bandura (1977), there are four influential sources that determine an individual's level of self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and physiological and emotional states. Bandura asserts that the most effective means of creating change in people's beliefs about their efficacy is through *mastery experience*. It is through successes, especially if these involve overcoming obstacles, that a strong sense of efficacy is created. Moreover, the level of difficulty of the task and the early achievement of success during learning directly influence the extent to which the level of efficacy is maintained. Inasmuch as success though perseverance creates a strong sense of efficacy, so does failure under the same effort undermine it. It is through practice and increased success on increasingly difficult tasks that the highest and best maintained level of self-efficacy is established. The second source that is identified as creating and strengthening self-efficacy is through social models or *vicarious experiences*: Seeing people similar to oneself succeeding through sustained effort creates a sense that success can be obtained on a similar task (Bandura, 1994). The more closely the observer identifies with the model, the stronger the effect on efficacy (Bandura, 1977). When a credible model teaches well, the efficacy of the observer is enhanced. When the model performs poorly, the expectations of the observer decrease. Therefore, observing sustained successful efforts, as well as failed efforts, influences self-efficacy. Bandura (1994) describes the third source of self-efficacy, *verbal persuasion*, by stating that "people who are persuaded verbally that they possess the capabilities to master given activities are likely to mobilize greater effort and

sustain it than if they harbor self-doubts and dwell on personal deficiencies when problems arise" (p. 73). Importantly, the level of effort that is initially asserted when verbally persuaded depends on how realistic the individual perceives the task to be. Verbal persuasion, though potentially limited in its impact, may provide encouragement to counter occasional setbacks; the effectiveness of persuasion depends on the credibility, trustworthiness, and expertise of the persuader (Bandura, 1986). The final source that influences self-efficacy is the *physiological and emotional state* of an individual during a given task. The level of a person's physiological states, given their experiences in a given situation, often affects how the person defines his or her capabilities. As Bandura (1994) states, "It is not the sheer intensity of emotional and physical reactions that is important but rather how they are perceived and interpreted" (p. 73). For example, people with a high sense of self-efficacy view anxiety and excitement about a performance as a catalyst for success, whereas people with a low sense of self-efficacy may interpret the same anxiety and excitement as an inhibitor of success.

Teacher Self-Efficacy

Teaching self-efficacy was initially studied by researchers at RAND (Armor, Conroy-Oseguera, Cox, Kink, McDonnell, Pascal, et al., 1976). With the theoretical foundation of Rotter's (1966) work, RAND showed that teachers with high levels of self-efficacy believed they could control, or strongly influence, student achievement and motivation (Tschannen-Moran, Woofolk-Hoy, & Hoy,1998). Tschannen-Moran and Woolfolk-Hoy (2001) found that teachers with high self-efficacy tend to be more open to new ideas, more willing to experiment with new methods to better meet the needs of their students, and more committed

to teaching. In a review of numerous studies on teacher self-efficacy, Ross (1994) identified potential links between teachers' sense of efficacy and their behaviors. Ross suggested that teachers with higher levels of efficacy are more likely to (a) learn and use new approaches and strategies for teaching, (b) use management techniques that enhance student autonomy, (c) provide special assistance to low achieving students, (d) build students' self-perceptions of their academic skills, (e) set attainable goals, and (f) persist in the face of student failure. Moreover, Ramey-Gassert (1994) provided a holistic view of the factors that influence teacher self-efficacy. She explained that teaching-efficacy beliefs are developed though a combination of life experiences, teacher preparation and professional development experiences, and teaching experience. Much like Bandura's (1981) conception of self-efficacy, Ramey-Gassert found that teaching efficacy is influenced by internal factors such as persistence, effort, motivation, academic focus, and task orientation as teachers and external factors including aspects of the school workplace environment such as facilities, administrative support, and resources and student variables such as motivation, academic achievement, and behavior.

In science teaching contexts, teaching self-efficacy is an individual's belief that he or she has the ability to effectively perform science teaching behaviors (Ramey-Gassert, Shroyer, & Staver, 1996). Bandura (1981) asserts that self-efficacy is situation-specific as well as subject-specific. Teachers might feel efficacious in certain subject areas such as science and mathematics, but they might be fearful of other subjects such as language arts or social studies. Through her analysis of the literature, Ramey-Gassert (1994) found that science teachers teach science effectively because they believe they possess sufficient science

background, have a positive attitude toward science, and believe in their abilities to teach science effectively and to help their students succeed in learning science. Moreover, positive or negative teacher preparation experiences such as professional development institutes also affect science teacher self-efficacy (Ramey-Gassert, 1994).

A component of this study is to identify factors that affect changes in teachers' perceptions of their self-efficacy; therefore, it is important to understand the various sources and factors that tend to influence teacher self-efficacy. Although the factors and sources of teacher self-efficacy that are identified in this review could potentially influence the results, the teachers' professional development experience, specifically their participation in the FAST-1 institute, is the focus of this study. That is not to say that the teachers' attitudes, background, and belief about their effectiveness as teachers are absent, but that these factors are not directly controlled in the study or thoroughly addressed in the discussion.

The subject-specific nature of self-efficacy, and the idea that teacher efficacy is influenced by professional development experience, make this study of the differential effects of two versions of a professional development institute on science teaching self-efficacy a relevant topic.

Professional Development and Teacher Change

With respect to the components of a professional development program that affect teacher change, Doyle and Ponder (1977), suggested that three criteria influence teachers' decisions to implement new practices: (a) how clearly and specifically practices are presented, (b) how well the new practices are aligned with the teachers' present teaching philosophy and practices, and (c) the teachers' estimate of the extra time and effort new

practices require. Sparks (1983) added two additional criteria: teachers' perceptions of the importance of the new practices and their perceptions of the difficulty of use. Guskey (1988) found that there was a significant relationship between teachers' perceptions of teaching practices they generally associated with instructional effectiveness and their attitudes toward the implementation of new instructional practices. Interestingly, Guskey (1988) also suggested that teachers who volunteer to participate in professional development institutes whose aim is to introduce innovative instruction were perhaps already talented and effective teachers.

In line with Doyle and Ponder (1977) and Sparks (1983), Guskey and Sparks (1991, 1996) suggested that the development of an effective professional development program should address several factors: the context in which the program is delivered, the content that will be presented, and the process by which the program is delivered. Guskey and Sparks (1991) reviewed several studies that also identified these factors contributing to a change in teachers' behaviors and instructional strategies, including studies by Guskey (1986), Huberman and Miles (1984), and Joyce and Showers (1988). The context characteristics, content characteristics, and process characteristics, as described by Guskey and Sparks (2002), are detailed in their theoretical model of the relationship between professional development activities and components and improving student achievement. The *context characteristics* (Guskey & Sparks, 2002) include the traits of the group involved in the professional development, the group's work environment, and the students the group serves. Also, context includes the policies at the district and school levels that may affect implementation. For a change in teachers' behavior including self-efficacy to implement a

new teaching strategy to be affected, the developers of the professional development institutes should attend to these context factors. A teacher must believe that the new information and skills they have received can function in their current school environment. The *content characteristics* (Guskey & Sparks, 2002) of professional development include the new knowledge that is gained, which can be from understanding how students learn to learning new pedagogical processes. Two important issues that developers should consider are the extent to which the teachers have the experience and knowledge base to understand the new concepts and the level of understanding at which the teachers leave the professional development institutes. In the end, teachers who feel that they do not fully understand the material and skills needed to teach the program will not implement the program. The *process characteristics* (Guskey & Sparks, 2002) refer to the overall organization of the activities included in the program. The process training components may include exploration of theory, demonstrations, modeling, and practicing the new skills, which should all be based on solid research (Joyce & Showers, 1987). Further, Joyce and Showers (1983) found that programs which contained these training components resulted in the highest teacher behavior changes.

A primary aspect of the differences between the two institutes examined in this study is their length. In examining the effects that the duration of a professional development program had on teacher efficacy, Crowther and Cannon (2002) compared two science programs, including a three weekend course and a two-week intensive course with a long-term follow-up session and support. The results indicated that their was no difference in the change in science teacher efficacy as measured on the Science Teaching Efficacy Belief Instrument (Enochs & Riggs 1990) between the two programs. However, the authors did find

a decrease in teacher efficacy for the three weekend course over the time period of the workshop, while the intensive workshop showed an increase after the follow-up session, suggesting that the time to practice and follow-up support were important factors in causing positive change in teacher efficacy (Crowther & Cannon, 2002).

As the literature suggests, several components need to be addressed when creating effective professional development programs: context, content, duration, perceived importance and difficulty of use, and support, to name a few. In an effort to identify common characteristics of effective professional development programs, Guskey (2003) examined over a dozen lists and concluded that the characteristics were often derived in different ways, used different criteria to determine effectiveness and varied in the characteristics they identified. This finding suggests that while there are agreed upon components that a professional development program should have, no firm criteria have been established.

The intent of this literature review was to present some background on the concept of teacher self-efficacy and the sources of self-efficacy change, as well as to identify the factors that are related to effective professional development and how they influence teacher change. The review of the sources of self-efficacy provides a foundation from which to identify change, and the factors that affect change, in the levels of teacher self-efficacy. The components of effective professional development were reviewed in order to identify the FAST-1 program components and determine if they influence teachers' belief systems. Chapter 3 will present the methodology and specific procedures used in this study.

