EXAMINING EVIDENCE-BASED EXPLANATIONS IN

IN-SERVICE SCIENCE TEACHERS' REFLECTIONS

by

CYNTHIA C. MINCHEW DEATON

(Under the direction of Lynn A. Bryan and Thomas R. Koballa, Jr.)

ABSTRACT

This qualitative study examined evidence-based explanations developed by in-service elementary science teachers as they reflected on their science teaching practice. To examine their evidence-based explanations, this study focused on how elementary science teachers used the Video Analysis Tool (VAT), a reflection framework, and evidence of their science teaching to develop explanations about their science teaching practice. Open coding was used to analyze participants' VAT analyses, journal entries, interview transcripts, and presentation transcripts. A layered case study approach was used to organize the data for four participants. Findings showed participants used multiple evidence categories, such as observatory, experiential, and preparatory evidence, to support explanations developed while reflecting on their science teaching. VAT was used for multiple purposes, such as examining teaching from another perspective, helping students monitor their own behavior, and gathering evidence of other teachers' science teaching practice. Participants were not able to thoroughly address the reflection framework. They struggled with identifying curriculum standards relevant to the focus of their reflection and contradictions between their teaching practice and teaching philosophy. The nature of evidence used by participants focused on nurturing students' emotional needs, examining how students learn, and addressing technical issues of practice. VAT afforded participants the opportunity to

identify issues in their teaching practice and develop plans for solving dilemmas in their teaching practice. Through VAT, the reflection framework, and using accessible evidence, participants were able to engage in the reflective process.

INDEX WORDS: Professional development, reflection, elementary science teachers, explanations, evidence, evidence-based explanations

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DEDICATION

This work is dedicated to my parents who taught me to love learning. I owe all I am to you. Your lessons gave me a wonderful foundation for teaching, learning, and life. To my mother, thank you for teaching me compassion, the value of hard work, and to believe in myself. To my father, thank you for teaching me to love science, stand up for my beliefs, and honor my word and handshake. I will never be able to express my gratitude for your love and support. I love you both.

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CHAPTER ONE

INTRODUCTION

The process of studying one's own practice is consistent with Vygotsky's notion of the highest stage of cognitive development. He believed that in order to truly understand the higher stages of development, one should "concentrate not on the product of development but on the very process by which higher forms are established" (Vygotsky, 1978, p. 61). From Vygotsky's study of knowledge development, teacher educators may draw useful parallels for teachers' use of reflection to study their practice. Through Vygotsky's examination of stages of cognitive development, it becomes apparent that teachers should have opportunities to reflect on the processes, not just the products, of their teaching.

The three themes that ground Vygotsky's study of knowledge development -- examining processes, developing explanations of relationships, and analyzing automated processes (Vygotsky, 1978) -- are components of teachers' reflective practice. One theme emphasized in Vygotsky's study of knowledge development was the importance of analyzing processes instead of objects (Vygotsky, 1978). Teachers' critical examination of their practice through reflection focuses on the processes of teaching and learning. By reflecting on their teaching practice, teachers can examine relationships and reconstruct specific moments in their teaching.

During their reconstruction of their teaching practice, reflective teachers develop explanations of their practice. Teachers' development of explanations is consistent with another theme of Vygotsky's research, the development of explanations during analysis (Vygotsky,

1978). Reflective teachers do not simply narrate or describe their teaching practice. They use their reflections to investigate anomalies in their teaching and develop explanations of involved processes and relationships. As stated by Vygotsky , "mere description does not reveal the actual causal-dynamic relations that underlie phenomena" (1978, p. 62),.

A third theme surrounding Vygotsky's study of knowledge development, the analysis of automated processes (Vygotsky, 1978), is also part of teachers' reflective practice. Through reflection, teachers are given the opportunity to examine their beliefs and tacit knowledge about teaching and learning. Through observing and reflecting on experiences, teachers may develop descriptions of their tacit knowing (Schön, 1987). Reflective teachers are able to address and articulate knowledge that has become a part of their established teaching practice.

The teaching experience is shaped by the knowledge and beliefs that teachers bring to their practice (Barnes, 1992; Desforges, 2003). Since knowledge about education is bound in specific contexts (Carr & Kemmis, 1986), teachers need to understand that their beliefs and experiences of teaching directly impact their construction of knowledge about teaching and learning. Teachers can only make sense of new teaching experiences and information by interpreting them using their own previous knowledge, beliefs, and experiences (Dewey, 1938; Barnes, 1992; Weiss & Weiss, 2001). Bryan and Abell (1999) stated "the beliefs that students of teaching hold play a pivotal role in the interpretation and construction of professional knowledge" (p. 122). The use of reflective activities in professional development experiences will help in-service teachers make their beliefs more explicit and allow them to address inconsistencies between their beliefs about teaching and their actual teaching practice. Their experience and reflection on those activities will help teachers "become cognizant of their beliefs

about teaching and learning" (Bryan & Abell, 1999, p. 136), a crucial step in teachers'
development of knowledge.

<div align="center">What is Reflection?</div>

Defining Reflection

Reflection is a systematic and purposeful methodology for examining ones' own practice.
It is a way of thinking about an experience that allows one to understand and resolve conflicting
situations and expectations through inquiry (Richardson, 1994; Weiss & Weiss, 2001). The
concept of reflection is ancient (Houston, 1988). Historical views of reflection play a large role
in how reflective practice is utilized today by researchers and practitioners. While the definition
of reflection may vary slightly from scholar to scholar, cognitive and moral aspects of teaching
and learning to teach (Calderhead, 1989) unite the various conceptions of reflection. This section
briefly details the elements essential to reflection.

Self-awareness. One feature of reflection is self-awareness. Self-awareness, "the ability
to see oneself as object" (Fendler, 2003, p. 17), leads to the development of knowledge.
Through deep examinations of their practice, teachers may become aware of their own beliefs
and knowledge and the environment they create in their classrooms. Essential thinking skills and
attitudes that foster self-awareness include openmindedness, responsibility, and
wholeheartedness (Calderhead, 1989; Zeichner & Liston, 1996). Dewey (1938) identified the
importance of these skills and attitudes in the process of reflecting on an experience. In order to
practice self-awareness, a teacher must enter into the process with an open mind. Furthermore,
teachers must take on the responsibility of examining their teaching.

Perturbation. Another feature of reflection is "a state of perplexity" (Dewey, 1910, p. 9) or perturbation. In the case of teacher practice, teachers begin to reflect on their practice after facing a moment of perturbation. The teacher's familiar routine produces unexpected outcomes or they begin to question or view an expected outcome differently (Schön, 1987). This event in teachers' practice can be handled in multiple ways. The teacher may chose to brush aside the anomaly in an attempt to preserve their common teaching practice and beliefs or the teacher may choose to reflect on the situation as a way of understanding the anomaly (Schön, 1987). During reflection, teachers start to address the situation that conflicts with and causes them to reevaluate their teaching beliefs or practices. Once a perplexing situation is noted, the practitioner often frames "the problem to identify goals or purposes that will be attended to and those that will be ignored" (Nolan & Huber, 1989, p. 127). When practitioners frame a teaching situation, they use their previous knowledge and beliefs of teaching to examine the situation. Then, the teacher participates in a "search or investigation directed toward bringing to light further facts which serve to corroborate or to nullify the suggested belief" (Dewey, 1910, p.9).

Examining Practice. Teachers' investigation of their teaching practice is another component of reflection. Once teachers frame their problem, they can continue to reframe and investigate their problem until they reach an appropriate solution. When framing their problem, teachers develop a framework of beliefs and knowledge to examine their teaching practice. It is with this process that they begin reflection. As teachers continue to examine their problem, they may become aware of additional variables impacting their teaching problem. Teachers will use this new information to reframe their problem, where they adjust or refine their framework of beliefs and knowledge. According to Calderhead (1989), Dewey (1910) and Schön (1987) identify reflection as an exercise of skills in analyzing and finding solutions for complex

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problems of practice. During the analysis and development of solutions, teachers gather evidence of their teaching that may support or contradict their beliefs about teaching and learning. Teachers engage in the process of reflection to note and address issues of teaching and learning as they arise.

Knowledge Construction. An overarching outcome of reflection is the construction of knowledge. Schön (1987) believed that reflection leads to the development of knowledge. Specifically, he argued that two forms of reflection, reflection-in-action and reflection-on-action, can result in professional knowledge. He coined the phrase *reflection-in-action* and defined it as "the rethinking of some part of our knowing-in-action leads to on-the-spot experimentation and further thinking that affects what we do" (Schön, 1987, p. 29). Reflection-in-action provides an opportunity for individuals to question their knowledge by critically examining the thought processes involved in a situation and restructuring their understanding of the situation (Schön, 1987). Not only will individuals restructure their understanding of the current situation, they will use reflect-in-action to "indirectly shape [their] future action" (Schön, 1987, p. 31).

Reflection-on-action, which is "the systematic and deliberate thinking back over one's action that characterizes much of what we do when we pause after an action and attend to what we believe has occurred" (Munby & Russell, 1992, p. 3), also shapes future action. Like reflection-in-action, reflection-on-action helps teachers question their knowledge structure and develop a deeper understanding of the actions and knowledge contained within a situation. The constructionist view positing that practitioners construct situations of their practice (Schön, 1987) is consistent with Schön's conception of reflection. Knowledge is developed when teachers have a "reflective conversation with the materials of a situation" (Schön, 1987, p. 31). This reflective conversation is created when teachers frame and reframe issues of practice. As

teachers reframe issues of practice, they use their previous understanding of their teaching along with new evidence from their teaching to refine the examination of their teaching practice. Through reflective conversations, teachers reveal, develop a deeper understanding of, and restructure their knowledge about teaching and learning.

The Role of Explanations in Reflection

Explanations of practice developed during reflection should help answer questions about a teacher's understanding of their teaching practice (Gilbert, 1999). Through the construction of explanations, teachers use and refine skills necessary for developing knowledge about teaching and learning. The process of constructing an explanation through reflection is similar to the process of constructing explanations in science. To engage students in conducting scientific inquiry is to engage them in the construction of scientific explanations (Sandoval & Reiser, 1997). Engaging teachers in reflection on their teaching practice involves the process of developing explanations about their teaching. Teachers begin to develop explanations of practice as they examine their teaching and identify certain actions or strategies that influence their lesson. Once they identify evidence, such as teacher or student actions, that support or refute their teaching beliefs and expectations, the teachers are able to develop solutions for problems of practice. It is through this development of solutions, or a plan of action for a deeper investigation, that teachers develop explanations about teaching and learning situations within their classrooms.

In order to develop explanations of practice, teachers need to possess and make explicit certain beliefs and knowledge about teaching and learning. Similar to what occurs in reflection, Sandoval and Reiser (1997) suggested that an understanding of scientific knowledge and the nature of science is needed to construct scientific explanations. Like students of science, science

teachers' need an understanding of certain content knowledge. Specifically, they need to understand pedagogical content knowledge and their philosophy of teaching to develop explanations of their practice.

The development of explanations may also be influenced by context, personal views, and resources. The construction of an explanation is constrained by the context of the situation (Wong, 1996) or in the case of reflection, the specific event or situation you want to examine. The quality of available technology, teacher expectations, and collected evidence can influence students' construction of scientific explanations (Wong, 1996). Gilbert (1999) summarized Wong's study by stating that "[the students'] judgement of what constituted an 'appropriate explanation' was coloured by their perceptions of the teachers' expectations (they thought that they should give the 'right' answer) in the context in which they were working (a laboratory practical session)" (p. 551). Explanations of practice developed during reflection may provide insight into the context and perceptions surrounding problems of practice. Explanations may also provide insight about ways to further improve one's practice.

The Role of Evidence in Reflection

The process of teaching and learning to teach is grounded in evidence (Desforges, 2003). On a daily basis, teachers utilize evidence, ranging from student behavior to test scores, in order to make decisions about teaching and learning in their classrooms (Zeichner & Liston, 1996; Desforges, 2003). Reflection is a practice that may extend teachers' use of evidence to influence their teaching (Elliot, 2004). Through the collection of evidence about their practice, teachers can identify perturbations that exist in their classroom practice and thinking about teaching and learning. They can also use the evidence to further their understanding of their classroom environment and their teaching practice. Using evidence to construct explanations of practice

lends some credibility to the explanations being developed. The evidence-based explanation developed by teachers helps to ground their examinations of practice and helps them reframe situations being explored.

Teachers' exploration of their teaching practice does not end with the process of reframing a problem (Russell & Munby, 1991). The practice of reflection may extend to further examinations of practice which necessitates the continued collection of evidence and examinations of practice. The cyclical nature of reflection may lead to deeper investigations of a specific issue or the unveiling of new problems to investigate. This continued "reflective conversation with the situation" (Schon, 1987, p. 64) promotes critical thinking about the teachers' thinking of the phenomena under investigation. Critical thinking about one's practice may encourage teachers to continue to refine their knowledge about teaching and their teaching practice.

Why Study Teacher Explanations of Practice?