CHAPTER 3
METHODOLOGY

The purpose of this study is to (a) examine the extent to which two versions of FAST-1 professional development program changed middle-school science teachers' self-efficacy to implement inquiry-based science instruction, (b) identify aspects of the institutes contributing to self-efficacy change, and (c) determine if there were differences in self-efficacy between the two versions. This study used both qualitative and quantitative methods, including a focus group and a self-report retrospective pre/posttest self-efficacy scale. The focus group was the primary method for this study; it was conducted at the conclusion of each of the two versions of the FAST-1 professional development institutes. Because of the affective nature of belief systems and their impact on behavior, using a qualitative method as a primary means of data collection is an appropriate approach to understanding and explaining science teachers' self-efficacy beliefs and their experiences with science and science teaching after participating in the FAST-1 institutes. The factors contributing to strong, exemplary science teaching are complex and require a rich, complex explanation (Fraser & Tobin, 1989; Tobin & Fraser 1991); therefore, more definitive and meaningful answers are revealed through purposeful, in-depth qualitative research. A retrospective pre/posttest self-efficacy scale was developed to guide discussion and examine the major stages of science inquiry defined in this study. The self-efficacy scale's function was to facilitate discussion during the focus group; and to collect quantitative self-efficacy data. The multiple data collection methods were employed to offer alternative perspectives on the effects of the two versions of professional development.

Overview of the FAST Professional Development Institute

Both versions of the FAST-1 professional development institutes are designed to develop an understanding of teaching inquiry-based science for upper elementary and middle-school science teachers. The courses emphasize the development of foundational concepts and skills necessary for teachers to teach integrated science courses in middle-schools (M. Gray, personal communication, December 20, 2004). The schedules of the two versions of the FAST-1 professional development institutes held during Summer 2004 are presented in Appendix A, Figures 2 and 3.

The institutes involve participants in the kinds of activities that characterize a modern scientific community. The methods of investigation pay careful attention to experimental design, the setting of controls, execution of experimentation, and interpretation of results. By being active learners, teachers develop their own laboratory skills, thinking skills, and content backgrounds, all of which enable them to better facilitate and coach students in conducting science in their classrooms. The course also provides background information on the scientific theories and thereby helps the participants develop the level of understanding of the physical, biological, and earth sciences that is necessary to teach middle-school science.

During the FAST-1 institute, participants begin with studies of buoyancy, out of which the concepts of mass, area, volume, density, properties of matter, thermal effects on buoyancy, and the buoyancy-density relationships of solids, liquids, and gases emerge. Changes in the states of matter, pressure and temperature effects on matter, properties of pure substances, mixtures, and fluids are also investigated. Finally, an understanding of

environmental relationships through investigations of plant and animal growth, life cycles, life needs, interaction, and interdependence are presented.

While the traditional 10-day version of the FAST-1 institute is designed to provide participants with the skills necessary to begin full implementation, the enhanced 5-day institute takes teachers though nearly half of the sequence of investigations in the program. The second half of the investigations of the 5-day institute are guided and learned virtually though a DVD, which supports teachers in implementing the FAST-1 program by showing events of actual student investigations and teacher preparation, and through an on-line course, which provides follow-on instruction and interaction with teachers during the regular school year to support their learning and teaching. The 5-day follow-on support is designed to supplement the additional modeling, investigative interaction, and classroom management techniques that are received during the second week of instruction in the 10-day institute.

The focus of this paper is to examine the extent to which the in-class elements of the two versions affect teacher self-efficacy and the extent to which changes vary among the institutes.

Participants

The subjects in this study included middle-school science teachers participating in the 5-day and 10-day FAST-1 professional development institutes during the Summer of 2004 at the University of Hawai'i at Mānoa. Of the participants in each of the two professional development institutes, seven teachers from the 10-day institute and seven teachers from the 5-day institute agreed to participate in this study. In both groups, teacher experience, which was ascertained during the focus group sessions, ranged from those who would be teaching

their first science classes in Fall 2004 to teachers who were seasoned science instructors with over 20 years of experience.

FAST Teacher Self-Efficacy Scale

The purpose of the self-efficacy scale was to identify teachers' perceptions of their ability to implement five defined stages of inquiry-based science. The scale was devised to assesses the specific nature of science inquiry. Items from the scale were constructed to align with the conceptual definition of self-efficacy by phrasing them, respectively, as an individual's ability to use an aspect of inquiry science to facilitate student understanding of inquiry science. The scale consisted of five 10-point Likert-scale items (one item for each stage), with the descriptors, *low ability* and *high ability,* at the ends. The internal consistency of the items is presented in Chapter 4. The scale is presented in Appendix B.

Four of the five stages for examining teachers' self-efficacy to implement inquiry-based science were taken and slightly modified from Northwest Regional Educational Laboratory's (2002) definitions of science inquiry. Stage 5 was developed as a result of a the pilot testing of the instruments. The participants of the pilot test agreed that being able to enable students to link knowledge to new situations is an important aspect of the FAST program. Therefore, the five stages of inquiry-based science used in this study are defined here.

- *Stage 1. Introducing new science investigations* – the ability to introduce students to new science investigations by reviewing and tying to previous work.
- *Stage 2. Facilitating valid experimental design* – the ability to help students understand the components of valid experimental design, including such things as developing methods for collecting data to answer their questions and paying attention

to setting standards, replications, and controls.

- *Stage 3. Facilitating the investigation process* – the ability to guide the students during the investigation process, including recording revisions to their procedures, setting up and using equipment safely and correctly, and accurately recording the data generated.
- *Stage 4. Constructing meaning* – the ability to facilitate the students in analyzing and interpreting data, identifying and examining trends in the data, and using the information provided by the data to formulate explanations of science investigations.
- *Stage 5. Linking knowledge to new situations* – the ability to enable students to use their knowledge and understandings to explore new situations.

The teachers first were asked to rate their ability to implement a stage at the present—that is, after attending the professional development institute. Then the teachers were asked to retrospectively rate their ability to implement a stage *before* attending the professional development institute. Finally, the teachers discussed as a group why they perceived a change, if any, in their perceived ability to implement the stage (focus group). This procedure was carried out for each of the five stages.

By using a scale that allowed the teachers to reflect on their previous levels of self-efficacy after they had a clear sense of FAST-1 program processes, a more accurate view of the actual changes was obtained than if a self-efficacy pretest had been given before the institutes. That is, had the teachers completed the scales before the institutes, their definitions of the inquiry process may have differed in varying degrees from the FAST version, causing the validity of the measurement to be in question because of a false decrease in the gains of

self-efficacy to implement. The teachers may have thought they could carry out the process effectively, by their definition of the inquiry process, when in fact, according to FAST's definition, they might not have been as efficacious as they initially thought. To answer accurately, the teachers' needed to have a clear sense of what each of the science teaching strategies taught in FAST-1 intends to accomplish, and to determine the extent of their perceived ability to implement each strategy. Howard and Daily (1979) referred to an individual's change of reference because of program participation as *response shift bias*. To deal with response shift bias, participants first report on their knowledge, behavior, or attitudes after the occurrence of an event or experience such as an educational intervention. Then, in the same sitting, the participants complete the self-report again, this time reporting their perceptions of their levels of knowledge, behavior, or attitudes before the event or experience (Goedhart & Hoogstraten, 1992; Terborg, Howard, & Maxwell, 1980).

Hoogstraten (1982) provided evidence of the validity of retrospective pretest-posttest designs when using self-report measures as outcome criteria by showing how subjects initially overestimated their performance as shown in pretest mean score comparisons. Similarly, in studying retrospective versus traditional pretests for measuring science teaching efficacy beliefs, Cantrell (2003) found a significant difference in the means of the two pretests, with the retrospective pretest showing a greater gain than the traditional pretest when compared to the posttest scores. The findings of a greater gain on the retrospective pretests reflected teachers' misconceptions of their efficacy when assessing themselves before the treatment. Follow-up interviews with participants provided evidence for greater internal validity for the retrospective pretest and also supported the notion that retrospective

pretests may produce gain scores with greater validity and greater statistical power (Cantrell, 2003). Other researchers have also found that the use of a retrospective pretest design produces greater validity and statistical power than a typical pre-post design (Lam & Bengo, 2003; Pratt, McGruigan, & Katzev, 2000).

A two-way split-plot analysis of variance (ANOVA) was done to compare within-group retrospective pre-post mean rating changes and to determine if there was a statistically significant between-group difference in the changes from pre to post. SAS software was used for the quantitative analyses.

FAST Teacher Focus Groups

Focus group qualitative research methodology was used to gather information about the aspects of the FAST-1 institutes that may have affected teachers' sense of self-efficacy to implement inquiry-based science. A focus group is a small group discussion designed to obtain in-depth qualitative information (Dean, 1994). The overall goal of any focus group is to reveal the participants' perceptions about the topics for discussion (Dean, 1994). The focus group guide used in this study was adapted and modified for this study from an existing version (Higa & Brandon, 2001), which was developed based on the work of Stewart and Shamdasani (1990) and Dean (1994). Higa and Brandon developed and refined the guide in several focus groups that were conducted in several projects. It includes thorough instructions to the focus group facilitator and was designed to standardize the process and to address all relevant aspects of focus groups. The self-efficacy scale was incorporated into the focus group guide for the present study by providing prompts and explanations to facilitate teachers' discussion of their self-efficacy change. The focus group guide and script

are presented in Appendix B.

Focus group procedure. The focus groups were conducted at the University of Hawai'i at Mānoa immediately following the professional development training in the same classroom in which the training took place. The 5-day professional development institute was conducted during the week of June 14–18, 2004; the focus group was conducted on June 18, 2004. The FAST-1 10-day professional development institute was conducted during the weeks of June 21–July 2, 2004; the focus group was conducted July 2, 2004. A practicing FAST-1 science teacher was recruited to facilitate the groups including administering the self-efficacy scale and conducting the focus groups. The researcher was present for both groups and video recorded each of the sessions.

To begin each session, the facilitator introduced the purpose of the focus group and the focus group procedure. The self-efficacy scale was then distributed and explained to the group. For each stage, teachers were asked to complete the self-efficacy scale and then asked to discuss their change, if any, between their pre-institute and post-institute self-efficacy rating and the rationale for the change. The data collection session lasted one hour for both the 10-day group and the 5-day group.

Focus group pilot test. A focus group pilot was conducted to (a) determine the quality of the definitions for each stage of inquiry science on the self-efficacy scale, (b) train the facilitator to conduct the focus group sessions, and (c) gauge the maximum amount of time to spend on discussing each stage. Five individuals participated in the focus group pilot; all had extensive knowledge of the FAST program, with participation in its development or dissemination. The focus group pilot test resulted in adding the final stage, *linking knowledge*

to new situations. The four stages defined for inquiry science, which were borrowed from the Northwest Regional Educational Laboratory (2002), were parallel to how the FAST program would define inquiry science, which was confirmed by the pilot test participants, but they suggested a fifth stage that addressed the level of change in teachers' perceived ability to facilitate student understanding of the scientific concepts to the real world—that is, to reach the ultimate goal of the FAST program: "to develop scientifically literate students" (Young & Pottenger, 1992, p. 3).

Focus group analysis. The focus group videotapes were transferred to DVD and transcribed verbatim for analysis. The researcher transcribed, analyzed, and coded the focus group results for both groups. The first step in the analysis was to review the focus group results for statements that demonstrated an increase in self-efficacy. This was done by isolating statements that showed a shift in the teachers' ideas or concepts about their teaching practices as well as instances that showed an intent to change teaching practices. This categorization is supported by the research of Bandura (1993) and Pintrich, Marx, and Boyle (1993), who found that self-efficacy was closely related to an individual's confidence in his or her ability to change ideas or concepts. The comments were then separated into two categories: those in which the statements implied an increase in self-efficacy and those that did not imply an increase in self-efficacy or implied a questionable increase in self-efficacy. Finally, the comments in the two categories were reviewed for common themes (i.e., characteristics of teachers, the teachers' students, classroom, aspects of the professional development, and so forth) that the teachers' identified as influencing their self-efficacy. The factors were identified, in addition to isolating the statements that implied an increase in self-

efficacy, because a goal of the FAST-1 professional development is to provide a foundation from which the participants can initiate inquiry-based instruction on a regular basis; therefore, it is important to identify the facets within the FAST-1 professional development institutes, as well as its participants, that affect change in teacher self-efficacy. The complete focus group transcriptions are provided in Appendix C.

To compare the effects of the professional development institutes on teachers' self-efficacy, a quantitative summary of the comments in the two categories and their associated influencing factors was done. For this comparison, a factor was counted only once for a participant even though a participant may have referred to that factor more than once throughout his or her discussion of the various stages. Similarly, only what was identified as the primary influencing factor was counted even though other factors may have been present in the participant's statement. The reason for the aggregation of the comments was based on the analysis of the focus group data and will be presented in Chapter 4. The total number of comments for each factor, as well as the number of teachers making these comments, are also presented Chapter 4.

CHAPTER 4
RESULTS

Self-efficacy was assessed using both quantitative and qualitative data. Quantitative data were gathered using the 10-point self-efficacy scale that was developed for this study. The self-efficacy scale was administered at the conclusion of both versions of the professional development institutes. Qualitative data were gathered during post-institute focus groups. The results of the participants' self-efficacy ratings were used to facilitate discussion during the focus group sessions.

Self-Efficacy Scale Results

In this section I describe the quantitative results on teachers' perceptions of their changes in self-efficacy to implement inquiry-based science. I present the 10-day group results first, followed by the 5-day group results, and then the results of the between-group comparison. The overall Cronbach's alpha (both groups combined) for the five items on the scale was α=0.89 for the pretest and α=0.77 for the posttest, indicating internal consistency of the items.

10-day group results. The results on the self-efficacy scale showed a mean increase of 2.29 points (1-to-10 scale) for the 10-day participants' self-efficacy rating. The participants' mean rating of their retrospective, pre-institute self-efficacy was 5.94, with a standard deviation of 1.39, and their mean rating after attending the institute was 8.23, with a standard deviation of 0.41. The two-way split-plot ANOVA indicated a statistically significant difference in the 10-day groups' mean rating gains (F=35.23, df=6, $p<0.01$).

5-day group results. The results on the self-efficacy scale showed a mean increase of

1.71 points (1-to-10 scale) in the 5-day participants self-efficacy rating. The participants' mean rating of their retrospective, pre-institute self-efficacy was 6.09, with a standard deviation of 1.50, and their mean rating after attending the institute was 7.80, with a standard deviation of 0.55. The two-way split-plot ANOVA indicated a statistically significant difference in the 5-day groups' mean rating gains (F=18.62, df=6, p<0.01).

Two group comparison. A two-way split-plot ANOVA was conducted on the results of the self-efficacy scale to determine the statistical significance between the two group's pre-to-post self-efficacy changes. No statistically significant difference was found in the gains of self-efficacy ratings between the groups (F=0.08, df=1, p>0.05). Figure 1 provides a visual representation of the changes in self-efficacy ratings for the two groups.

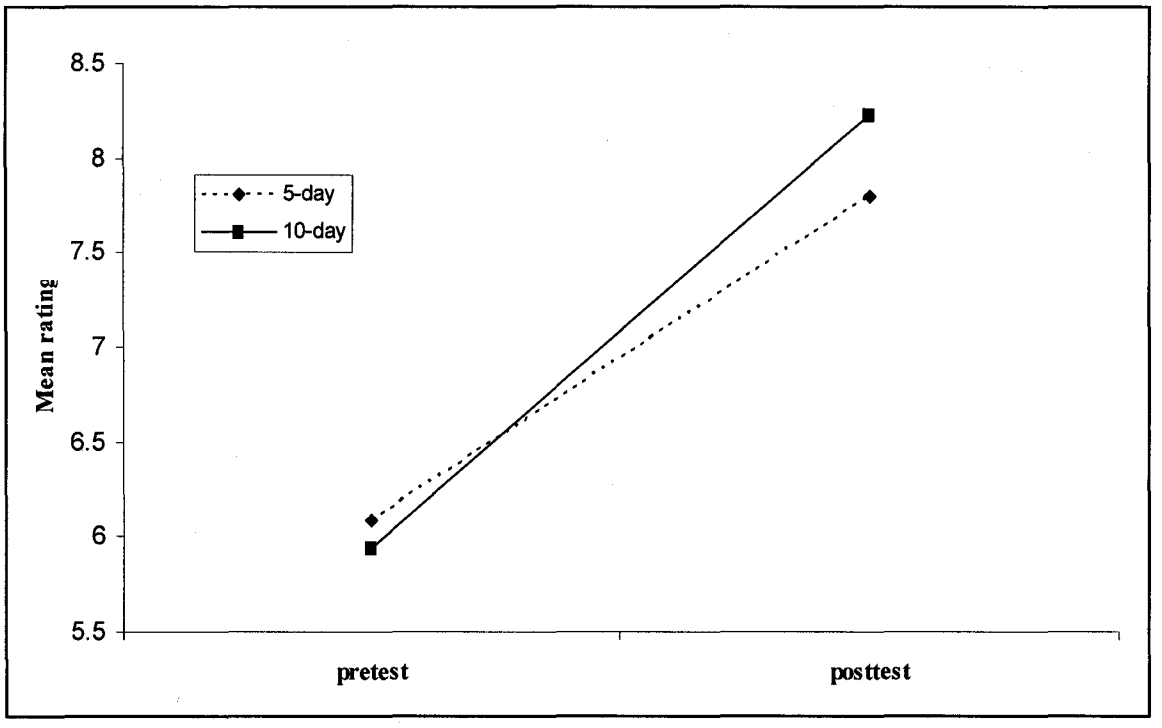

Figure 1. Changes in teachers' mean ratings of their self-efficacy to implement inquiry-based science for the two versions of FAST-1 institutes

Focus Group Results

Teacher comments were coded for instances that provided examples of increases in the teachers' self-efficacy or no change in self-efficacy to implement inquiry-based science. Table 1 provides a list of the common themes (hereafter referred to as factors) that were identified. Although the focus groups were designed to determine the extent to which self-efficacy affected each of the defined stages of inquiry science, the similarity in the comments by the participants across the stages suggested that the participants were commenting on their overall change in self-efficacy to implement inquiry-based science. That is, their sense of self-efficacy was not stage-specific. Further investigation of the comments provided the researcher with enough evidence that a participant's change in self-efficacy was not reliant

Table 1. Summary of Focus Group Coding Scheme with Descriptions of Codes

Primary Factor	Description
Content/pedagogical knowledge	Reference to learning or relearning skills, material, and so forth and the steps they would take to practice the new knowledge.
Experience	Reference to the level of experience as affecting change, including teaching experience and/or science experience.
Program structure	Reference to some aspect of the training, organization, or process of the program as a change agent.
Student characteristics	Reference to some aspect of the student that is influencing their intent to change, including behavior, demographics, learning styles, and so forth.
Professional collaboration	Reference to the interactions with other teachers as a means for affecting change.
Practice/ feedback	Reference to needing more practice or requiring some form of feedback as a basis for influencing change.
Time issues	Reference to time as a factor for influencing change.