The processes of learning science and learning how to teach science are parallel in many ways (Abell, Bryan, & Anderson, 1998). Likewise, one may draw many parallels between science students developing explanations about science concepts and teachers' developing explanations about their teaching practices and expectations. Like students of science, science teachers develop explanations based on the context of the situation they are examining and any available evidence or resources, such as video of their lessons, and student products. Science teachers, like science students, develop explanations of practice using knowledge that is specific to the situation being explored. In the case of science teachers, they utilize their science content knowledge, pedagogical content knowledge, and pedagogical knowledge to reflect on their practice. In additional to these knowledge bases, both science teachers and students of science

are influenced by their instructors' coaching and the questions used to focus their exploration of a situation. By examining how science teachers develop explanations of practice, teacher educators can better understand how they reflect on their practice. Teacher educators can see how they utilize evidence presented to them through reflective activities and how they assess and improve their teaching practice.

Using Reflection Tools to Examine Teachers' Reflections

In order to reflect on their teaching using evidence, teachers may use tools for collecting, storing, and examining evidence of their teaching practice. The Video Analysis Tool (VAT: http://vat.uga.edu) is one tool that combines the features of data collection, storage, and examination (Recesso et al., in press). Teachers can use VAT to reflect on their teaching practices and "systematically examine evidence" (Recesso et al., in press, p.3). In the case of practicing science teachers, they may use VAT to identify and examine various aspects of their teaching practice. As well as being a tool for analyzing data, VAT is a web-based system used to store and organize data. Data collected by practicing teachers can range from video of their teaching to written reflections on their teaching. The VAT is designed to promote sharing of evidence and ideas about teaching and learning. By using VAT to gather reflections on in-service teachers' science teaching practice, teacher educators are able to examine evidence, explanations, and reflections that are relevant and meaningful to the teachers.

To supplement the use of VAT, teachers may use various frameworks to guide their reflections on their science teaching practice. Frameworks used by the teachers can range from the use of specific state and national standards to prompts that encourage teachers to think about specific questions relating to their teaching practice. By using tools, such as frameworks, to prompt teachers to further study their teaching, teachers are able to more systematically examine

their practice. Practicing teachers can use the evidence provided in tools like VAT to link evidence of their teaching to certain framework standards or questions and develop explanations about the evidence and their teaching.

Using a Professional Development Experience as the Context for Studying Teacher Reflections

The processes of teaching and learning to teach is embedded in the context of the teaching environment (Guskey, 1995). The context of each teacher's classroom is complex and comprised of many interconnected influences (Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003, p.9). Professional development experiences play a large role in the teaching and learning environment of in-service teachers. Since reflection is a fundamental component of many professional development programs (Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003), it seems evident that the reflective practice of in-service teachers during those experiences will influence the teachers' practice. In order for professional development experiences to be effective, professional development facilitators should address needs and issues that are relevant to their participating teachers (Guskey, 1995). Professional development experiences that utilize teachers' daily practice as the context for their development of knowledge about teaching and learning allow teachers to reflect on their own classrooms and teaching practice.

The context for this study is a year-long professional development experience that utilized elementary teachers' classrooms and daily practice as the context for their reflections on their science teaching practice. By studying participants in the yearlong professional development experience, I was able to develop an understanding of classroom issues that elementary teachers' faced and addressed in their reflections on their science teaching. By using the participants' practice and classrooms as the focus of their reflections, this study examined reflections that are relevant to the teachers. The emphasis on reflection and the use of reflection

tools, such as VAT and reflection frameworks, during the professional development experience supported in-service teachers' development of knowledge about their science teaching practice. By studying in-service teachers' use of reflection and reflection tools during a professional development experience, I developed an understanding of how the reflection tools are used by in-service teachers' and how the reflection tools supported teachers' development of knowledge about their science teaching practice.

Purpose of the Study

This study both builds on current literature about reflection in in-service teacher education and helps establish a research base on teachers' development of evidence-based explanations in the process of reflecting on practice. In this study, I examined teachers' explanations of their science teaching practice as they used an innovative evidence-based tool, Video Analysis Tool (VAT) and a reflection framework. The research questions guiding this study were:

- How do elementary science teachers develop explanations of practice using Video Analysis Tool?

- How do elementary science teachers develop explanations of practice using a reflection framework?

- What is the nature of the evidence that elementary science teachers use to develop their explanations?

Significance of Study

Learning to develop explanations of teaching practice is essential to the process of thinking and discussing teaching and learning. By examining the explanations of practicing elementary teachers' teaching experiences, teacher educators can begin to understand how

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teachers' beliefs (Zeichner & Liston, 1996) and context influence their teaching practice. Teacher educators can also develop a better understanding of how teachers use evidence to influence their teaching practice. Through reflection and the development of explanations, teachers use evidence to support or contradict their beliefs about teaching and learning. This study identified how teachers used evidence to explain and refine their teaching practice. These findings provide insight to science teacher educators and professional development facilitators about their role in supporting science teachers' development of evidence-based explanations of their teaching practice through reflective writings.

The uniqueness of this study is the use of VAT as a resource for teachers to collect evidence and reflect on their practice. This study explored how using an innovative technology (VAT) allowed teacher educators to better understand the relationship between teachers' use of evidence and development of explanations of their teaching practice. Through the examination of teachers' explanations within a system such as VAT, teacher educators can develop an understanding of teachers' utilization of video evidence when reflecting on their practice. This study introduced a framework for guiding teachers' reflective writings as they used video evidence. Furthermore, this study provides insight into the importance of on-going support for the reflective process through the use of feedback and framework prompts to guide reflection.

CHAPTER TWO

CONCEPTUAL FRAMEWORK

Several bodies of literature comprise the conceptual framework of this study, including: professional development, reflection, and explanations. The first area of literature that supports this study is professional development. Professional development experiences aimed to enhance the teaching of elementary science are valuable to the context of this study. This study is set within a year-long professional development experience that incorporates various strategies in its design. Components focused on in the literature on professional development are 1) a definition of professional development, 2) the need for professional development, and 3) the components of professional development. Since reflection was one of the main foci for the professional development experience serving as the context for this study, literature on reflection also grounds this study. Areas of reflection discussed are 1) a definition of reflection, 2) the cycle of reflection and 3) tools for reflection. The third body of literature that guides this study is explanations. Explanations within teachers' reflection are the main focus of this study. Areas of explanation highlighted in this chapter are 1) a definition of explanations, 2) types of explanations, and 3) the use of evidence to inform explanations.

Professional Development

Professional development is a process through which practitioners construct new knowledge and skills and enhance existing knowledge and skills to become effective in their practice (Hoyle, 1982). Hoyle (1982) described professional development as being guided by two ideas: (a) "the notion of a *process* starting with initial training . . . and continuing throughout

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an entire career" (p. 163) and (b) "the notion that knowledge and skills should . . . be more directly related to the substantive problems faced by teachers" (p. 164). Posnanski (2002) stated:

> Teachers are professionals who engage in constant decision-making processes regarding the facilitation of student learning. Comparable to the on-going training and development undertaken by other professionals, effective teachers of the sciences need continuous skill development throughout their careers. As contemporary ideas of both science teaching and learning change, so too must teachers have opportunities to study and engage in the theories and research that drive these reformative changes (p. 189).

Current reform efforts aim to support education through the development of new ideas about teacher development, teaching, and learning (Lieberman, 1995; NRC, 1996; Shulman, 1987). Meeting the needs of current science teachers requires the development of programs that support current reform efforts (Luft, 2001). Due to this inherent requirement, many educators have called for the reform of professional development practices (Guskey, 1995; Kwakman, 2003; Posnanski, 2002; Zimmerman & May, 2003). Most proposals discussing the reform or transformation of education emphasize professional development as a key vehicle for change (Guskey, 1995; Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). In addition to supporting current reform efforts, professional development programs provide teachers with an opportunity to further develop their practice and their knowledge of teaching and learning.

Professional Development for Teacher Development

Literature on professional development for teachers emphasizes the need to meet teachers at their stage of development and help them continue in their development (Jeanpierre, Oberhauser, & Freeman, 2005; Loucks-Horsley, Kapitan, Carlson, Kuerbis, Clark, Nelle, Sachse, & Walton, 1990). Teachers, like other professionals, are expected to continue learning

throughout their career in order to expand their teaching expertise and enhance their teaching (Loucks-Horsley et al., 2003). All professional development endeavors need to address improved teaching approaches and expanding teachers' content knowledge (Loucks-Horsley et al., 1990). In order to cultivate quality teachers, professional development should be an on-going effort where various organizations collaborate to support teachers' development (Loucks-Horsley et al., 1990). Through effective professional development experiences, teachers are able to refine their practice and enhance their knowledge of teaching and learning.

Components of Professional Development Experiences

There are a variety of different criteria for and models of professional development (Loucks-Horsley et al., 2003; Posnanski, 2002). Research on professional development experiences has concluded that effective professional development share common themes. Themes of effective professional development include: extensive support, collaboration, modeling, embedding local context, practice, and reflection (Loucks-Horsley et al., 1990; Loucks-Horsley et al., 2003; Posnanski, 2002; Xu, 2003). This study focuses on the component of relevant and meaningful content, as well as the components of practice, extensive support, collaboration, embedding, and reflection listed above. These components have been identified as effective professional development components and relate to the context of this study. The following section briefly discusses these influences and their impact on teacher development.

Relevant and meaningful content. The five knowledge bases that professional development designers use to inform the design of their professional development experiences are: learners and learning, teachers and teaching, the nature of science, professional development, and the change process (Loucks-Horsley et al., 2003). Researchers have suggested that professional development experiences must be relevant to teachers, focus on their daily

classroom activities, and address concerns of teachers and students (Guskey, 1995; Loucks-Horsley et al, 2003).

In order to develop their practice, teachers need experiences, such as staff development courses, focused on teaching and learning that is relevant to their classrooms. "The teaching and learning process is a complex endeavor that is embedded in contexts that are highly diverse" (Guskey, 1995, p. 3). Contributing to the complex nature of the science classroom are content knowledge, teachers' translation of this knowledge into science lessons, students' prior knowledge, teaching strategies, teacher beliefs about science teaching, classroom organization, and classroom management (Smith & Neale, 1989). Furthermore, teachers are aware of and understand the complexity of their teaching environments, which emphasizes the importance of learning about science teaching within the context of their classrooms. As stated by Loucks-Horsley et al. (2003),

> [Teachers] recognize that they practice in uncertain circumstances, that much of their knowledge is embedded in their practice rather than in codified bodies of knowledge, and that their extensive, complex knowledge, particularly with respect to their understanding of how learners learn, profoundly influences how they teach. Based on this, teachers need learning opportunities that focus on their practice (p. 40).

Professional development experiences should incorporate situations and environments that are relevant and meaningful to teachers. Teachers direct their learning and construct knowledge by using their teaching context as a guide (Kwakman, 2002).

Practice. Since teacher learning and student learning are intertwined (Goodlad, 1984: Loucks-Horsley et al., 2003), it is evident that to improve student learning one should improve teacher learning (Fullan, 1996; Goodlad, 1984: Jeanpierre, Oberhauser, & Freeman, 2005;

Kwakman, 2003). Teachers need opportunities to hone their practices by trying out various activities and strategies during their professional learning experiences (Jeanpierre, Oberhauser, & Freeman, 2005). These experiences may lead to increased teacher confidence with both the content and strategies discussed (Jeanpierre, Oberhauser, & Freeman, 2005; Loucks-Horsley et al, 1998; van Driel, Beijaard, & Verloop, 2001). By engaging in experiences that simulate methods or concepts emphasized in a professional development course, teachers can gain an understanding of a student's perspective and the instructional issues that surround the implementation of those methods or concepts (Luft, 2001).

Like students of science, teachers of science need to learn by doing and interacting with materials of science teaching (Lieberman, 1995; Loucks-Horsley et al., 1998; Yinger, 1990). Significant amounts of time should be provided for teachers to practice with science teaching approaches and materials (Rosebery & Puttick, 1998). Various researchers have stated that individuals learn best from being actively involved in and thinking about what they are learning (Lieberman, 1995). To support teachers' active involvement and thinking about concepts, multiple strategies should be incorporated into staff development that support change in teachers' knowledge (van Driel, Beijaard, & Verloop, 2001). Changes in teachers' knowledge about teaching and learning may influence their teaching practice. Rosebery and Puttick (1998) describe science teaching as:

> A process of sense-making in which teachers draw upon multiple resources, including their experience with and knowledge of their [content], their experience of science as a way of knowing, their own histories as learners, their knowledge of individual children, and their pedagogical expertise, to build bridges between children's ideas and ways of knowing and the ideas and practices of science (p. 651).

Teachers use their understanding of content, teaching, and learning as resources to develop their teaching practice. Activities that support their understanding of and development of their science teaching should encourage a deeper understanding of both their teaching practice and content. The combination of both a deep understanding of pedagogy and subject matter content supports the development of effective teaching strategies (Kubota, 1997). In addition to gaining increased confidence with science materials and content (Jeanpierre, Oberhauser, & Freeman, 2005; Loucks-Horsley et al, 1998; van Driel, Beijaard, & Verloop, 2001) during professional development courses, activities that provide practice with materials and strategies may facilitate teachers' adoption of them into their own classroom (Guskey, 1995).