Table 2. Comparison Between 10-day and 5-day institutes on the Factors Influencing Participant Self-Efficacy, Aggregated Across Stages and Participants

	10-day institute		5-day institute	
Increase in self-efficacy category	No. of teachers making a comment	No. of comments	No. of teachers making a comment	No. of comments
Content/pedagogical knowledge	5	11	1	1
Program structure	5	10	5	8
Professional collaboration	0	0	1	2
Experience	1	1	1	1
Total		22		12
No change in self-efficacy category				
Practice/feedback	2	2	5	7
Student characteristics	2	2	2	3
Experience	2	2	1	1
Time issues	0	0	1	1
Total		6		12

on a change in only one of the five stages but rather a combination of all the stages. Therefore, the teacher comments were aggregated by the number of teachers making the comments and the number of comments overall rather than by stage. As all the stages are vital for effective inquiry science instruction, the comparison of the overall change in self-efficacy based on aggregated results was appropriate for generalizing these findings to the study of effects of inquiry science professional development on teacher self-efficacy. Table 2 provides comparisons between groups on the number of statements that were categorized

as showing an increase in self-efficacy and those categorized as showing no change (or a questionable change) in self-efficacy. The contributing factors are also provided in the table. Seven factors were identified by the teachers as influencing a change in their self-efficacy. As seen in Table 2, the 10-day participants made 22 comments showing an increase in their self-efficacy and six comments showing no change in self-efficacy. The 5-day participants made 12 comments showing an increase in their self-efficacy and 12 comments showing no change in self-efficacy.

Examples of statements about increases in self-efficacy. The following teacher quotations provide examples of the teachers' increase in their self-efficacy, shown by a shift in their ideas and concepts toward inquiry science teaching. For the statements that demonstrated an increase in self-efficacy to implement, four factors, including content and pedagogical knowledge, program structure, experience, and professional collaboration, were identified. Content and pedagogical knowledge and the program structure were the two factors that teachers identified the most as influencing their change.

In the following statement the teacher's deeper understanding of the content knowledge that is needed to teach inquiry science has caused a shift in his approach to how he will help students better understand the principles being taught.

> I always felt that taking what I knew and applying to something that I didn't quite understand was a strength. But the very first day it was demonstrated to me that I really don't know that much. So that's what FAST has taught me, you have to break it further down to the common elements and then start to build on the principles. Because, if I have broken down those elements, the kids will understand the

principles that are going on.

Another example of how the gain in content and pedagogical knowledge has caused a shift in a teacher's approach to teaching inquiry science is seen in this statement that shows an intent to set-up an inquiry environment for the students.

> Big increase, just because I had a hard time asking discussion questions, summary questions, follow-up questions that would get them to critically analyze their data and formulate their results. I've learned to look at what types of questions to ask so they can be critical.

An example of how FAST's program structure has provided an increase is seen in this teacher's statement about how she now feels she has the tools to support her students in the investigation process.

> What I got now is more ways for them to structure their designs and then it will carry through on other ways to analyze different data or collect the samples. Whereas, I didn't know how to articulate that to them, you got to have this reference. That was really helpful.

The comment about how professional collaboration has increased one teacher's self-efficacy is seen in the following example.

> What I would like to say about this is that it always nice to work with other colleagues. I think it wasn't so much the way it was presented, it was presented very well, but just seeing different ways other people set standards and seeing the various ideas of controls. Its nice to work with a bunch of other professional people who teach the same subject that I do and it's neat to see the differences.

Examples of statements about no change in self-efficacy. The following teacher quotations provide examples of the statements that were classified as no change in their perception of self-efficacy. For the statements that demonstrated no change in self-efficacy, the need for more practice or feedback was identified as the primary factor. Student characteristics, experience, and time issues were also identified by the teachers as factors that did not influenced their level of self-efficacy to implement.

The first statement shows how the teacher's perception of her students' characteristics contributes to her lack of change in self-efficacy to implement an aspect of the inquiry process.

> I gave myself an 8 before and an 8 now. And the reason why I did that is because the construction of meaning is going to fall on their proper social skills. I can see my students just getting into it and then getting on each other, and then there is all of these middle-school issues that come into play. When really I can't make this mean anything to them. So I just have to keep providing a stage for them to construct the meaning and to stop them from interfering with each other while their learning the lesson. There are too many variables to analyze for me right now.

Statements showing the need for more practice or needing additional feedback is seen in the next two examples. In the first example, we see that the structure of the program helped the teacher with an aspect of the inquiry process; however, her need to get more classroom practice and feedback did not create a distinct intent to shift her teaching approach and was identified as the primary factor influencing her self-efficacy.

> It's really hard to tell, because I'm not in the classroom yet. And I think that once I

> do get in and I start teaching then I'll be able to tell where I'm at. I think that this class has really helped me link things together, but I won't really know until I start teaching.

The next example shows how the teacher's perception of her self-efficacy will be entirely dependent on the feedback she gets when she tries to implement all the information she received.

> I feel that it's so much information that when we go away from here and plan classes that we are going to go, huh? So, I'm hesitant to mark it higher until I try it. When I actually think about actually doing all the things that we did I go, Oh!

Interestingly, experience was seen as a factor that influenced both an increase and no change in the teachers' self-efficacy. For example, the following excerpt shows how the teacher identified experience as influencing her lack of change in self-efficacy.

> This coming year will only be my third year and I've always have trouble with assessing what they know. I tend to think they know a lot more than they do. That's why it's not higher, I'm just not particularly good at that.

An example of how experience aided in the increase in self-efficacy is,

> Strangely enough, this was one of the things I felt really comfortable with before. It sort of came naturally to me and it has given me a good foundation for improvement.

CHAPTER 5
DISCUSSION

The overall purpose of this study was to examine the differential effects of two versions of inquiry-based science professional development institutes on middle-school teachers' reports of self-efficacy immediately following the institutes. The research questions asked whether the 10-day version changed teacher self-efficacy to implement inquiry-based science, whether the 5-day version changed teacher self-efficacy to implement inquiry-based science, and whether there was a difference in the levels of change between the groups. The study also addressed the factors that influenced teacher self-efficacy change.

This study is significant for two reasons. First, a better understanding of the differential effects of two versions of FAST professional development institutes on teacher self-efficacy can help clarify the process by which teachers' develop these beliefs. Second, the results can provide insights into the design of the FAST-1 professional development program and the aspects of the program that might need attention.

The quantitative and qualitative data collected in this research reflect the initial, brief exposure of participants to the FAST-1 program—namely, their participation in the professional development institutes. The analysis of the quantitative results of the study was designed to show within-group and between-group differences in pre- and post-institute levels of self-efficacy. The analysis of the qualitative results of the study was based on the researcher's identification of statements that reflected teachers' changes in self-efficacy due to the institutes and, associated with those statements, the aspects of the institutes or teaching science that the teachers' associated with changes in their self-efficacy.

The results of the self-efficacy scale showed a statistically significant increase in the level

of teacher self-efficacy in both groups and no significant difference in the levels of change between the groups. The findings of no difference between groups might be accounted for in part by the low statistical power due to small *N*s, which is a critical factor in statistical significance testing.

The self-efficacy scale results are contradicted by some of the findings from the qualitative data, which suggest that the 10-day institute had a more meaningful effect on teachers' perceived self-efficacy. There were some discrepancies between the way the teachers rated their pre-post self-efficacy and their discussion of this change with the rest of the group. For example, one teacher rated her pre-institute self-efficacy to introduce students to new science investigations as a *2* and her post-institute rating as a *7*, but in the focus group, she said,

> I feel that it's so much information that when we go away from here and plan classes that we are going to go, huh? So, I'm hesitant to mark it higher until I try it. When I actually think about actually doing all the things that we did I go, Oh!

Because the teachers were aware that this study was examining changes in self-efficacy, they might have rated themselves in a socially desirable manner on the scale (i.e., showing that the institute was beneficial). However, when given the chance to discuss their ratings, and hearing how other teachers' self-efficacy was influenced, they might have provided a more deliberate self-perception of their actual changes. Teachers also may have felt that given their significant investment of time, they wanted to believe that the institute positively affected their behavior.

The major contradiction between the two instruments is seen in the findings for the 5-day

group. The self-efficacy scale showed a significant increase in the teachers' pre-to-post self-efficacy gains, but the focus group results indicated no overall change in teacher self-efficacy. On the other hand, the results from the two data sources support each other in the findings of the self-efficacy gains for the 10-day group.

I believe that when comparing the self-efficacy scale to the focus groups, the self-efficacy scale results most likely represent inflated scores for both groups. This reasoning is based on the lack of qualitative support, which I believe brings into question the scale's validity as a stand-alone instrument. Therefore, the strength of these research findings are tied to the results of the qualitative data. That is, I place more confidence in the teachers' explanations of their self-efficacy change during the focus group sessions than the quantitative results of an instrument in which no previous reliability or validity exists.

Nevertheless, the scale was an excellent tool for facilitating the focus group discussions, which was its primary intended use. The confidence in the focus group results is not meant to suggest that the teachers' discussions of their self-efficacy was not itself influenced by the groups' dynamics, as is sometimes the case in a focus group setting, but rather to provide the reader with the understanding that the substance of the conclusions about the differences between the groups' self-efficacy is grounded in the qualitative findings.

The teachers' comments that reflected increases in self-efficacy most frequently were tied to increases in their content and pedagogical knowledge and their knowledge of the structure of the program. There was a particularly large gap between groups in the teachers' perceived gains in self-efficacy about content and pedagogical knowledge. Five of the seven teachers in the 10-day group made 11 comments on this factor, compared to only one comment made

by one of the seven teachers in the 5-day group. This suggests that the additional week of instruction provided the 10-day teachers with the content and pedagogical knowledge that made a difference in their perceived ability to implement the program. However, the 5-day group's knowledge that they only received half their training and were going to receive additional training on process and content on the DVD and in the on-line course probably affected their perceptions of their self-efficacy, especially with respect to gains in content and pedagogical knowledge. This finding supports Guskey and Spark's (2002) *content characteristics* component, which they point out is an important component for teacher change when designing effective professional development. Content characteristics of professional development include, among other things, the new knowledge that is gained (Guskey & Sparks, 2002). Program structure, which was the other highly influential factor affecting self-efficacy, was discussed by both groups, with five of the 10-day teachers' commenting on this factor 10 times and five of the 5-day teachers' commenting eight times. This finding suggests that the teachers in both groups believed that the structure of the program, including its smooth transition from lesson to lesson and its natural progression within investigations, affected their perceived ability to implement. This parallels another of Guskey and Sparks' (2002) components of effective professional development, *process characteristics*, which refers to the overall organization of the activities, as well as the demonstration, modeling, and the practicing of new skills. In addition, this finding also supports a criterion set forth by Doyle and Ponder (1977), *how clearly and specifically practices are presented*, which they found affects the extent to which teachers' decide to implement new practices.