Extensive support. In addition to opportunities to practice activities and to discuss teaching strategies and science content with their peers over a long period of time, teachers should be provided with opportunities to receive and respond to facilitator feedback on their practice. Feedback, when used as formative assessments, may take the form of evaluating, critiquing, questioning, and encouraging individuals' performances to enhance their practice and competence level (Tunstall & Gipps, 1996). The use of feedback in professional development courses is essential to the success of professional development courses because it provides teachers with an understanding of their achievement of certain strategies and materials (Guskey, 1995). Feedback, as a form of ongoing support, may be individualized for participants to make content meaningful and relevant to their practice. It may take the form of reflective conversations, written comments on teaching products, notes from lesson observations, or e-mail correspondence about classroom concerns. Whatever form it may take, feedback from the professional development facilitator should be timely and relevant to the professional development participant. An important condition for professional development experiences is

"providing ongoing assistance based on teachers' needs" (Xu, 2003, p. 355). Not only does feedback support teachers' understanding of their abilities to implement various strategies or materials, it also helps direct their development of knowledge about their teaching practice (Luft, 2001).

  Collaboration. Teachers need opportunities to participate in a community of learners (Jeanpierre, Oberhauser, & Freeman, 2005; Lieberman, 1995; Locks-Horsley et al., 1998) so that they can discuss and practice new teaching concepts. A community of learners has been defined as a group of individuals who, through cooperation and collaboration, work together to support one another and develop a deeper understanding of a shared practice or goal (Dow, 2005). A study by Xu (2003) described how "building an environment of trust" (p. 354) supports professional learning and collaboration through open lines of communication. In order to enhance the sharing within professional development experiences, teachers need to feel valued and safe. Building a safe community of learners allows teachers to share their expertise with their peers (Day & Pennington, 1993). Participating in a community of learners affords teachers the opportunity to interact with colleagues as they develop a deeper understanding of teaching. As stated by Kubota (1997),

> The notions of pedagogical content knowledge and constructivism suggest that expert and novice teachers as well as those in teacher preparation programs need opportunities to work together, discuss, share, justify, and clarify their understanding of what it means to be a teacher of science (p. 141).

Opportunities, such as those described above, support teachers in refining their understanding of their science teaching. Teachers can come together to share stories of their good and bad

teaching experiences, successful teaching strategies, and new ideas, while providing a support network for teachers in similar situations (Lieberman, 1995).

Reflection. Reflection is a vital component of professional development design (Loucks-Horlsey, 2003; Spilkova, 2001). The use of reflection allows teachers to examine the daily teaching practice of themselves and others. As quoted by Posnanski (2002): "Effective in-service professional development programs should attempt to have teachers identify, discuss and reflect on various pedagogical issues, as well as their own beliefs about effective teaching behaviors" (p. 191). The emphasis of reflection during professional development experiences supports the idea that teachers should use reflection to inform their teaching practice. Since many professional development experiences aim to help teachers address their experiences with and concerns about teaching and learning, it seems evident that reflection would be a valuable complement to these experiences.

Experiences, teaching context, teaching practices, and knowledge of teaching are all embedded in the teaching practice (Rosebery & Puttick, 1998). Reflection allows teachers to address these factors and their role in their teaching practice. Ideally, "teaching involves a complex cycle of planning, acting, observing, and reflecting" (Loucks-Horsley et al., 2003, p. 40). The cyclical nature of reflection easily supports and situates itself within the cycle of teaching. Since "the terrain of teaching is complex, multidimensional, and importantly, grounded in particular instructional situations" (Rosebery & Puttick, 1998, p. 650), reflection examines the complexities comprising one's teaching practice. The incorporation and emphasis of reflection in professional development experiences provide an avenue for teachers "to make decisions that are informed rather than reactive" (Loucks-Horsley, 2003, p. 39).

A well-designed professional development course should provide teachers with opportunities to examine their practical knowledge (Bryan & Abell, 1999). According to van Driel, Beijaard, & Verloop (2001): "Practical knowledge consists of teachers' knowledge and beliefs about their own teaching practice" (p. 138). The beliefs and behaviors evident in their teaching (Jeanpierre, Oberhauser, & Freeman, 2005; Luft, 2001) need to be studied in order to help teachers develop a deeper knowledge basis. The practice of reflection allows for such assessment. Through the cycle of reflection, teachers make explicit their beliefs and knowledge about their teaching practice. By making these ideas explicit, they are able to assess how they influence their teaching practice. The examination of beliefs and behaviors is important in that the examination of one may provide insight into the other (Jeanpierre, Oberhauser, & Freeman, 2005). Researchers have also emphasized the link between teacher beliefs and teacher actions (Tobin, Tippins, & Gallard, 1994). By developing a deeper understanding of their beliefs about science teaching, science teachers may be able to develop a deeper understanding of their teaching practice.

Working Definition of Professional Development

For the purpose of this study, professional development will be defined as a process by which teachers are engaged in constructing knowledge about teaching and learning. Professional development affords teachers the opportunity to examine and evaluate teaching, participate in activities that provide them with both pedagogical and content knowledge, and provide tools and skills for enhancing and examining their future teaching practices. Through professional development, teachers are presented with opportunities to communicate with peers, participate as a member of a learning community, and collaborate with other education professionals on issues.

Professional development experiences are opportunities for teachers to develop a deeper understanding of teaching, learning, and content knowledge.

Research Findings about Professional Development

A study by Jeanpierre, Oberhauser, and Freeman (2005) examined characteristics of professional development experiences that allow teachers to integrate inquiry skills into their teaching. They found that teachers participating in these experiences developed a deeper understanding of and comfort with the content and inquiry skills. The researchers attributed the teachers' increase in inquiry activities and content knowledge to three characteristics of the professional development experiences: 1) multiple opportunities to engage in science content and process skills, 2) accountability requirements for teachers, and 3) professional development facilitators holding high expectations of their participants and integrating multifaceted experiences. Melber and Cox-Petersen (2005) also examined professional development experiences that provided teachers with hands-on experiences, opportunities to learn science content, and activities that could be easily integrated into the teachers' classes. They found that teachers participating in their professional development experiences reported positive feelings toward the experiences, as well as an increased understanding of content.

A two-part study by Kwakman (2003) examined teachers' participation in professional learning activities. The researcher found that teachers were more likely to participate in learning opportunities where "professional readings, sharing ideas with colleagues, or improving lessons" (Kwakman, 2003, p. 166) was the focus on the activities. Teachers were less likely to participate in activities that focused on feedback from students or classroom observations or in-depth collaborative activities. Kwakman also revealed the importance of personal factors in teachers' participation in on-site learning activities. This study revealed the significant roles that attitudes,

beliefs of feasibility and meaningfulness, emotional issues, and personal accomplishments played in teachers' participation. In a similar research study, Sherin and Han (2004) also focused on teachers' participation in professional development experiences. Their study examined teachers' participation in video clubs, which allowed teachers to examine video of their own teaching. While Kwakman noted that teachers were less likely to participate in this type of experience, Sherin and Han identified the positive impact that classroom observations via video can have on teachers' ability to analyze their classroom practice. Conversations held during the teachers' video club meetings mainly focused on pedagogy and students' conceptions. They found that teachers were more likely to examine the pedagogy behind their practice than students' conceptions. Additionally, the study found that teachers' ability to analyze pedagogy and students' conceptions increased as the professional development experience continued. Roseberry and Puttick's (1998) study on a professional development seminar reiterated the importance of videotape observations. In their study of a participant's use of video to examine her practice, they found that the teacher was able to use the video episodes to ask questions concerning her teaching, her students' learning, and future instruction.

Studies by Boyle, While, and Boyle (2004) and Boyle, Lamprianou, and Boyle (2005) examined professional development, in which in-service teachers were engaged and how the professional development influenced their practice. Boyle et al. (2004) surveyed primary and secondary teachers about their experiences in professional development. Their study showed that primary science teachers were less likely than primary English or mathematics teachers to participate in content specific conferences and workshops or long-term professional development (Boyle et al., 2004). The study also noted that collaborating with and observing colleagues were the most common forms of long-term professional development. Most of the participants, who

participated in long-term professional development, noted changes in their teaching practice due to their experiences (Boyle et al., 2004). Boyle et al. (2005) also surveyed primary and secondary practicing teachers about their professional development. As in Boyle et al. (2004), this study also reported that a) primary science teachers were less likely to participate in content specific conferences, workshops, or long-term professional development, b) observing and collaborating with colleagues were the most common form of professional development, and c) most participants in long-term professional development activities noted changes in their teaching practice. Professional development experiences that focused on coaching or research inquiry were considered the most effective forms of professional development (Boyle et al., 2005).

Garet, M., Porter, A., Desimone, L., Birman, B., & Yoon, K. S. (2001) conducted a study on the relationship between professional development and self-reported change in participants' knowledge and teaching practice. Their study reported that many professional development experiences are not high quality. However, those that were of high quality resulted in the subsequent findings. This study showed that longer professional development experiences positively influence participants' opportunities to participate in active learning and content knowledge. These findings indicate that higher quality professional development experiences may consist of a substantial number of contact hours for a longer period of time. Experiences that focused on specific content and were relevant to participants' practice resulted in improved skills and knowledge about teaching (Garet et al., 2001). This finding suggests that professional development with this emphasis may eventually result in participants' changing their teaching practice.

The studies above identify some key features that should be considered when designing effective professional development for science teachers. Professional development needs to

provide participants with opportunities to engage in science activities and learn science content that is relevant to their classroom instruction. Participants should be provided with chances to collaborate with and share ideas with colleagues. Videotaped observations can serve as a method for engaging participants in reflection on and discussions about their teaching practice. Longer professional development experiences often support a change in teaching practice.

<div align="center">Reflection</div>

The notion of reflection is an ancient concept (Houston, 1988). Many different scholars, ranging from Plato to Schön, have influenced our current notion of reflection. From these scholars came many different definitions of reflective practice. Decartes' view of reflectivity, philosophy of self, is "the ability to see oneself as object" (Fendler, 2003, p. 17). This view of reflection, which is a characteristic of academic inquiry, is grounded in the assumption that self-awareness can lead to knowledge (Fendler, 2003). Vico (1710/1988) believed we develop knowledge from understanding the context around us. Modern conceptions of reflection are indicative of this view because of the prominence of self-awareness during teachers' examination of their practices. Through these examinations, teachers are becoming aware of their own beliefs, knowledge, and the environment they create in their classroom.

One of the primary goals of professional development experiences is to help teachers gain a better understanding of teaching skills and knowledge necessary to be an effective teacher. In order to gain these skills, teacher educators should provide teachers with opportunities, such as apprenticeship experiences, to implement, test, and enhance their teaching knowledge and skills into their practice. During these experiences and their use of reflection, in-service teachers are able to show competence in teaching and begin to better understand connections between theory and their practice. Reflective practice allows teachers to make sense of their daily

activities and learn from their teaching practice (Grimmett & Mackinnon, 1992). By utilizing reflective teaching practices, in-service teachers are capable of developing a richer, deeper understanding of teaching and learning.

Science teachers should be provided with opportunities to develop their professional knowledge by reflecting on their classroom practice (Artzt, 1999; Bryan, 2003; Bryan & Abell, 1999; Grossman, Wilson, & Shulman, 1989; Loucks-Horsley et al., 2003; Shulman, 1986; Shulman, 1987). By examining classroom practice, science teachers can use their observations of the classroom and previous teaching and learning experiences to develop a deeper understanding of their science teaching. As stated by Loucks-Horsley et al. (1990), "Teachers come to the teaching profession with their own experiences of teaching and learning, observations of what works in the classroom, and ideas about the appropriate curriculum and effective teaching strategies" (p. 131). Many teachers use their own learning experiences as a model for their teaching practice (Artzt, 1999; Bryan & Abell, 1999; Goodlad, 1984; Kubota, 1997; Loucks-Horsley et al., 1990; Loucks-Horsley et al., 2003; Luft, 2001; Osborne, 1998). Additionally, many teachers also rely heavily on their prior knowledge and beliefs to make decisions about their teaching (Artzt, 1999; Bean & Stevens, 2002; Bryan & Abell, 1999; Driver, Guesne, & Tiberghien, 1985b; Goodlad, 1984; Osborne, 1998). Their knowledge and beliefs influence the theories they have about science teaching. As stated by Kubota (1997), "Individuals construct their own theories of how the natural world works based on their prior experiences and knowledge" (p. 138). However, the teachers' theories of teaching and learning and their experiences are not always consistent with reform efforts. In order to help teachers reconstruct their ideas and views of teaching and learning science, they need experiences that help them

make their prior knowledge about teaching and learning explicit (Abell & Bryan, 1997; Loucks-Horsley et al., 1990).