The comments that most reflected a lack of gain in self-efficacy were tied the factor practice or feedback. The number of comments between groups on this factor was substantial, with five of the seven 5-day teachers' commenting five times and two of the seven 10-day teachers' commenting two times. Although the teachers' reference to needing more practice and feedback suggested that specific aspects of teachers' self-efficacy were limited, this finding does not necessarily suggest that these teachers will not implement the program fully. Guskey (1985) stated that "the most significant changes in teachers attitudes' and beliefs come *after* they begin a new practice successfully" (p. 57).

An interesting relationship exists between the two groups' comments about the need for more practice and feedback and their discussion of the gains in content and pedagogical knowledge. The relationship suggests that 10-day teachers' perception about how much content knowledge they received actually decreased their perceptions that they need to receive more practice or feedback, which in turn suggests that self-efficacy is influenced by an individual's belief in his or her level of content and pedagogical knowledge. This speculation is supported by other studies, which have also found the existence of a relationship between the level of content knowledge and increases in self-efficacy (Brown, 2003; Russell, Fraas, & Newman,1998).

Other factors that emerged during the analysis are supported by findings in the self-efficacy literature. For example, experience and student characteristics were found by Ramey-Gassert (1994) as factors influencing teacher self-efficacy. Time issues, another factor that emerged in this study, corresponds to Doyle and Ponder's (1977) findings, which show that the teachers' estimate of the extra time and effort new practices require affects

teachers' decisions to implement new practices. Finally, professional collaboration, another factor that emerged, is an aspect of the *context characteristics* component that affect teachers' sense of self-efficacy determined by Guskey and Sparks' (2002) effective professional development model.

Conclusions and Recommendations

In conclusion, the results of this study show that the 10-day FAST-1 institute provided the teachers with a somewhat higher sense self-efficacy to implement the FAST-1 program immediately following the institute. However, the overall differences found between the groups are not as large as one might expect, given that the 10-day version had an extra week of training. Although their was a substantial gap between the groups perceived level of content knowledge gained, the 5-day group's knowledge that they were going to receive more content from the DVD and on-line course was most likely the reason for the lack of discussion of this factor as a self-efficacy change agent. Because the 5-day teachers knew about the follow-on support, they were perhaps more likely to search for other attributes of the institute, such as program structure, as influencing their self-efficacy rather than discuss the level of content knowledge they received, which, from their point of view, was incomplete. This suggests that the 5-day institute, coupled with the follow-on support, might positively affect teacher self-efficacy to a greater extent than the traditional 10-day version. This is supported by the findings of Crowther and Cannon (2002). The researchers found that a professional development institute providing follow-on support produced greater long-term gains in self-efficacy compared to a professional development that did not provide follow-on support. However, several factors could also influence the overall effectiveness of the 5-day

version, such as (a) the extent to which the 5-day participants utilize the multimedia DVD to receive the additional content and pedagogical knowledge that had been delivered to the 10-day group during the second week of instruction; (b) the level of support that the 5-day participants receive during the two-semester on-line course as they implemented the program; or (c) the degree to which the teachers value the FAST program. End-of-the-year interviews that examine these potential factors and allow the teachers to reflect on the aspects of the professional development that supported their teaching will be a helpful addition to this study. One-to-one interviews could potentially provide more telling information about the teachers self-efficacy when not influenced by a group discussion. This information could enhance the findings of the present study and provide a more complete examination in ultimately determining the differential effects of the two versions.

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APPENDICES

Appendix A

Schedule of FAST 10-day and 5-Day Institutes

FAST 1, The Local Environment				
10-DAY INSTITUTE SCHEDULE				
DAY 1	**DAY 2**	**DAY 3**	**DAY 4**	**DAY 5**
AM	**AM**	**AM**	**AM**	**AM**
Registration Introduction to *FAST*: What is inquiry PS 1–4 LAB SAFETY	*FAST* Overview Science Standards Student books Ecology 4 &5 Oral/written reports	PS 8 & 9 Discussion on GROUPING PS 10, 11 & 12	Ecology 29 & 30 Field Mapping Ecology 26 Animal Care	Discuss QUESTIONING STRATEGIES In FAST *PS 15, 16 & 17*
PM	**PM**	**PM**	**PM**	**PM**
Ecology 1 & 2 FLOW DIAGRAMS	PS 5, 6 & 7 CGS Assign Reading on GROUPING	TEACHER'S GUIDE Format & Content EVALUATION Evaluation Guide PS Evaluation 1 Assign PLANT PROPAGATION	PS 13–14 Balloons in Water Submarine Assign Reading on QUESTIONING STRATEGIES	Ecology 6, 7, & 8 Soils Ecology 17 Weather Station
DAY 6	**DAY 7**	**DAY 8**	**DAY 9**	**DAY 10**
AM	**AM**	**AM**	**AM**	**AM**
THE FAST INSTRUCTIONAL SYSTEM Ecology 31 & 32	PS 23–28	Ecology 18–25	PS 34–40	Relational Study Air Pollution OR Water Resource Management
PM	**PM**	**PM**	**PM**	**PM**
PS 20, 21, & 22	Ecology 9–16	PS 29–33 CLASSROOM ORGANIZATION & MANAGEMENT	Collect and analyze Seed Scarification Data Plant Propagation Reports	Summary of FAST 1 Planning for the Academic Year Evaluation of Institute

Figure 2. The FAST program's depiction of the schedule of activities for 10-day professional development institute

FAST 1, The Local Environment 5-DAY INSTITUTE SCHEDULE				
DAY 1	**DAY 2**	**DAY 3**	**DAY 4**	**DAY 5**
AM	**AM**	**AM**	**AM**	**AM**
Introduction to *FAST* What is inquiry PS 1–4	*FAST* Overview Science Standards Student books E. 27–28 E. 3– 5	PS 8 & 9 Brief discussion Grouping PS 10, 11 & 12	E. 30 E 26 (talk) E. 6–8	Discussion Questioning Strategies *PS 15, 16 & 17*
PM	**PM**	**PM**	**PM**	**PM**
E 1 & 2 Flow diagrams HW. Instructional Guide 1-35	PS 5, 6 & 7 Enhancement Web/media training HW Grouping Inst guide 36–56	Teachers Guide Evaluation in FAST	PS 13–14 HW Questioning Strategies Inst. Guide 56–69	Relational Study Analyze E. 2 Submarines Plans for follow-up

Figure 3. The FAST program's depiction of the schedule of activities for 5-day professional development institute

Appendix B

Data Collection Instruments

FAST Teacher Self-Efficacy Scale

Instructions:
Please *circle one number* that best estimates your ability as a science teacher to implement each of the stages described.

1. *STAGE:* Introducing new science investigations - my ability to introduce students to new science investigations by reviewing and tying in previous work.

Now

low ability	1	2	3	4	5	6	7	8	9	10	high ability

Before

low ability	1	2	3	4	5	6	7	8	9	10	high ability

2. *STAGE:* Facilitating valid experimental design - my ability to help the students understand the components of valid experimental design; including such things as developing methods for collecting data to answer their questions and paying attention to setting standards, replications, and controls.

Now

low ability	1	2	3	4	5	6	7	8	9	10	high ability

Before

low ability	1	2	3	4	5	6	7	8	9	10	high ability

–continue to next page–

3. *STAGE:* Facilitating the investigation process - my ability to guide the students during the investigation process, including recording revisions to their procedures, setting up and using equipment safely and correctly, and accurately recording the data generated.

Now

low ability	1	2	3	4	5	6	7	8	9	10	high ability

Before

low ability	1	2	3	4	5	6	7	8	9	10	high ability

4. *STAGE:* Constructing meaning - my ability to facilitate the students in analyzing and interpreting data, identifying and examining trends in the data, and using the information provided by the data to formulate explanations of the science investigation.

Now

low ability	1	2	3	4	5	6	7	8	9	10	high ability

Before

low ability	1	2	3	4	5	6	7	8	9	10	high ability

5. *STAGE:* Linking knowledge to new situations- my ability to enable students to use their knowledge and understandings to explore new situations.

Now

low ability	1	2	3	4	5	6	7	8	9	10	high ability

Before

low ability	1	2	3	4	5	6	7	8	9	10	high ability

–Thank you for your time–

FAST Teachers Focus Group Guide

Procedures for Conducting Focus Groups at the Conclusion of the FAST-1 Institute

Introduction and Background

1. This guide gives the procedures for conducting focus groups of science teachers at the conclusion of the 5-day and 10-day FAST-1 professional development institutes. Focus groups are moderator-led, informal discussions between several people who potentially can offer various perspectives on a topic.
    1) Focus group discussions address pre-determined questions, but participants are encouraged to raise their own issues and *focus on* issues that are important to them.
    2) The discussions need not necessarily lead to consensus about issues, but instead will result in a collection of opinions.

    b. The focus groups will be led by a practicing FAST-1 teacher, who is also a certified FAST-1 instructor.
        1) Each focus group session will last for approximately 1 hour.

    c. The purpose of the focus groups will be to collect information about teachers' change in self-efficacy after attending one of either a one-week or two-week FAST professional development institute.
        1) The information collected through a focus group discussion will not necessarily be generalizable to other bodies of teacher self-efficacy but will provide some descriptive information that CRDG can use when preparing to disseminate the scaled-up FAST-1 program.

    d. The questions that will be addressed by the focus group participants after attending the FAST professional development are:
        1) What are the changes in teacher self-efficacy related to using inquiry-based science instruction?
        2) What aspects of the professional development or science teaching in general effected this change?.