Defining Reflection

Shulman (1987) describes reflection as the process "a teacher does when he or she looks back at the teaching and learning that has occurred, and reconstructs, reenacts, and/or recaptures the events, the emotions, and the accomplishments. It is that set of processes through which a professional learns from experiences" (p. 19). By reconstructing situations of practicing teachers learn from their experiences. The National Science Education Standards (National Research Council, 1996) highlight the importance of reflection in the professional development of teachers. "When teachers have the time and opportunity to describe their own views about learning and teaching, to conduct research on their own teaching, and to compare, contrast, and revise their views, they come to understand the nature of exemplary science teaching" (NRC, 1996, p. 67). By becoming reflective practitioners, teachers can use research on their practice to inform their teaching practice.

Reflection is often seen as an essential component of teacher development (Carr & Kemmis, 1983; Day & Pennington, 1993; Schön; 1983). Although teachers hold previous knowledge about teaching and learning and utilize that knowledge on a daily basis, they are often not able to articulate what and how they know certain information (Shulman, 1987). Through reflection, teachers' beliefs, theories, and knowledge about teaching and learning are made explicit (Day & Pennington, 1993; Schön, 1983). As stated by Splikova (2001):

> The teacher's individual conception of teaching is mainly implicit, relatively unconscious and considerably stable. The essential method of influencing individual teachers is by means of critical analysis, by making it conscious, by rationalization and verbalization of

'tacit knowledge' of these intuitive views, ideas, approaches and of their own theories,

which originated spontaneously in the past (p. 62).

To support teachers' understanding of their practice, they need opportunities to recognize beliefs

and knowledge that influence their practice. Once they have an understanding of these

influences, they are better able to identify and analyze aspects of planning and lesson facilitation

(Yinger, 1990). Furthermore, reflective teachers are better equipped to confront inconsistencies

in their practice and thinking and may revisit core beliefs they have about teaching and learning

(Day & Pennington, 1993). Dewey (1991) believed that the whole process of reflective thought

was driven by the act of confronting and considering reasons for personal beliefs and their

consequences. The process of confronting and examining beliefs allows teachers to reflect on

their previous understanding of and experiences with teaching. "Active, persistent, and careful

consideration of any belief or supposed form of knowledge in the light of the grounds that

support it, and the further conclusions to which it tends, constitutes reflective thought" (Dewey,

1991, p. 6). Addressing inconsistencies in their beliefs and knowledge helps teachers view

teaching and learning issues in new ways (Rosebery & Puttick, 1998).

Conceptions of Reflection

There are various conceptions of reflection. However, the most common notion of

reflection is the idea of it being a method of responding to issues of practice. By responding to

issues of practice, teachers are refining their teaching. "According to Dewey, reflection does not

consist of a series of steps or procedures to be used by teachers. Rather it is a holistic way of

meeting and responding to problems, a way of being as a teacher" (Zeichner & Liston, 1996, p.

9). Dewey (1910) stated that reflective thinking "involves overcoming inertia" (p. 13) that

persuades individuals to accept ideas without questions and to endure mental turmoil. The

notion of overcoming inertia is supported through Dewey's belief that reflective thought is initiated by uncertainty (Calderhead, 1989). This idea of reflection is grounded in the idea that individuals base their decisions on specific evidence. As stated by Dewey (1910), "reflection thus implies that something is believed in (or disbelieved in), not on its own direct account, but through something else which stands as witness, evidence, proof, voucher, warrant; that is as *ground of belief*" (p. 8, italics in original). Dewey's conception of reflection encompasses specific thinking skills and attitudes, open-mindedness, responsibility, and wholeheartedness (Calderhead, 1989; Zeichner & Liston, 1996). Additionally, he identified specific processes that are incorporated into every reflective operation: "(a) a state of perplexity, hesitation, doubt; and (b) an act of search or investigation directed toward bringing to light further facts which serve to corroborate or to nullify the suggested belief" (Dewey, 1910, p. 9).

Schön also believed reflection leads to knowledge development. He argued that two forms of reflection, reflection-in-action and reflection-on-action, can result in professional knowledge. Schön stated "the rethinking of some part of our knowing-in-action leads to on-the-spot experiment and further thinking that affects what we do" (Schön, 1987, p. 29) as reflection-in-action and "the systematic and deliberate thinking back over one's action that characterizes much of what we do when we pause after an action and attend to what we believe as occurred" (Munby & Russell, 1992, p. 3) as reflection-on-action. Underlying Schön's reflection-in-action is a constructionist view positing that practitioners construct situations of their practice (Schön, 1987). Individuals participating in reflection-in-action have a "reflective conversation with the materials of a situation" (Schön, 1987, p. 31). Like Dewey's notion of reflection as a means to solve problems of practice, Schön's reflection-in-action is an exercise of skills, interpretative and interactive, in analyzing and finding solutions for complex problems of practice (Calderhead,

1989). During this exercise, teachers frame and reframe issues of practice. They frame issues as they identify and begin to explain them based on their current beliefs and knowledge about their teaching. As they continue to examine the issues, they may find new information about their teaching issues that influence their teaching beliefs. In light of this new evidence, teachers will reframe the issue of practice. In addition to exercises necessary for solving complex problems of practice, "the practitioner's first task in resolving the context-bound problems of practice involves reframing the problem to identify goals or purposes that will be attended to and those that will be ignored"(Nolan & Huber, 1989, p. 127). Practitioners can then frame and reframe their problem, and generate and test out their solutions (Calderhead, 1989; Nolan & Huber, 1989). In this process, teachers combine both reflection and action (Calderhead, 1989).

Like Dewey and Schön, Ross (1989) identified main elements that comprise the reflective process: 1) recognizing dilemmas, 2) responding to the dilemma, 3) "framing and reframing the dilemma" (p. 22), 4) experimenting with solutions for the dilemma, and 5) examining consequences to the solutions. Generally, reflection is defined as a way of thinking about practices that incorporates assuming responsibility for and making rational choices (Ross, 1989; Zeichner & Liston, 1987). It has also been said that reflection is the deliberate process of examining an action for improvement (Ward & McCotter, 2004). Aligned with this view, reflection has been used for action research purposes (Carr & Kemmis, 1986). Carr & Kemmis (1986) believed critical reflection was a mechanism for developing "knowledge about the practices being considered and the conditions under which they take place" (Carr & Kemmis, 1986, p. 146). Reflection can also be described as a way of directing practice based on research findings and educational theories, deliberating between competing views of teaching and learning, and reconstructing experiences and contexts (Grimmett, Mackinnon, Erickson, &

Riecken, 1990). However one defines reflection in teacher education, the uniting theme in the many definitions emphasizes the cognitive and moral aspects of teaching and learning to teach (Calderhead, 1989).

Reflection and Teacher Development

The cyclical nature of reflection informing practice and practice needing reflection is indicative of knowledge construction (Altrichter, Posch, Somekh, 1993). As stated by Grimmett, Riecken, Erickson, and Mackinnon (1988) in their discussion of Schön reflections, "Schön argues that professional knowledge is constructed by practitioners through reflection-in-action and reflection-on-action" (p. 9). Through reflection-in-action and reflection-on-action, teachers can learn to recognize and examine their tacit knowledge about teaching and learning. The experiences needed for reflection and the practice of reflecting on their teaching can also help teachers gain tacit knowledge about teaching.

Teachers' tacit knowledge about teaching does not always provide the answers to questions about their teaching practice. In order to help them answer questions about their practice, teachers need to thoroughly examine their previous knowledge about teaching. By examining their previous knowledge, they can make that knowledge more explicit. As stated by Schön (1987):

> [Practitioners] have, in short, a particular, professional way of seeing their world and a way of constructing and maintaining the world as they see it. When practitioners respond to the indeterminate zones of practice by holding a reflective conversation with the materials of their situations they remake a part of their practice world and thereby reveal the usually tacit processes of worldmaking that underlie their practice (p. 36).

Schön's conception of indeterminate zones of practice "recognizes that the problems of practice do not present themselves in a neat format in which goals or ends are immediately clear" (Nolan & Huber, 1989, p. 127). Moreover, his understanding of indeterminate zones of practice emphasizes that teachers cannot always use a technical rationale for solving problems of practice. It is during moments when teachers are faced with perturbations or dilemmas that they begin to gain an understanding of their own, personal knowledge base. As stated by Tobin, Briscoe, and Holman (1990), "new knowledge is constructed or existing knowledge frameworks are altered when an individual is unable to find 'fit' between his/her constructions and the perceived environment or a 'fit' with others with whom interactions are taking place" (p. 411). Teachers internalize their experiences and construct knowledge about their teaching practice (Driver, Guesne, & Tiberghien, 1985). The observation and understanding of one's own tacit knowledge about teaching lays the groundwork for teachers to build on their knowledge. Only after knowledge, problem solving skills, and experiences utilizing knowledge and problem skills are afforded to teachers, may they begin to develop tacit knowledge about teaching. Schön uses the metaphor of learning to use a tool to further explain how one goes about acquiring tacit knowledge. Schön (1987) stated "To become skillful in the use of a tool is to learn to appreciate, directly and without intermediate reasoning, the qualities of the materials that we apprehend through the tacit sensations of the tool in our hand" (p. 23). Like learning to use a tool, teachers need experiences using and appreciating their teaching skills.

Tools for Reflection

Teacher education programs routinely integrate cases, videotape reflections, and portfolios to help teachers gain a better understanding of their knowledge and practice (Abell, Cennamo, Anderson, Bryan, Campbell, & Hug, 1996; Abell & Bryan, 1999; Bowers, Kenehan,

Sale, & Doerr, 2000; Delandshere & Arens, 2003). Concurrently, many professional development experiences integrate these tools to help teachers reflect on their teaching practice in addition to helping them develop a better understanding of school curriculum. Even though these efforts align with the use of evidence for the improvement of practice, they are usually isolated from one another and/or unsystematic (Recesso, Hannafin, Wang, Deaton, Rich, & Shepard, in press). Further, evidence from teacher practice cannot be assessed in the same manner as research evidence since much of teachers' practice is not documented (Hammersley, 2004). Teachers need to be able to systematically collect evidence of their teaching, examine their teaching practices, and organize their knowledge. Professional development facilitators should afford teachers with opportunities to gather evidence about their teaching. As stated by Land & Zembal-Saul (2003): "In order to support reflection, designers must use methods and tools to intentionally support the iterative and reflective aspects of knowledge building" (p. 65). Teachers need tools for documenting and reflecting on their knowledge. This section will provide a brief discussion of various tools used for reflective practice and an in-depth discussion on one tool, the Video Analysis Tool (VAT).

Many different tools have been used to assist teachers in their development of reflections on their teaching practice. Teachers and teacher educators have utilized tools ranging from journaling to videotape for reflection. These tools allow teachers to collect evidence, written, audio, or visual, of teaching. Teachers' examination of videos and transcripts allow them to stop and look at teaching by creating opportunities for constructive criticism of their own or other's practice (Rosebery & Puttick, 1998). In addition to these tools, teachers can develop reflective journals. Journaling provides teachers with a written forum for recording their thoughts, observations, and beliefs during reflection.

To assist in teachers' reflective practice, scaffolds are often employed. Scaffolds provide teachers with sets of prompts to guide them through the process of reflecting. Scaffolding is the assistance offered to support learning (Lipscomb, Swanson, & West, 2004). Scaffolds can be in the form of verbal conversations, written frameworks, or computer-based frameworks. Scaffolds are designed , like the practice of reflection, to acknowledge learner's prior knowledge (Lipscomb, Swanson, & West, 2004). Verbal scaffolds can be used in conversations by tutors or supervisors to support teachers as they construct explanations (Chi, 1996). Written frameworks may also support teachers development of explanations. Griffin (2003) developed a written framework to guide teachers' through reflecting on their practice. Her framework focused on helping teachers, "(a) use the language of their profession; (b) connect theory to practice as they explain their practice; (c) connect their practice to the standards of their profession; and (d) describe how their reflection/analysis would affect their actions in the classroom and school community" (Griffin, 2003, p. 208). Written frameworks are often integrated into computer-based systems that are used by teachers for reflection of or assessment on their teaching (Land & Zembal-Saul, 2003; Zembal-Saul, Munford, Crawford, Friedrichsen, & Land, 2001). Land and Zembal-Saul's (2003) study discussed how computer-based scaffolds helped preservice teachers gather evidence on their science learning and reflect on their experience. Their study showed that "evidence of increasing sophistication in explanations" (Land & Zembal-Saul, 2003, p. 70). The researchers found that the scaffolds their research participants used stimulated "learners to become more precise in their explanations, to offer justification, and to connect evidence with claims" (Land & Zembal-Saul, 2003, p. 70). This process of developing evidence-based explanations is crucial to both successful practices of reflection and science teaching.

Videotape, such as videotaped lessons or cases, allows teachers to observe, examine, and evaluate their teaching (Abell et al., 1996; Davies, 1999; Ratcliffe et al., 2003). The use of audio and visual components during reflection helps better capture the rich context of the classroom (Abell et al., 1996; Kurz, Llama, & Savenye, 2005; Tippins, Nichols, & Dana, 1999). Teachers can reflect on their practice away from classroom distractions. By stepping out of the classroom experience and looking at their teaching from another view, teachers are able to view factors in their classroom they may not have seen during their teaching episode. Observation is a powerful tool for collecting evidence. Research (Driver, Guesne, & Tiberghien, 1985b) has shown that students of science have the tendency to base their reasoning on the observable evidence of a scientific problem. Like students of science, teachers of science can use evidence from their personal observations in the classroom or video observations of the classroom to ground their explanations of their teaching practice.

Video Analysis Tool

There are many video analysis programs that allow individuals to watch, clip, and comment on video, such as Transana (http://www.transana.org) developed by the University of Wisconsin-Madison Center for Education Research and Digital Interactive Video Exploration & Reflection (DIVER) (http://diver.stanford.edu/home.html) developed by the Stanford Center for Innovations and Learning. One tool that facilitates video-based reflection is the Video Analysis Tool (VAT) (http://vat.uga.edu). VAT is an Internet-based tool designed to support and record evidence of deep learning outcomes for preservice teachers and teacher educators (Recesso et al., in press). Unlike the other video analysis programs listed above, VAT was specifically designed to supports teachers' video analyses of their teaching practices. VAT allows for the systematic examination of and reflection on teaching and learning. Through VAT, teachers can begin to

link evidence to processes of practice, not just the outcomes of an event. Furthermore, VAT also allows teachers to identify the relationship between their practice and specific learning goals (Recesso et al., in press). A unique feature of VAT is the capability to embed scaffolds, frameworks, or standards into the tool. Through its online interface and network storage capabilities, VAT collects teachers' written reflections, their selection of standards and goals that they view as being addressed in their practice, video and audio recordings of their teaching, a library of selected video and audio clips that they view as critical to specific issues of their practice, and various codes and comments that teachers develop while viewing their teaching footage. Specifically, VAT allows its users to develop direct links between practice and goals or standards (Recesso et al, in press). Being able to make those connections is crucial to the success of preservice and in-service teachers. Teachers can use VAT to examine issues of practice while evaluating their teaching through state and national standards. The identification and linking of standards is part of the data analysis and teacher development process.

Due to the constraints of the classroom, teachers usually only have seconds to respond to comments or situations within the classroom. "For fear of losing classroom order and pace, teachers wait only microseconds for answers to their questions" about teaching and learning situations in their classroom (Desforges, 2003, p.3). However, that practice is not always the best solution for solving certain dilemmas about teaching and learning. Teachers also need to be able to look at their teaching while they are not "in the moment". Critical examination of anomalies that arise during teaching often requires extensive time to gain an understanding of the classroom context, theories, and/or data relevant to the situation being explored. As a tool, VAT gives teachers the opportunity to examine their practice "outside of the moment" and away from

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the distractions of classroom events and interactions (Recesso et al., in press). Hammersley (2004) stated:

> When faced with a problem in their work, teachers may collect and process information about it with a view to finding out why it arose and how it can be handled. This may be done on the spot in the classroom or later when there is a respite. Similarly, teachers may sometimes reflect on their work in a less problem-oriented way, asking questions of a kind that are similar to those which preoccupy the various social-science disciplines and philosophy" (Hammersley, 1993, p. 223).

VAT allows teachers to collect information about their teaching in a form, such as video and audio footage, which can be reviewed and evaluated afterwards. Teachers can use all or parts of that information as evidence of their teaching practice. While a large amount of information can be collected and viewed in VAT, not all information may be viewed as evidence by teachers. Once teachers identify segments of information that support the question or problem they are investigating, they begin to gather data on their teaching. It is this information that the teachers will consider evidence of their teaching practice.

Hammersley (2004) posited that each source of evidence should be subjected to scrutiny and the sources and functions of beliefs should be reflected on. To help ease the process of examining evidence and research findings, teachers need methods of making their practices and knowledge explicit (Cordingley, 2003). Even though video technologies allow for the generation, evaluation and verification of observable teaching examples (Davies, 1999; Ratcliffe et al., 2003), it is not uncommon for teacher researchers to keep journals of their experience and make audio recordings of classroom discussions or interviews (Kemmis, 1993). Through its design, VAT can scaffold the analysis process and act as a portfolio and also enable teachers to collect

evidence and document their practices over time (Recesso et al., in press). VAT enables the documentation of evidence through the use of digital video and audio as well as written reflections that teachers can develop and refine.

In addition to providing teachers with a means of viewing their practice outside of the actual classroom experience, VAT allows teachers to review their collected data for comparisons with other experiences or situations and also share their evidence with peers or teacher educators. In a sense, it allows teachers to participate in a community of learners, such as ones made up of teachers or teachers and researchers that would not normally exist. Novice and preservice teachers can share their VAT products or portfolio with university or school supervisors while experienced teachers can share their products with their peers. This sharing of knowledge and experiences is important to teachers' professional development and understanding of teaching. "Whilst individual teachers are engaging *with* research without engaging *in* it, their experience is more meaningful if they are able to work closely with other teachers who *have* engaged in research" (Cordingley, 2003, p. 111). Through the sharing of VAT products during their preservice or in-service experience, teachers can view their situation through a variety of lenses (Recesso et al., in press).

Role of Explanations in Reflection

Many educators acknowledge the significance of reflection in linking evidence with practical judgment (Elliot, 2004). In Schön's conception of reflection, evidence plays an important role in the framing and reframing of issues of practice. When framing, teachers use evidence of their practice to alert them of anomalies and perturbations that exist in their practice as well as help them identify their framework of beliefs for examining the issue of concern. This evidence also allows teachers to examine concepts in terms of their various perceptions,

comparisons, and meanings while establishing a richer understanding of the concept being explored (Schön, 1987). The process of reflection provides teachers with the opportunity to focus on specific situations of their teaching practice and select evidence of teaching. "Through complementary acts of naming and framing, the practitioner selects things for attention and organizes them, guided by an appreciation of the situation that gives it coherence and sets a direction for action" (Schön, 1987, p. 4). It is in this selection and organization that evidence plays a critical role in helping teachers develop an understanding of the issues at hand. Once an understanding of the anomaly is developed and/or tension occurs between variables of practice, teachers use evidence of their practice from their initial problem and framing as a basis for new exploration or reframing of the problem. Reframing "does not mean an end to puzzles and problems; the scrutiny of one's own practice continues, but it moves to more elaborate views of practice" (Russell & Munby, 1991, p. 173). Through the collection of evidence and understanding about one's practice, teachers are able to further explore their practice. This exploration of their practice may result in knowledge development.

Schön (1987) described the function of reflection-in-action as being a process of questioning the structure of knowing-in-action. Knowing-in-action, as defined by Schön (1987), is "the know-how we reveal in our intelligent action—publicly observable, physical performances . . . We reveal it by our spontaneous, skillful execution of the performance; and we are characteristically unable to make it verbally explicit" (p. 25). He believed that by "thinking critically about the thinking that got us into this fix . . . we may, in the process, restructure strategies of action, understandings of phenomena, or ways of framing problems" (Schön, 1987, p. 28). As stated by Barnes (1992), the constructivist view of learning focuses on the reconstruction of any offered knowledge. By reflecting on their thinking and examining the

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process of their teaching, preservice teachers are continuously developing knowledge about their teaching and their philosophy of teaching. Altrichter et al.'s (1993) discussion of teacher action research equates reflection with the stages of knowledge construction. The results of reflection inform teachers' practice and teachers' practice constantly call for the use of reflection (Altrichter et al., 1993, p. 208). This notion is resonant with Russell and Munby's (1991) discussion of reframing, which they recognize as "an integral part of a cycle in the development of teachers' professional knowledge" (Russell & Munby, 1991, p. 184). Russell and Munby (1991) describe two aspects of reframing that are crucial to the development of knowledge: reframing of experience which "facilitates the use of pedagogical knowledge acquired in courses, workshops, and conferences" (p. 165) and the ability of reframing to "mediate between theory and practice, revealing new meanings in theory and new strategies for practice" (p. 166). The search for reliable links between "theory and practice" (Russell & Munby, 1991, p. 184), as well as effective practices, are valuable elements of reframing (Russell & Munby, 1991). This influence on behavior provides an argument for the study of reflections and the explanations within them in order to develop a better understanding of teachers' behaviors, attitudes, and understanding of their teaching practice.

The process of reflection, the inquiry into one's practice, may provide new ways of viewing a situation, lead to a change in practice, or stimulate an enhanced understanding of one's practice (Richardson, 1994). We develop knowledge by trying to understand that around us (Vico, 1710/1988). The process of reflecting on one's practice, as described by Schön (1987), leads to the development of practitioner knowledge. Darling-Hammond (2000) reiterated this idea in her review of Dewey's conception of knowledge for teaching. She stated

"Knowledge for teaching is one that features inquiry into problems of practice as the basis for professional judgment grounded in both theoretical and practical knowledge . . . [Teachers] become sensitive to variation and more aware of what works for what purposes in what situations. Access to contingent knowledge allows them to become more thoughtful decision makers" (Darling-Hammond, 2000, p. 170).

Teachers' knowledge of teaching should include the idea of inquiring into their teaching practices. By accessing their knowledge in order to reflect on their teaching, they are able to use that knowledge to more thoughtful decisions and future inquiries into their practice.

Working Definition of Reflection

For the purpose of this study, reflection will be defined as a systematic and purposeful examination of one's teaching practice. This examination of practice is a result of teachers' need to further study issues of teaching that may inform their teaching decisions and practice. A perplexing teaching situation or a teaching interest may be used as the basis for one's reflection. Teachers' examination of these issues will further their knowledge about teaching and learning and allow them to reconstruct or recapture events and emotions associated with their practice (Shulman, 1987). Through reflection, teachers will examine and address their prior knowledge, which is influenced by beliefs and experiences. By examining their prior knowledge, teachers are able to build a larger repertoire of knowledge about their teaching practice and philosophy.

Research Findings about Reflection

Studies by Bryan (2003) and Van Zee and Roberts (2001) examined how reflective practice supports pre-service teachers' development of knowledge about science teaching. Bryan (2003) examined a pre-service teacher's knowledge and beliefs developed during a reflective science teacher education program. This study discussed the pre-service teacher as being initially

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hesitant to examine and critique her teaching. However, the teacher developed into a more reflective preservice teacher throughout her participation in teaching experiences and reflective activities. Bryan (2003) addressed the need for science teacher educators to support teachers in the examination of their teaching practice and provide early teaching opportunities in order to help preservice teachers move past issues of classroom management to the examination of their teaching practice.

Van Zee and Roberts (2001) examined how pre-service teachers' reflections provide them with a base knowledge of effective science teaching practices. Their study showed how participants' identified factors of reform-based teaching practices by reflecting on positive learning experiences they had in science. Learning activities and strategies used by teachers during the participants' positive learning experiences related to National Science Education Standards (NRC, 1996). By reflecting on their positive experiences in learning science, the prospective teachers were able to demonstrate they could identify good science teaching and form their own framework for teaching science (Van Zee & Roberts, 2001).

Zembal-Saul, Blumenfeld, and Krajcik (2000) and Griffin (2003) also studied the influence of reflection on prospective teachers' teaching practice. Zembal-Saul et al. (2000) examined how reflection, along with planning and teaching, influence prospective teachers' instruction and how their reflection, planning, and teaching changed over time. Through two cycles of planning, teaching, and reflection, the participants in this study were able to identify and address issues related to student learning. The reflective component of this study afforded the participants to use their reflections to inform their future teaching practice. Zembal-Saul et al. (2000) noted that their participants were able to move from reflecting on superficial features of classroom practice to address more learner-related concerns.

Griffin (2003) examined the use of the Critical Incidents framework and coaching to support pre-service teachers' reflections. The Critical Incidents framework was designed to help pre-service teachers focus on the meaning of an event. The findings from this study indicate that the participants were able to focus on larger issues of practice. Griffin (2003) noted that the results showed that the framework may increase pre-service teachers' awareness of the multiple variables that impact the teaching and learning in their classroom. Additionally, one third of the participants' were identified as possessing the attributes of "open-mindedness, responsibility, and wholeheartedness" (Griffin, 2003, p. 218).

Studies by Land and Zembal-Saul (2003) and Rhine and Weisner (2003) reported on using technology to support teachers' reflections. Land and Zembal-Saul (2003) examined the use of computer-based scaffolds to engage students in developing scientific explanations and reflecting on their explanations. This study showed that scaffolds allowed the participants to record, revisit, and reflect on their explanations and understanding about science content. However, the background knowledge and dialogue amongst participants influenced how the participants revised explanations and reflected on their scientific understanding. The researchers also noted that while the participants were engaged in reflection the scaffold did not necessarily support critical evaluation and deep awareness of their scientific knowledge (Land & Zembal-Saul, 2003). Rhine and Weisner's (2003) study examined on how video and web-based discourse provides preservice teachers with opportunities reflect on their teaching. Their study reported on a program that used reflective tools, web-based discourse and digital video, during preservice teachers' student teaching experience. Rhine and Weisner stated that the reflective tools used in the course allowed students to develop characteristics of reflective thought, such as identifying incidents, developing alternative solutions, and testing solution, and collaborate with their peers.