2. The procedures given in this document should be followed for each focus group session.
    a. *Without exception,* the moderator should prepare herself by reading the section on the moderator's role and responsibilities.
    b. She should also prepare herself for each focus group by reading the moderator's script and instructions shortly before beginning the session.

Selection of Participants for the Focus Groups

1. A total of two focus groups will be held between the two models of the FAST professional development.
   a. *5-day model*
      1) One group consisting of seven to eight teachers.
   b. *10-day model*
      1) One group consisting of seven to eight teachers.
2. All teachers participating in the Hawai'i FAST-1 professional development institutes this summer will be asked to participate in the post-institute focus groups
3. A written explanation of the data collection components, along with a consent form will be distributed at the beginning of the training to all teachers participating in the FAST-1 professional development for the summer 2004 sessions.

Pilot Testing and Focus Group Moderator Professional Development Procedures

1. A pilot-test will be held approximately one-week before the beginning of the first professional development class.
   a. Participants will include members of the development team who are familiar with the FAST-1 program.
2. At the end of the session, participants will be asked for feedback about all facets of the session, the feedback will be documented to help interpret the results.
3. Focus group moderators will be trained two weeks prior to the FAST professional development institutes.

Selecting Rooms for Conducting the Focus Groups

1. The focus groups will be held in the classrooms in which the teachers participated in the FAST-1 professional development.

The Moderator's Role and Responsibilities

1. This section presents background information for the moderator.
   a. The moderator should study this section carefully and refer to the guide often to ensure that all important topics are covered.
2. The moderator's script, with instructions for each focus-group step, is given at the end of these procedures.
3. ***Facilitating the discussion***
   a. The role of the moderator is to optimize the type of group dynamics that will encourage in-depth discussion.
      1) The discussion should flow naturally and be flexible.
      2) Participants should feel free to offer new insights about the topic.
      3) The moderator should make it clear that there are no pre-defined answers that may constrain participants' willingness to offer opinions.

4) The discussion should elicit information about how participants formed their perspective about a topic.
5) Participants should be allowed to revise their perspective on a topic by listening to the discussion in the focus group.
6) The flow and flexibility of the discussion may be influenced by the social dynamics between participants, physical context of the focus group, and the moderator.

b. The moderator is responsible for directing the conversation; taking minimal notes about points to follow up on later in the discussion.
c. The moderator should memorize the questions and their sequence.
   1) The moderator's guide can be used as a reminder.
d. The moderator should self-monitor her listening behavior by the following questions:
   1) Do I need more information to completely understand this respondent's statements?
   2) Am I able to tie this respondent's comments into the research?
   3) How much time is left in the session?
   4) How does this comment tie in with the other comments?
   5) How do I elicit information about other facets of the participant's experience (e.g., the academic impact of the experience)?
e. The moderator should also practice other traits of a good listener such as:
   1) exhibiting real interest in what people say.
   2) encouraging participants' enthusiasm to talk.
   3) keeping silent while participants are offering their points of view.
   4) limiting the amount of tangential comments that are offered to the group.
   5) monitoring the contributions by different respondents to ensure that each participant has offered a perspective on the topic.
   6) ensuring that body language is not inadvertently suggesting a judgmental attitude.
f. The moderator can expect that two or three participants will be willing to share their points of view, and two or three will be less apt to self-disclose and perhaps nervous and uncomfortable.
g. If participants bring up specific information when a general question is posed, the moderator must decide if the conversation should continue or if he or she should ask the participant to hold the comments until later.
h. The moderator can add questions to follow-up on the group's comments.
i. In many cases, the moderator can let the conversation flow freely without redirecting its flow.
j. Encourage both positive and negative comments.

4. ***Techniques for encouraging participants to contribute to the discussion***
   a. Move closer to an individual.
   b. *The five-second pause*
      1) Used right after a question is posed or a participant offers a comment.
      2) After pausing, establish eye contact with the participant.

c. *The probe*
    1) Probing questions and comments are used early in a session to illustrate the level of detail or specificity that is desired in responses, when participants have offered vague or very general responses.
        a) "Would you give me an example of what you mean?"
        b) "Can you say more?"
        c) "What do you mean by that?"
        d) "I don't understand."
        e) "Is there anything else you want to say about that?"
d. Keep the discussion flexible and judgment-free.
e. Use subtle and unobtrusive techniques.
    1) Spontaneously compose and articulate questions in clear, simple, and straightforward terms to show connectedness and differences between responses.
    2) Monitor the mood of the group in the flow of the discussion and interject a question or comment to keep the conversation appropriately focused.
        a) Watch the discussion and decide on the right time to wrap up a line of conversation and move on.
f. Use humor to keep the discussion from being too tense or judgmental.
    1) Use humor carefully to avoid offending any participants.
    2) Use of spontaneous, creative, imaginative humor is better in a focus group than canned humor.

5. ***Techniques for dealing with self-appointed experts***
    a. Underscore the fact that all participants have important perceptions that need to be expressed.
6. ***Techniques for dealing with dominant participants***
    a. Avoid eye contact with the person.
    b. Redirect the discussion to other participants; for example, say:
        1) "Thank you, John. Are there others who wish to comment on the question?"
        2) "Does anyone feel differently?"
        3) "That's one point of view. Does anyone have another point of view?"
7. ***Techniques for dealing will shy participants***
    a. Make eye contact with the person.
    b. Verbally call on them.
8. ***Techniques for dealing with rambling participants***
    a. Discontinue eye contact with the rambler after about 20 seconds.
    b. Look at moderator's guide.
    c. Look around the circle of participants.
    d. If the rambler stops or pauses, move to the next participant or next question.
9. ***Types of questions***
    a. The moderator will allow for the group to develop discussion related to changes of their self-efficacy toward the implementation of the five stages outlined. The self-efficacy scale was developed to facilitate discussion.

10. ***Closing discussion about one topic and move on to the next topic or redirecting the discussion:***
    a. You may ask questions that include "such as," "how satisfied," "to what extent," and "how much" to wrap up the discussion on a topic.

Setting up the Facilities

1. Arrive approximately 15 minutes before the participants are scheduled to finish the professional development to get a layout of the room and determine how you think the group should be placed.
2. Arrange the participants' chairs and tables in a circle so that they are equally spaced apart and at a comfortable distance that allows for eye contact.
    a. Arrange a chair for the moderator, place the moderator's name tent on the moderator's table.
3. Set up the video recorder
    a. Test the equipment to make sure voices are recorded clearly

Moderator's Script and Instructions

1. ***Greeting the participants***
    b. The moderator should greet the participants as soon as they are seated.
    c. As participants arrive, hand them a name tag.
        1) Ask them to write on the name tag: their first name or name that they would to be called.

2. ***Opening the focus group***
    d. In the first few critical moments of the focus group, the moderator should:
        1) create an environment that is thoughtful, nonjudgmental, comfortable, and permissive;
        2) discuss the purpose of the group and how participants were selected; and
        3) inform the participants of the procedures.

—Go to the script on the next page—

3. *Introducing the purpose of the focus group: 5 minutes.*

Hello, my name is Tyra. I want to thank you all for participating in this focus group.

First of all, we are going to be recording this discussion. We were planning on *video* recording; however, if some of you would feel more comfortable with just having the audio on, we would be happy to place the cap on the lens of the camera. Is there anyone who would rather we audio record only? [Brian will prepare recording equipment according to the groups request.]

Before we begin, I am going to review the purposes and procedures of the focus group today.

There are two purposes:
1) to evaluate the FAST professional development, which is part of a larger study looking at the FAST program as a whole and
2) to fulfill the requirements for a masters thesis in educational psychology.

Some things to keep in mind throughout the process are:

- **the discussion should flow naturally and be flexible;**
- **feel free to offer new insights about the topic being discussed;**
- **there are no pre-defined answers, so don't be afraid to offer your opinions;**
- **the more you can offer about how you developed your different views, the more we can understand what you mean; and finally**
- **this session is *not* to evaluate you as a teacher, it is to get a sense of how much the FAST institute has helped you. Only Brian and his thesis committee will have access to the actual recordings.**

—continue with script on the next page—

Now, I would like to discuss the focus of this session: The focus is to examine the changes, if any, in your self-efficacy to implement five different stages of inquiry-based science. For those of you who might not be familiar with the term, *self-efficacy is an estimate or personal judgment of your ability to succeed in reaching a specific goal.* In our case, this is an estimate of your ability to implement a stage of inquiry-based science.

There may be times that you may want to give your overall opinions about the FAST institute; if this should happen, I may stop you so we can refocus our discussion on how the program has affected your self-efficacy.

4. *Distribution and instructions of the self-efficacy scale*: **<1 minute.**

We are now going to distribute self-efficacy scales, which we will use to help facilitate our discussion. [Brian will distribute the scales.] Before you begin, let me explain what were going to do.

(1) First, I am going to read the stage to you. (2) Next, you will rate your ability to implement the stage now, that is, after attending the FAST training. (3) Then you will rate your ability to implement the stage before, that is, prior to coming to the FAST training – Monday morning 7:30am. (4) We will then discuss the changes in the ratings, if any, and the reasons for the changes. (5) After we've had our discussion, we will move on to the next stage.