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A study by Ellsworth (2002) examined teachers' reflections on using student portfolios to assess their students. By reflecting on students portfolios, the teachers were able to enhance their use of portfolios, understand their students better, make more informed decisions about their teaching, and understand the support needed for them to successfully integrate portfolios (Ellsworth, 2002). The teachers realized how their reflections on portfolios influenced their individual and collaborative use of portfolios. Reflecting on students' portfolios caused the teachers to " more deliberately question the rationale for their instructional choices"(Ellsworth, 2002, p. 350). By reflecting on their students' portfolios they were able to understand students as individuals, recognize content knowledge and make changes to their practice based on the portfolios.

The studies above support certain notions about engaging teachers in reflection. Teachers need opportunities, early in their teaching career, to engage in reflection. Through extended opportunities to reflect on their practice, teachers may begin to develop deeper reflections. Reflecting on science learning experiences may help teachers identify the beliefs and knowledge they hold about effective science teaching. By reflecting on positive learning experiences, teacher can begin to develop an understanding of their knowledge about what constitutes effective science teaching. The use of reflection tools, such as paper-based or computer based scaffolds, support teachers reflections on their practice. Scaffolds guide the development of reflections by prompting teachers to explain their teaching practice. They guide teachers in identifying and discussing the meaning of teaching and learning issues. Examining student portfolios support teachers' reflections on their practice. The examination of these portfolios provides teachers with a conception of students' science knowledge, which in turn may be indicative of teachers' science teaching practice. The use of video and web-based discourse

affords teachers with opportunities to identify issues of practice in their own practice and support peers in reflecting on their teaching.

<div align="center">Explanations</div>

Explanation plays a critical role in science (Dagher & Cossman, 1992). If the science classroom reflects the nature of science as emphasized by reform efforts, explanations should also play a large role in science classrooms (Dagher & Cossman, 1992). Likewise, if teachers are supposed to support their students' learning of science and science process through the teaching of explanations, they should support their own learning of science teaching through the use of explanations of their own practice.

Defining Explanation

An explanation may be defined as a statement or set of statements developed for answering the question 'why' (Green, 1971; Smith & Meux, 1970). However, explanations can also be given as answers to questions other than 'why'. They can also be used to answer 'how' and "what questions', describe events and illustrate cause and effect relationships. Smith and Meux (1970) describe explaining as an

> activity intended to fill the gaps in someone's understanding. On this conception, the
>
> need for an explanation arises when a person encounters something which according to
>
> his experience was not to be expected, or which he cannot relate to his experience. It is
>
> the function of explanation to fill the gap between the person's experience and this new
>
> phenomenon. When this gap is filled in, i.e., when the new phenomenon is associated
>
> with the person's experience, he is said to understand the new phenomenon (p. 139).

By developing explanations, individuals are able to make connects between their experiences and their understanding of those experiences. "In every case of explaining something to someone

there is *some* question which the explainer …. may be viewed as having answered or tried to answer even though it may not always be obvious what the question is" (Martin, 1970, p. 61). An explainer is always trying to help others or himself make connections between ideas and situations. Social science researchers believes that an explanation is an attempt "to explain away impediments of some kind . . . to deprive puzzles, mysteries, and blockages" (Brown, 1963, p. 41). By the process of developing an explanation, you are making something plain or intelligible (Brown, 1963). The formulation of explanations helps bring about understanding of an event or phenomenon, as well as provides insight into one's interpretation of the event or phenomenon.

Since explanations are used to discuss people's interpretations of a situation, explanations may influence the individuals' attitudes about an event which may in turn influence their behavior (Antaki, 1988). In the case of science education, teachers can develop an explanation, for example about their students' behavior during a specific lesson. To enhance teachers' understanding of an event, the explanation about that event needs to be adapted to a context or content that is relevant to the teachers (Smith & Meux, 1970).

The evidence used to answer questions of interest also determines the value of an explanation. As stated by Brem and Rips (2000), "a good story without evidence is still only a story" (p. 576). In order to be strong, explanations need to be supported by evidence. The identification of relevant evidence provides support for a teacher's explanation of practice. "An explanation that is unsubstantiated by evidence provides less support for a claim" (Brem & Rips, 2000, p. 576). Evidence represented in explanations varies with the type and use of explanations. Many people often confuse evidence with explanations (Brem & Rips, 2000) and use them interchangeably. In one study of explanations (Sandoval, 2001), students occasionally identified evidence that was relevant to their explanation but did not reference the evidence in their

explanations. Even if they did not always support their explanations with specific references to evidence, the students understood the need for evidence. There may be a similar parallel in teachers' use of evidence to ground explanations of their teaching. The chance of this occurrence solidifies the need for adequately defining evidence and explanation in science and science teaching.

There is a definite delineation between evidence and explanation. Evidence or data used to inform claims is defined as the foundation of claims (Brem & Rips, 2000). On the other hand, explanations, or warrants, are statements that act as a bridge between the hypotheses and evidence (Brem & Rips, 2000). The basic characteristics of explanations, as described by Brem and Rips (2000) are:

- Explanations improve our ability to understand and remember information.

- Explanations are an easy way to investigate claims.

- Explanations can be used to determine correlations in data.

- Explanations can support generalizability once patterns are recognized in data.

Although they can be differentiated from one another, explanations and evidence play complementary roles in understanding phenomena (Brem & Rips, 2000).

Even though explanations can increase our development of knowledge, they are only as useful as interpretation by their user. The array of possible explanations depends on both the knowledge of the developer and the knowledge of the user (Edginton, 1997). Beliefs and context play a large role in not only how explanations are used, but also how they are interpreted. Evidence and explanations that are well-received by others may be rejected by members of another group (Brem & Rips, 2000). For example, an explanation of the impact of urban sprawl on ecosystems may be valued in suburban science classrooms, but given less value in rural

science classrooms because of its lack of relevancy. In the case of teacher research, the question being explored and the explanation addressing that question are dependent on the teacher's classroom context, beliefs about teaching and learning, and their teaching practice.

The process of developing explanations incorporates many process skills that are necessary for learning. The construction of explanations includes generating information, interpreting data, and synthesizing conclusions (Sandoval & Reiser, 1997). The process of engaging students to construct explanations also engages them in the processes of scientific inquiry (Sandoval & Reiser, 1997). Conversely, "supporting students in performing their own scientific inquiry requires supporting them in their efforts to construct scientific explanations about natural phenomena while helping them to understand the purposes and goals for such explanations" (Sandoval & Reiser, 1997, p. 1). Therefore, the process of engaging teachers to construct explanations of practice engages them in inquiries on their practice and vice versa.

Types of explanations. There are many different reasons for developing explanations. Explanations can be developed to make predictions, make sense of previous events, or develop an understanding of an action (Keil & Wilson, 2000). It is not always easy to identify an explanation due to its complex nature (Antaki, 1988). However, one common theme of all explanations is the claim to disclose what someone considers to be the reality of a situation (Antaki, 1988). Explanations can be classified by various methods. Individuals may use the terms good or bad to describe if an explanation appropriately answers to a question (Gilbert, 1999). The worth of an explanation is determined by its relevance to the issue being explored. In addition to being considered good or bad, explanations can be typed into other categories according to the issue being explored or questions being answered.

While there is a variety of research on explanations and the types of explanation, most of the studies in teacher education focus on the uses of explanations while teaching or learning science (Avraamidou & Zembal-Saul, 2005; Chi, 1996, Dagher & Cossman, 1992; Land & Zembal-Saul, 2003; Thiele & Treagust, 1994; Zembal-Saul et al., 2001). Two studies are used as the primary literature on explanation types. Research by Dagher and Cossman (1992) and Gilbert (1999) describe different types of teacher explanations used by teachers in the science classroom.

A study by Dagher and Cossman (1992) resulted in ten types of explanation. The types of explanation were analogical, anthropomorphic, functional, genetic, mechanical, metaphysical, practical, rational, tautological, and teleological. Analogical explanations liken familiar situations to unfamiliar events (Dagher & Cossman, 1992). This type of definition recognizes the similarities between the two and provides the listener or reader with existing knowledge to tie to the unfamiliar event. In anthropomorphic explanations, human characteristics are given to a nonhuman concept to make it more familiar (Dagher & Cossman, 1992). Functional explanations supply the consequence to an event or phenomenon (Dagher & Cossman, 1992). The function or consequence discussed in the explanation is ground in prior knowledge. A genetic explanation relates a sequence of events (Dagher & Cossman, 1992). This form of explanation provides step-by-step accounts of an event. Mechanical explanations offer causal relationships between issues (Dagher & Cossman, 1992) while a metaphysical explanation identifies a supernatural being as the cause. Another type of explanation is the practical explanation. This explanation provides a instruction on performing a physical or mental process (Dagher & Cossman, 1992). For rational explanations, evidence is used to encourage the reader or listener to belief the explanation (Dagher & Cossman, 1992). For tautological explanations "the how/why question or statement is reformulated without adding any new information to its content"(Dagher & Cossman, 1992, p.

366). The last form of explanation discussed by Dagher and Cossman is the teleological explanation. This form of explanation discusses how the function of a phenomena, in addition to other phenomena, result in an overall goal (Dagher & Cossman, 1992).

Gilbert (1999) delineated five different types of explanations: intentional, descriptive, predictive, interpretational, and causal. Intentional explanations detail what issues you are looking at and your purpose for examining that issues (Gilbert, 1999). In the case of teacher research, intentional explanations are used to describe the teaching phenomenon being studied. Descriptive explanations identify the uses of variables (Gilbert, 1999). In science, descriptive explanations answer questions such as "what are theories used for in science" (Gilbert, 1999, p. 545). Predictive explanations addresses change (Gilbert, 1999). Questions, such as why do beliefs about teaching and learning change over time, can be addressed. Interpretational explanations address how theories can be put into practice. Scientists can examine theories, develop a deep understanding of those theories, and describe, through interpretational explanations, how a concrete structure of those theories can be put into practice (Gilbert, 1999). Causal explanations feature linear cause and effect relationships (Gilbert, 1999). Teachers can use causal explanations to discuss how students' learning is influenced by certain teaching strategies.

This study will examine explanations supported by evidence. Explanations, such as rational explanations (Dagher & Cossman, 1992) and causal explanations (Gilbert, 1999), will provide a basis for identifying evidence-based explanations. Both forms of evidence identify how evidence is used and influences results. Explanations used to support this study will be evidence-based and answer questions about one's teaching practice. Teachers' explanations

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identifying cause and effect relationships within their science teaching practice will be examined. Participants' explanations that are not supported by evidence will not be studied.

Role of evidence in explanations. On a daily basis, teachers may attend to a variety of questions and data pertaining to their teaching practice (Desforges, 2003). Teachers may concentrate their inquiries on their students or their own teaching. The questions or problems that guide teacher inquiry can be resolved or further explored through "the exercise of expertise or wisdom on the basis of evidence" (Desforges, 2003, p. 3). This expertise and wisdom is grounded in their experiences and knowledge of their teaching, their students, and the context of their classroom. The use of one's experiences is consistent with the origin of evidence. As stated by Rycroft-Malone, Seers, Titchen, Harvey, Kitson, & McCormack (2004), "the etymology of the word 'evidence' is rooted in the concept of experience" (p. 82). Teachers can use their knowledge about teaching, along with evidence of their practice, to corroborate or refute issues of their teaching practice (Rycroft-Malone et al, 2004; Shulman, 1987).

The use of evidence is critical to the development of well-formulated explanations. To develop explanations about their own practice, teachers need to have some knowledge of their practice. Evidence of practice may play an important role as knowledge which helps ground teachers' explanations (Rycroft-Malone et al., 2004). Some educational researchers believe evidence about best practices should be cumulative and based on continuous investigations of exceptions to one's practice (Hargreaves, 1999). Hargreaves defined exceptions as being counter-examples that expose deficiencies in teachers' original generalizations about practice that need to be further researched (Elliot, 2004). It is during the examination of these anomalies of practice that teachers are able to develop a deeper understanding of their own teaching practices.

Table 1

Types of Explanations

Study	Type of Explanation	Description
Dagher & Cossman (1992)	Analogical	Likens unfamiliar to familiar events
	Anthromorphic	Attributes human characteristics
	Functional	Supplies the consequence of an event
	Genetic	Relates sequences of events
	Mechanical	Offers causal relationship
	Metaphysical	Identifies supernatural beings as cause
	Practical	Provides instructions for process
	Rational	Uses evidence as basis
	Tautological	Reformulates questions
	Teleological	Discusses function in relation to goal
Gilbert (1999)	Intentional	Addresses details of a phenomenon
	Descriptive	Identifies use of variables
	Predictive	Addresses change
	Interpretational	Addresses theories used in practice
	Causal	Addresses cause and effect relationships

Types of evidence. Evidence can range from data depicting strengths, structures, and patterns of relationships between variables, such as interactions or conversations, to descriptions about context. Tacit knowledge is also considered a form of evidence. However, this form of knowledge is hard to articulate and often considered as an invisible form of supporting evidence (Ratcliffe et al., 2003). This invisibility is often due to the intuitive and deeply embedded nature of tacit knowledge (Rycroft-Malone et al., 2004).

Practitioners' use of evidence needs to consider the context in which the evidence is situated. Neither the evidence nor the decisions that are informed by them are context-free (Davies, 1999; Elliot 2004). Elliot (2001) stated

The primary role of educational research, when understood as research directed towards the improvements of educational practice, is not to discover contingent connections between a set of classroom activities and pre-standardised learning outputs, but to investigate the conditions for realizing a coherent educational process in particular practical contexts (p. 564).

Like educational research, reflection should produce knowledge that can be effectively used to inform realistic issues and concerns faced by teachers (Elliot, 2001).

The usefulness of research evidence also depends greatly on the relevance of research to the situation and context being explored (Davies, 1999). Teachers' collection and analysis of research evidence may not directly influence practice. However, Desforges (2003) noted that the integration of new evidence does not necessarily create a change in practice. "There is a very long trail to be negotiated before new evidence alters 'old' understanding" (Desforges, 2003, p. 8). For teachers to appropriately implement evidence-based practice, they must scrutinize and

challenge new evidence (Davies, 1999; Desforges, 2003; Rycroft-Malone et al., 2004) before

deciding if the evidence is suitable to their situation.

   Evidence-based approaches. Teachers integrating evidence-based approaches, such as

gathering and using data from inquiries to guide practice, do not always draw on evidence from

research outside of their own. The use of evidence to support and inform practice is a tenet

central to evidence-based education. The critical examination and utilization of existing research

evidence is also a key aspect. Teachers' cannot truly grasp the implications of their research if

they are not informed on the evidence and implications found in other educational research.

"One can only understand a particular instance by studying features it has in common with other

situations and yet 'paradoxically' we can only understand what situations have in common

through studying particular instances" (Elliot, 1978, p. 14). By identify the connection that

research has with their practice, educators are able to identify the results of their own inquiries.

Working Definition of Explanation

   For the purpose of this study, an explanation will be a statement or statements used to

answer questions about one's practice. These statements will answer why and how an issue

arose. Individuals will construct these statements as a result of interpreting and synthesizing

information about an event or situation (Sandoval & Reiser, 1997). They are developed to make

sense of previous events or actions (Keil & Wilson, 2000) and allow individual to investigate

events or situations. Specific explanations focused on in this study will be supported by

evidence. These evidence-based explanations will be developed in response to questions they

pose about their teaching practice. These explanations will be supported through teachers' use of

evidence from their teaching practice.

Research Findings about Explanations

As stated before, most studies on explanations in science education examine the development of scientific explanations for learning science (Chi, 1996; Coleman, 1998; Sandoval & Reiser, 1997). Even though that may not be the focus of this study, there are many similarities to teachers' development of explanation about their science teaching practice. Chi (1996) examined the use of tutoring strategies to elicit explanation development. This study found that learners developed an understanding of physic's problems due to being elicited to develop self-explanations by the tutor. The tutor used questions, hinting, and brief explanations of scientific rules to guide the student to think about certain issues and discuss his understanding of physic's concepts. It was through this conversation with physics material and tutoring that the learner was able to develop an understanding of the physics concepts and solve the problems.

Coleman (1998) investigated the use of an explanation scaffold on the development of collaborative explanations during group science activities on photosynthesis. Groups, who received the explanation scaffold as an intervention in their group discussions, developed significantly more conceptually advanced explanations. The scaffolds were used to guide group discussed and decision-making. Coleman also identified how participants, who were able to correctly link science concepts, also develop more advanced explanations and a deeper understanding of photosynthesis (Coleman, 1998). Results indicated that the process of developing explanations supported students understanding of the science concept being discussed.

A study by Sandoval and Reiser (1997) examined the coherence of learners' causal explanations and the learners' use of evidence to support their explanations of biological concepts. This study focused on how students develop explanations using a software program,

which scaffolds their explanations, and how they use reflective activities to assess their understanding. Results show that students were able to develop explanations for questions posed by the researchers. Student usually cited data to support their explanations or components of their explanations (Sandoval & Reiser, 1997). However, the students were not able to thoroughly assess their reflections and the evidence the used to support them.

As mentioned in research findings on reflection, Land and Zembal-Saul (2003) discussed prospective teachers' use of technology scaffolds to develop scientific explanations and reflect on their explanations. The teachers used software scaffolds to develop, revise, and reflect on their explanations about light experiments. The integration of the scaffolds helped them revisit and reflect on their evidence and previous explanations. This study showed that prospective teachers used a variety of evidence to support their explanations and developed a deeper understanding through the use of "the best evidence" (Land & Zembal-Saul, 2003, p 76) to support their explanations. Land and Zembal-Saul also identified some limitations in the use of scaffolds to support learners' reflection on their explanations. Limitations discussed included the learner's limited background, the tasks and scaffolds used did not encourage self-evaluation and understanding of one's knowledge, learner's failure to engage others in critical examination of their explanation and task, and teachers' failure to recognize inappropriate explanations (Land & Zembal-Saul, 2003).

The studies above provide insight into how explanations are developed. Individuals may need to be guided through the process of developing explanations. Support, in the form of tutoring conversations, may encourage individuals to develop self-explanations. Through prompts and questions, teachers can be guided to develop explanations of their practice. Scaffolds can be used to support reflective conversations about explanations and explanation

development. Computer-based scaffolds also guide individuals to revisit and reflect on the evidence they used and the explanations they developed. By using scaffolds that encourage discussion, the use of evidence, and decision-making, teachers may develop more advanced explanations and a deeper understanding of their teaching practice. These scaffolds prompt teachers to use their knowledge of teaching and learning to examine their teaching practice while developing evidence-based explanations of their teaching practice.

The Significance of Professional Development, Reflection, and Explanations

The importance of reflection, explanations, and experiences are integrated throughout the philosophy of science. In Thomas Kuhn's (1996) model of development in science, he explains how the continuous employment of good explanations keeps a paradigm active. Science advances when one paradigm is not able to sustain the incidences of good explanations resulting in its abandonment (Gilbert, 1999). This advancement in science is similar to science teachers' use of reflection to a) develop a better understanding of their science teaching practice and b) face and address issues in their teaching practice. Like paradigms in science, teachers' explanations of their practice during reflections may change due to a new insight into and understanding of their teaching practice. New experiences, or opportunities, to revisit old experiences may provide new insights for teachers. During experiences, such as professional learning opportunities, teachers may be presented with opportunities to examine and explain their teaching practice. By using evidence of their science teaching to inform their views and explanations of their practice, science teachers are using reform-based instructional strategies, which they would normally use to help their students develop knowledge about science (Avraamidou & Zembal-Saul, 2005), to help them develop knowledge about their science teaching. Through this examination, teachers may realize that what appears to be a reasonable

explanation of their teaching during one instance may later seem unreasonable (Brems & Rips, 2000). When faced with anomalies that are not solvable through normal teaching methodologies or previous explanations, they may need to use another frame to examine those issues of practice. By using another frame, teachers are able to step outside of their normal view of teaching and learning and try to look at the situation from another point of view. Stepping outside of their normal lens will help teachers further examine their practice and gather evidence to develop better explanations of their practice. The use of reflection, evidence, and experience is critical to science teachers' development of knowledge about their teaching practice.

CHAPTER THREE

METHODOLOGY

The purpose of this chapter is to detail the methodological perspective and research design that guided my study. The perspective and research design resonate with my research focus which aims to understand the participants through their reflective practice and interpretations of their teaching. This study aims to understand: (a) the nature of the evidence that elementary science teachers use to develop their explanations about their teaching practice, (b) how elementary science teachers develop explanations of practice using the Video Analysis Tool (VAT), and (c) how elementary science teachers develop explanations of practice using a specific set of questions which guides them through developing reflections in VAT. Specifically, this study examined the explanations of in-service elementary science teachers participating in a professional development course that emphasized multicultural teaching strategies, environmental science, and reflection. Only by taking into account how teachers interpret classroom actions and develop explanations of their practice will I be able to gain an understanding of how they engage in reflective practice.

Methodological Perspective

My study is grounded in a constructivist perspective. The constructivist perspective that guides my study is cognitive constructivism. As stated by Grandy (1997), "cognitive constructivism is the view that individual cognitive agents understand the world and make their way around in it by using mental representations that they have constructed"(p. 44). Cognitive

constructivism affords me the opportunity to examine how the construction of knowledge is dependent on resources, personal experiences, and motivation (Grandy, 1997).

The constructivist perspective imposes certain claims that guide my research. Those claims are:

- Each person's "making sense of the world" (Crotty, p.58) is worthy of respect and valid.

- Each person's construction of knowledge is based on his or her personal experiences (Gergen, 1995; Grandy, 1997).

- There is no direct access to individual's constructed representations (Grandy, 1997).

- The process of learning requires "self-regulation and the building of conceptual structures through reflection and abstraction" (von Glasersfeld, 1995, p. 14).

The complexity of constructivism arises within the integration of these four simple tenets. von Glasersfeld (1995) stressed the adaptive nature of knowing: "One should think of knowledge as a kind of compendium of concepts and actions that one has found to be successful, given the purposes one had in mind" (von Glasersfeld, 1995, p. 7).

Application to Study

The constructivist perspective is integral to this study because of the nature of teachers' reflections. Constructivism acknowledges personal experiences as an influence in individuals' knowledge construction (Grandy, 1997). Since the reflections in this study center on the teachers' personal experiences, science teachers' development of knowledge about their teaching practice is influenced by the teaching experience that they are examining as well as their previous knowledge and beliefs about their science teaching practice. To develop an understanding of their teaching experience, teachers situate their experience within the context of

their classroom. "Teachers make sense of their roles in the teaching-learning process by constructing pedagogical knowledge which 'fits' the context of the classroom environment" (Tobin, Briscoe, & Holman, 1990, p. 411) as well as their previous knowledge. The development of knowledge, like reflection, is an interpretive process (Tobin, Briscoe, & Holman, 1990).

Reflections are represented through discourse. Grandy (1997) explained how individuals cannot directly access another individual's construction of knowledge. Since we cannot directly access an individual's construction of knowledge, we need to access the discourse or writing that represent an individual's knowledge and understanding about their practice. These data are not reality, but traces of reality that represents the situation being researched (Altrichter, Posch, & Somekh, 1993). In the case of this study, the teachers' reflective writings will be used to represent the reality of each teacher's science teaching practice and their knowledge of science teaching.

To understand reflective practice, researchers can access data about teachers' construction of knowledge through the process of reflection by examining reflective writings and classroom discourse. In this study, I examined the teachers' reflective writings and interviews about their science teaching practice. For me to develop a deeper understanding of the teachers' reflective writings, I had to combine both information contained within the text and information outside of the text, such as interview data about the reflections. Information within the text should be combined with other information, such as prior knowledge and the context surrounding the text, to better understand the ideas presented through the text (Spiro, Feltovich, Jacobson, & Coulson, 1995). This study lends itself to this notion by utilizing teachers' reflective writings along with interviews about their teaching practice in order to construct a better understanding of the teachers' explanations about their science teaching practice.

Research Design

Teachers' reflective writings provide a way of determining what and how teachers think about the teaching and learning in their classrooms. They provide an insight into teachers' understanding of their teaching and the many complexities of the classroom. "From a cognitive constructivist perspective, knowledge is not independent of the knower; knowledge is understanding physical and abstract objects in our experience" (Keys & Bryan, 2001, p. 633). As teachers encounter new teaching situations, they begin to develop their own interpretations and understanding of their teaching practice. Thus, teachers' narrative accounts, such as written reflections, have become a major source of data for research on teachers' thinking (Johnson, 2001) about their teaching. Their thinking may be represented through explanations developed in their reflections on their science teaching practice. This study will specifically examine those explanations and the evidence that supports the teachers' explanations. To do this for each participant, a multiple case study approach will be employed.

Multiple Case Studies

The nature of examining the reflective practice of in-service teachers involved the use of a case study approach. Like other forms of qualitative methods, case studies "permit inquiry into selected issues in great depth, context, and nuance" (Patton, 2002, p. 227). The case study approach is used to incorporate pertinent contextual details (Yin, 2003). The methodology embedded in the case study approach guided data collection and analysis (Patton, 2002). The subject of each case study was an individual in-service elementary teachers participating in the professional development experience. This study involved a multiple case study approach so that data can be organized "for in-depth study and comparison" (Patton, 2002, p. 447).

I developed a total of four cases developed for this study. Each of the four cases was developed around an individual participant. Only four participants were selected since the data set for a single case study required a large accumulation of data (Patton, 2002). The use of four cases provided four different contexts to study in-service elementary teachers' reflections. Additionally, the use of multiple cases may expand the transferability of the study's findings (Yin, 2003).