If during the course of our discussion of your ratings you want to change how you rated yourself, either now or before, go ahead and mark an X on your first choice, then circle a new number. Does Anybody have any questions about what we are trying to accomplish? [field any questions.]

—continue with script on the next page—

5. *Teachers' self-efficacy on introducing new science investigations: 10 minutes.*

Beginning with the first stage: *Introducing new science investigations - My ability to introduce students to new science investigations by reviewing and tying in previous work.* Go ahead and rate your ability now, after the training and your ability before the training.

[give about 10 seconds for the teachers to rate themselves.]

OK, it looks like everyone is finished, lets talk about how you rated yourselves.

[Potential prompts if teachers need some facilitation.]

- **Was there any change in the way you rated yourself now and before?**
- **What aspects of the training caused this change?**
- **What kinds of things do you think might be challenging when implementing this stage?**
- **What effect do you think that spending more time in the training on this topic would have had on your ability to implement it? Less time? More or less time wouldn't matter?**
- **Does any body have any significant changes between now and before? Would you mind sharing why you think there is a significant change in your ratings?**
- **Does anybody have any small or no change between now and before? Would you mind sharing why you think there was a small or no change in your ratings?**

[Allow for about 10 minutes of discussion – Brian will help you keep track of time. If it ends before 10 minutes, proceed to the next section.]

—continue with script on the next page—

6. *Teachers' self-efficacy on facilitating valid experimental design*: **10 minutes.**

Moving on to the next stage: *Facilitating valid experimental design - My ability to help the students understand the components of valid experimental design; including such things as developing methods for collecting data to answer their questions and paying attention to setting standards, replications, and controls.* Go ahead and rate your ability now and before.

[give about 10 seconds for the teachers to rate themselves.]

OK, it looks like everyone is finished, lets talk about how you rated yourselves.

[Potential prompts if teachers need some facilitation.]

- **Was there any change in the way you rated yourself now and before?**
- **What aspects of the training caused this change?**
- **What kinds of things do you think might be challenging when implementing this goal?**
- **What effect do you think that spending more time in the training on this goal would have on your ability to implement it? Less time? More or less time wouldn't matter?**
- **Does any body have any significant changes between now and before? Would you mind sharing why you think there is a significant change in your ratings?**
- **Does anybody have any small or no change between now and before? Would you mind sharing why you think there was a small or no change in your ratings?**

[Allow for about 10 minutes of discussion – Brian will help you keep track of time. If it ends before 10 minutes, proceed to the next section.]

—continue with script on the next page—

7. *Teachers' self-efficacy on facilitating the investigation process:* 10 minutes.

Moving on to the next stage: *Facilitating the investigation process - My ability to guide the students during the investigation process, including recording revisions to their procedures, setting up and using equipment safely and correctly, and accurately recording the data generated.* Go ahead and rate your ability now and before.

[give about 10 seconds for the teachers to rate themselves.]

OK, it looks like everyone is finished, lets talk about how you rated yourselves.

[Potential prompts if teachers need some facilitation.]

- **Was there any change in the way you rated yourself now and before?**
- **What aspects of the training caused this change?**
- **What kinds of things do you think might be challenging when implementing this goal?**
- **What effect do you think that spending more time in the training on this goal would have on your ability to implement it? Less time? More or less time wouldn't matter?**
- **Does any body have any significant changes between now and before? Would you mind sharing why you think there is a significant change in your ratings?**
- **Does anybody have any small or no change between now and before? Would you mind sharing why you think there was a small or no change in your ratings?**

[Allow for about 10 minutes of discussion – Brian will help you keep track of time. If it ends before 10 minutes, proceed to the next section.]

—continue with script on the next page—

8. *Teachers' self-efficacy using the constructing meaning process*: **10 minutes.**

Moving on to the next stage: *Constructing meaning - My ability to facilitate the students in analyzing and interpreting data, identifying and examining trends in the data, and using the information provided by the data to formulate explanations of the science investigation.* Go ahead and rate your ability now and before.

[give about 10 seconds for the teachers to rate themselves.]

OK, it looks like everyone is finished, lets talk about how you rated yourselves.

[Potential prompts if teachers need some facilitation.]

- **Was there any change in the way you rated yourself now and before?**
- **What aspects of the training caused this change?**
- **What kinds of things do you think might be challenging when implementing this goal?**
- **What effect do you think that spending more time in the training on this goal would have on your ability to implement it? Less time? More or less time wouldn't matter?**
- **Does any body have any significant changes between now and before? Would you mind sharing why you think there is a significant change in your ratings?**
- **Does anybody have any small or no change between now and before? Would you mind sharing why you think there was a small or no change in your ratings?**

[Allow for about 10 minutes of discussion – Brian will help you keep track of time. If it ends before 10 minutes, proceed to the next section.]

—continue with script on the next page—

9. *Teachers' self-efficacy on linking knowledge to new situations*: **10 minutes.**

Moving on to the final stage: *Linking knowledge to new situations - my ability to enable students to use their knowledge and understandings to explore new situations.* Go ahead and rate your ability now and before.

[give about 10 seconds for the teachers to rate themselves.]

OK, it looks like everyone is finished, lets talk about how you rated yourselves.

[Potential prompts if teachers need some facilitation.]

- **Was there any change in the way you rated yourself now and before?**
- **What aspects of the training caused this change?**
- **What kinds of things do you think might be challenging when implementing this goal?**
- **What effect do you think that spending more time in the training on this goal would have on your ability to implement it? Less time? More or less time wouldn't matter?**
- **Does any body have any significant changes between now and before? Would you mind sharing why you think there is a significant change in your ratings?**
- **Does anybody have any small or no change between now and before? Would you mind sharing why you think there was a small or no change in your ratings?**

[Allow for about 10 minutes of discussion – Brian will help you keep track of time. If it ends before 10 minutes, proceed closing the focus group section.]

—continue with script on the next page—

10. *Closing the focus-group session*

Thank you all again for participating in this session. I want to make sure that there are no questions before we leave.

[field any questions from group]

If there is nothing else, than we're finished here. Good luck to you all.

a. Stop the video recording devise.
b. Make any notes that are relevant to the interpreting of the information collected.

—End of script—

Appendix C

Focus Group Transcripts

Table 3. 10-day Version Focus Group Transcripts

Group/ Participant	Category	Primary Factor	Transcription
10-day/2	Increase	Program Structure	I've got a science background, but I think the most important thing that I've learned is that things that the way in which you deliver the material is a important in what you know. I was thinking that maybe before I had delivered bigger blocks, bigger chunks of knowledge and what I had to learn was, okay you got to break those bigger chunks down. And that's what I learned
10-day/2	Increase	Experience	You can't just assume that everybody has the same background. So that's why it went up. But I think my science background did help with my being able to ties things together
10-day/2	Increase	Content/ Pedagogical Knowledge	It's been a long time since I've used Bunsen burners and stuff like that so this was a really good refresher course. Again you make the assumption that everybody is going to work safely, and do the right things, but even I got busted for not wearing goggles. So it really made me aware that, okay, these are all adults and, you know, you got kids that are going to be in 6th, 7th, and 8th, grade who are not going to be as focused.
10-day/2	Increase	Content/ Pedagogical Knowledge	I think the most important things that I picked up was – two things. The first one is, before someone would come and ask me a question and I would give it a direct answer because they needed the information from me to do something....the second thing that I learned was kids are going to come from every walk of life...and you got to be able to handle all of these from way left field. I think I learned ways to deal with those types of questions.

Group/ Participant	Category	Primary Factor	Transcription
10-day/2	Increase	Content/ Pedagogical Knowledge	I always felt that taking what I knew and applying to something that I didn't quite understand was a strength. But the very first day it was demonstrated to me that I really don't know that much....So that's what FAST has taught me, you have to break it further down to the common elements and then start to build on the principles. Because, if I have broken down those elements, the kids will understand the principles that are going on.
10-day/6	Increase	Program Structure	I have a lot of experience in the high school level and this was actually my first year teaching the middle-school. Coming down to the middle-school level, being a new teacher at the middle-school, I had to start from scratch. I had the prior knowledge, I kind of knew what I wanted, but it's very hard to put something together within a year and why you're doing it. So I had the opportunity to take the FAST course and man, I really like how it does tie everything in together. Basically, the lesson plans are in the text book and you are going to vary the pace depending on where the students are.
10-day/6	Increase	Program Structure	Just by repetition I feel the students are able to pick up, "what are my controls what are my variables?" without me telling them, "this is a control, this is a variable." So especially with science that I'm learning in the middle-school, it's going to come in really, really handy.
10-day/6	Increase	Program Structure	Ability was always there it's just the lack of time and class to do labs. Now that it is there in front of you, I should have no problem.

Group/ Participant	Category	Primary Factor	Transcription
10-day/6	Increase	Program Structure	Because it is set up so they have to make repetition, repetition, repetition, they seem to pick it up. Hopefully they'll pick it up a lot faster and therefore won't be as bored jumping lab to lab....Hopefully by doing it and seeing their friends presenting they will sort of pick up and say "okay now that's why we got what we got and we can share that with you. We can teach our friends why we got this versus what they got, we might be wrong or they might be wrong but that's okay, we followed the steps."
10-day/3	Increase	Program Structure	I think for me this helped me to be able to sew the lessons together better, because of the structure. And the structure reappears every time you do a lesson.
10-day/3	Increase	Program Structure	What I got now is more ways for them to structure their designs and then it will carry through on other ways to analyze different data or collect the samples. Whereas, I didn't know how to articulate that to them, you got to have this reference. That was really helpful.
10-day/3	Increase	Content/ Pedagogical Knowledge	I rekindled my interest in making fire in my room, controlled fire, that is. Now I feel like I got the education again.
10-day/3	No change	Student Characteristics	I gave myself an 8 before and an 8 now. And the reason why I did that is because the construction of meaning is going to fall on their proper social skills. I can see my students just getting into it and then getting on each other, and then there is all of these middle-school issues that come into play. When really I can't make this mean anything to them. So I just have to keep providing a stage for them to construct the meaning and to stop them from interfering with each other while their learning the lesson. There are too many variables to analyze for me right now.

Group/ Participant	Category	Primary Factor	Transcription
10-day/4	No change	Practice/ Feedback	A lot of times I didn't have that fluidity between the labs that flow from one another. Even after having taken this course, I scored lower than I probably would have because I haven't had a chance to try it out. I feel more prepared, but until I'm actually doing it, I can't really make a fair assessment.
10-day/4	Increase	Content/ Pedagogical Knowledge	With having taken this class, I learned to switch gears and give myself more of a grade, by putting it more on them.... It helped a lot as far as me conducting a more efficient class not having to call on them all the time.
10-day/4	Increase	Program Structure	I'm used to spoon-feeding the kids, but the way the structure is laid out I only have to give them limited demonstrations. It's more consistent throughout.
10-day/4	Increase	Content/ Pedagogical Knowledge	Last year when I wasn't trained and tried to do the test program I skipped over a lot of the graphs. Mostly because I was trying to get through all of the available science labs within a year, there was a lot pressure to get them done and move on....I don't feel rushed any more.
10-day/5	Increase	Content/ Pedagogical Knowledge	I guess before my lesson plans were really disjointed, but now I realize I can kind of let it flow and connect it with one another
10-day/5	No change	Experience	I just got my teaching license, I still sometimes assume the kids know things, when they really don't. So, sometimes I find it hard to have to break it down to simplify it a lot.
10-day/5	Increase	Content/ Pedagogical Knowledge	Basically, I was reintroduced to a lot of the equipment that I forgot how to use and I feel more confident, more comfortable teaching it to the students.

Group/ Participant	Category	Primary Factor	Transcription
10-day/5	Increase	Content/ Pedagogical Knowledge	Big jump, I guess, with my lack of experience I haven't had a lot of chance to apply this and then explore the situations. It's more like, "okay you learn it and then you go on." But now I see the relevance and how that really shows how much you know.
10-day/7	Increase	Program Structure	Before, I pretty much had to design from start to finish and last year was my first year teaching science. It takes a tremendous amount of work and I also feel it was kind of disjointed. I had to spend a lot time trying to order things in a way they would be most useful. That was one of the things that I was really impressed with FAST— it has a very natural progression.
10-day/7	Increase	Program Structure	Basically all of the FAST lessons are set up for experiment that follow that method. Yeah, I thought it was excellent.
10-day/7	No change	Student Characteristics	I need to try to have the kids do the lab themselves, forcing them to answer their own questions. Sometimes I think the design of some of these that were used present an anomaly, some big question or some mystery. We have to provide an incentive for them to want to figure it out. They want to know how it works and figure it out so it drives them and motivates them to want to do the experiment.
10-day/7	No change	Experience	This coming year will only be my third year, but I always have trouble with assessing what they know. I tend to think they know a lot more than they do. That's why it's not higher, I'm just not particularly good at that.
10-day/1	No change	Practice/ Feedback	I think I need some more practice with the class, in an actual class setting and I'm sure I'll make some mistakes, but through practice I'll get up there.

Group/ Participant	Category	Primary Factor	Transcription
10-day/1	Increase	Content/ Pedagogical Knowledge	Big increase, just because I had a hard time asking discussion questions, summary questions, follow-up questions that would get them to critically analyze their data and formulate their results. I've learned to look at what types of questions to ask so they can be critical.
10-day/1	Increase	Content/ Pedagogical Knowledge	In this training I learned a lot. I took a lot of notes, which will hopefully help me. The tools that I learned and the notes that I took and all of the resources that I have should help me tremendously.

Table 4. 5-day Version Focus Group Transcripts

Group/ Participant	Category	Primary Factor	Transcription
5-day/5	No change	Practice/ Feedback	I'm wondering, cause in my head, I'm thinking its going to help me when I do that part of the lesson. So, I guess as I teach more and read more of the FAST stuff, I'll figure how to tie in the rest of the things. But for now, I can only say its what we've done in class
5-day/5	Increase	Content/ Pedagogical Knowledge	Actually before I thought I was doing a pretty good job, but now that I'm here and I see how its done, I'm like Wow! You know that pretty good job that I was doing maybe wasn't too good....Now, (I know) there are standards I need pay attention to.
5-day/5	Increase	Program Structure	I think that this class really helped me see trends and I think just by having experiments done in stages where the current lab has to do with the previous lab and next lab, and so on, I think that really helps to ties things together.
5-day/5	No change	Practice/ Feedback	It's really hard to tell, because I'm not in the classroom yet. And I think that once I do get in and I start teaching then I'll be able to tell where I'm at. I think this class has really helped me link things together, But I wont know until I start teaching.
5-day/6	No change	Practice/ Feedback	I feel that it's so much information that when we go away from here and plan classes that we are going to go, huh? So, I'm hesitant to mark it higher until I try it. When I actually think about actually doing all the things that we did I go, Oh!
5-day/6	No change	Time Issue	In the past, I would do labs and then they would have questions and reflection and if they didn't get it, "oh well, move on." I did it because we have block scheduling where we have half a year with the kids and everything is condensed I still think this may be a problem with the FAST program and I really don't know how that's going to work out

Group/ Participant	Category	Primary Factor	Transcription
5-day/6	Increase	Program Structure	I had a pretty big increase because before I was given a book and they said, "here go with it." I pretty much just did labs and investigations. But here the way the program is setup is definitely about things that are around you.
5-day/3	Increase	Program Structure	Just seeing the way Mary went about every single one introducing it, this sort of common thread between all of them got it solid in my head. Whether or not that actually happens is another story, but right now I feel good
5-day/3	Increase	Experience	Strangely enough this was one of the things I felt really comfortable with before, it sort of came naturally to me and it has given me a good foundation for improvement.
5-day/3	Increase	Program Structure	I sort of already had this style of teacher, but I did increase because by looking at FAST as a series of experiments rather than reading, memorizing, so forth, I feel like I will approach things by questioning the kids with this style of investigation the class offers.
5-day/3	Increase	Program Structure	In this past year the experiments that I did came from the text book, that I was just sort of thrown into. So in comparison of not being guided in those specific experiments and not feeling like they're great experiments in comparison to being guided through these experiments, and feeling like these experiments were spot on, totally honed in on the basic building block that you need in order to then build to the next one. I feel like I'll always do that...It takes the scariness out of science.
5-day/2	No change	Practice/ Feedback	I think that setting up the equipment, getting ready, preparing and dealing with the students questions, and guiding them in the right direction I think it will take some practice

Group/ Participant	Category	Primary Factor	Transcription
5-day/2	No change	Student Characteristics	With the FAST approach, the inquiry approach, I see it as a harder way to guide the students because they're not introduced to the concepts. Their doing the experiment and figuring out the concept on their own and drawing their own conclusions. I feel I have to guide them more, even though they're doing a lot of it on their own, I'm still having to see are they reaching the right conclusions. In a sense I think the guiding process maybe a little bit more challenging, depending on the student.
5-day/2	Increase	Program Structure	I do feel that FAST will give students get a better understanding of how to create those experiments and investigations and how to design them better.
5-day/2	Increase	Program Structure	I think that the FAST program connects things a lot better, whereas, when I used to go unit by unit I may jump cells to ecology and there's not a whole lot of interdisciplinary connections that I'm making, which I should be, but I don't take the time to do that. I hope they're going to make the connections on their own. Whereas, FAST just naturally provides that as you progress.
5-day/4	No change	Experience	I'm a new teacher so I think that I may need to learn a bit more before I feel real comfortable.
5-day/4	No change	Practice/ Feedback	I think I need to have more time to kind of take everything in so I'll feel a little bit more confident about that
5-day/4	No change	Practice/ Feedback	I think the reason why I'm not higher is because I don't want to say scared but yeah I'm a little scared of all of the equipment in the lab right now. After I read more and see more I think I'll feel better

Group/ Participant	Category	Primary Factor	Transcription
5-day/1	Increase	Professional Collaboration	What I would like to say about this is that it always nice to work with other colleagues. I think it wasn't so much the way it was presented, it was presented very well, but just seeing different ways other people set standards and seeing the various ideas of controls. Its nice to work with a bunch of other professional people who teach the same subject that I do and it's neat to see the differences.
5-day/1	Increase	Professional Collaboration	Again, I learned a lot from watching you guys and how to use different things and that always excites
5-day/1	Increase	Program Structure	After his week I think that I'll spent a little bit more time on something and let some other things go. I just felt so many times I could have gone off on a lot of little tangents and really gotten deep into them. I mean you can spend a month on one thing, that would be the ridiculous end of it. But, maybe a few days on something, whereas before I would have only spent one day on it. I think I was encouraged to do more of those types of things, such as delving deeper into a topic.
5-day/7	No Change	Student Characteristics	It's kind of impossible or difficult. As far as reviewing and tying in previous work, I have a feeling that students that I'm going to get haven't done any inquiry type of activity in the past.
5-day/7	No Change	Student Characteristics	I may know exactly what to teach and how to teach, but there are other variables involved. Getting the kids focused on learning. Getting them motivated. I think in that the kids haven't been questioned like that before and I think most of the time they're looking for the right answer, looking for the standard. When you ask them to think like this you're going to get a lot of silence. It's hard if they don't come with prior knowledge of that science.
5-day/7	No Change	Practice/ Feedback	I won't have a real answer to that until I've tried the program.