To examine each case thoroughly, I used a layered case study approach was used to structure the data for analysis and present multiple reflections from each participant. Yin (2003) described this approach as a multiple-case design with multiple units of analysis. This layered case study approach included the development of four units of analysis for each participant. For the purpose of this study, each embedded unit of analysis (Yin, 2003) was related to a case study element. Each case study element was developed around a separate reflection focus. One unit of analysis was developed from each participant's summer reflective writings and three units of analysis were developed around the three reflective writings that were developed in Fall 2005 and Spring 2006. The structure of each individual case is illustrated in Figure 1. Cross-case comparison analysis (Patton, 2002) was used to examine the differences and similarities among the individual cases (Patton, 2002).
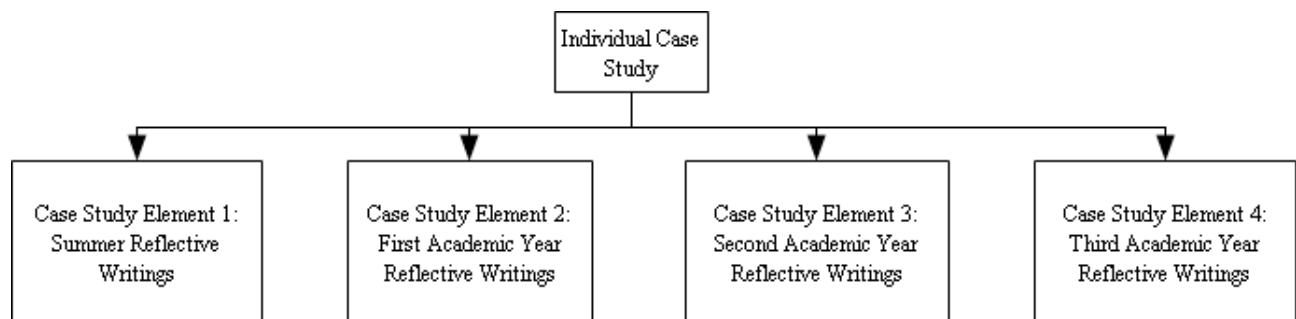
Figure 1. Layered case study design.

Role of Researcher

As the researcher for this study, part of my responsibilities were to collect data on the participants' VAT reflections about their science teaching practice. Specifically, I collected Word documents of their VAT reflections, Word documents of their journal entries, and conducted interviews with each participant. More details concerning the collection of data and research methods are discussed in the following Data Collection section.

Context

Two contexts influence this study, the professional development experience and the participating school system. The professional development experience was facilitated at the participating school system. All of the participants of this study were also teaching within this same school system. The combination of both contexts influenced this study.

Professional development experience. The context of this study is a professional development experience for elementary teachers who teach science. The professional development experience is part of a larger research project, which is being implemented by a research laboratory at a research university in the southeastern United States. The larger research project, Evidence Based Decision Support (EBDS) Research Collaborative, emphasized the use of evidence-based methods and the VAT, which emphasizes evidence-based methods for improving teacher practice. This study centered on in-service teachers' utilization of the electronic support tool, VAT, during a professional development experience, which was implemented as part of the Evidence Based Decision Support Research Collaborative. Specifically, this study examined how VAT is used to support elementary teachers' science teaching through reflection. To center on in-service teachers' utilization of VAT and reflection, I

examined the products of in-service teachers' participation in a professional development experience that was developed in partnership with the EBDS Research Collaborative.

The design of the professional development experience was based on the epistemological stance of situated learning. Situated learning stresses that what is learned is linked to the context in which it is learned (Anderson, Reder, & Simon, 1996; Brown, Collins, & Duguid, 1989). To understand and use tools of practice, the learning of the tools must be linked to the context in which they are used (Brown, Collins, & Duguid, 1989; Hedegaard, 1998). In the case of the professional development experience, teachers' use of teaching tools and their understanding of their teaching practice were linked to their personal teaching experiences. Teachers were provided with on-going support as they developed an understanding of various teaching strategies and concepts throughout the school year. The teachers were able to (a) discuss how materials, such as science content, science activities, and multicultural teaching strategies, could be used in their classroom, (b) practice using those materials during professional development meetings, and (c) develop an understanding of how they can use these materials with their students. The professional development experience focused on making the materials and concepts relevant to the teachers and their students. Additionally, the experience focused on helping teachers develop a better understanding of their science teaching philosophy through journal entries and reflections. Brown, Collins, and Duguid (1989) stated

> To explore the idea that concepts are both situated and progressively developed through activity, we should abandon any notion that they are abstract, self-contained entities. Instead, it may be more useful to consider conceptual knowledge as, in some ways, similar to a set of tools. Tools share several significant features with knowledge: They can only be fully understood through

use, using them entails both changing the user's view of the world and adopting

the belief system of the culture in which they are used (p. 33).

This professional development experience emphasized situated learning through the summer

workshop, where teachers were presented with opportunities to take part in and practice using

various science activities, and through its support of teachers' use of the workshop materials and

resources in their classrooms during the academic year. The context and content of the

professional development experience encouraged teachers to use their knowledge of teaching

(Herrington & Oliver, 1995; Herrington & Oliver, 1999) to reflect on their teaching practice.

Their use of VAT and reflection took place within their daily teaching responsibilities and were

based on their own science teaching. In VAT, they were able to examine video of lessons they

chose to have taped. Teachers were encouraged to use the video of their teaching, VAT, and

journal entries to examine and discuss issues that were relevant and meaningful to their own

practice.

Three topics-- environmental science, multicultural teaching strategies, and reflection--
were emphasized during the design and facilitation of the professional development experience.

Teachers were provided with content and activities for teaching environmental science. Forestry

was used as a theme for discussing environmental science and served as a focus for developing

science learning experiences for elementary students. Multicultural teaching strategies for

teaching science were modeled and discussed along with environmental science content.

Teachers were encouraged to share their uses of multicultural teaching strategies with other

teachers during group discussions.

All of the participants in this study worked in schools which were comprised of 66% or

more Hispanic students. The multicultural component of the course provided them with a forum

to discuss issues in the county and schools and develop science lessons that incorporated multicultural strategies for teaching science. The reflection component of the professional development was integrated into the course to help teachers examine their use of science teaching strategies and develop a deeper understanding of their teaching. Tools, such as the VAT, journal entries and the reflection framework, were used to help teachers examine their practice and collect their reflections. The teachers were able to reflect on their teaching of various science concepts or use of certain teaching strategies they found interesting, successful, unsuccessful, or surprising.

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│ Course  ││  Camp   │    │Meetings and│  │up Meeting  │  │  up Meeting  │
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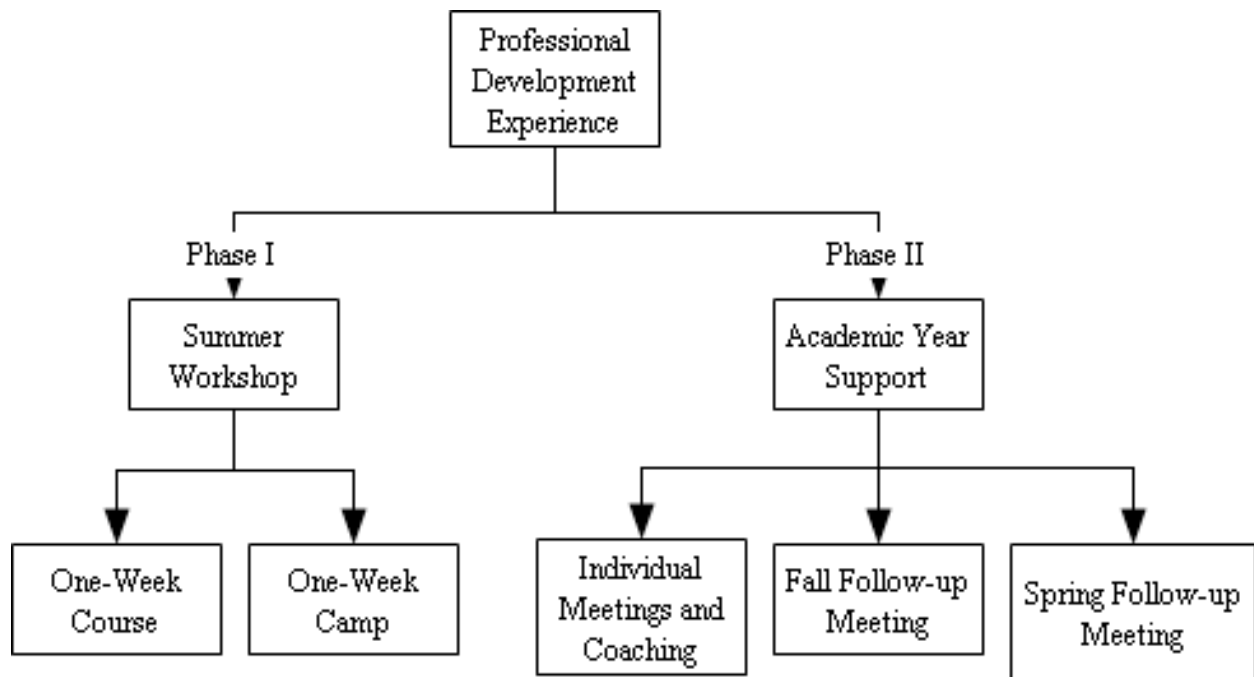
Figure 2. Professional development experience.

The professional development experience consisted of two phases, a two-week summer professional development workshop and follow-up support during the school year (see Figure 2). The summer professional development workshop consisted of a one-week course and a one-

week camp (see Figure 3). During the course, the teachers learned environmental science

concepts and multicultural teaching strategies (see Appendix A). Additionally, they developed

lesson plans/activities for the following camp. The camp provided the teachers with the

opportunity to practice activities and incorporate concepts they learned during the course and

learn to reflect on their science teaching practice using VAT (see Appendix A). During the camp,

the teachers were grouped into teams of two. Each team worked in the same room with the same

students during the camp. The teachers in each team developed and implemented lessons on

environmental science concepts. The teams had complete control in choosing the activities and

lessons they would develop and implement during the camp. However, they were asked to focus

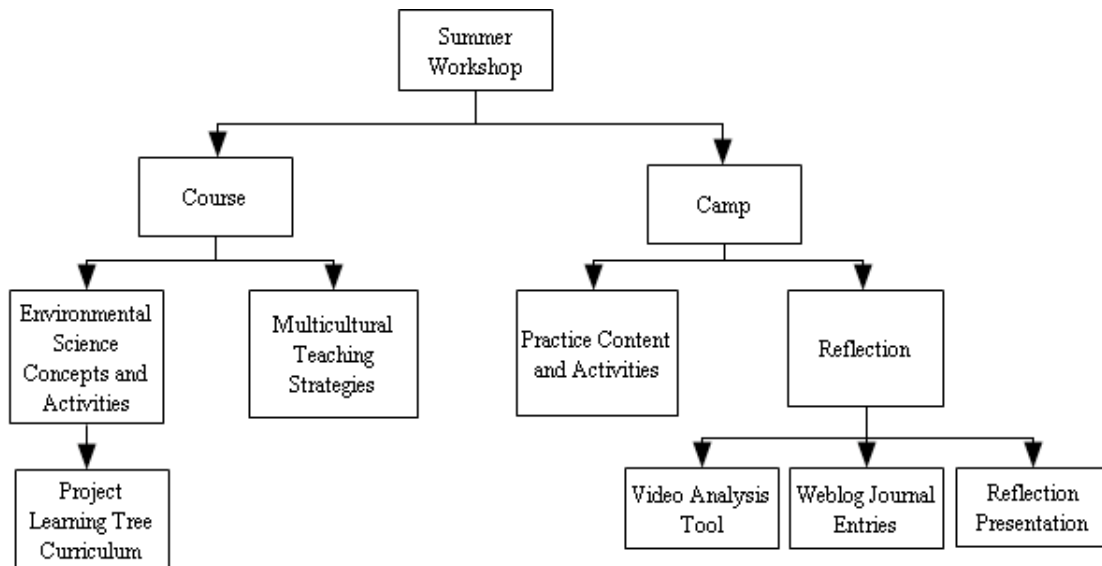on environmental science.

Figure 3. Summer workshop components.

The academic year support consisted of two group meetings, one fall and one spring,

individual meetings, videotaping the teachers' science lessons, and teachers' use of VAT to

reflect on their science teaching (see Appendix A). The professional development course

provided the elementary teachers with support to teach science, engage diverse students in

science learning, and reflect on their science teaching practice. The follow-up meetings were

used to continue discussing environmental science content, multicultural teaching strategies, and

reflection (see Figure 4). In the meetings, the teachers were encouraged to continue to analyze

their videotaped lessons and discuss their VAT analyses. During the first follow-up meeting, the

participants were introduced to a reflection framework. The reflection framework was adapted

from the Griffin's Critical Incident format (Griffin, 2003). The reflection framework consisted of

questions and prompts to guide the teachers through the analysis of their videotaped lessons in

VAT. During the second follow-up meeting, each participant presented a VAT analysis to other

participants. In addition to the presentations of their VAT analyses, the participants had an

opportunity to discuss their VAT analyses with the other teachers as they were working on them

during the meetings. The experiences discussed and examined by the teachers in their VAT

analyses and during the follow-up meetings were situations they personally chose.
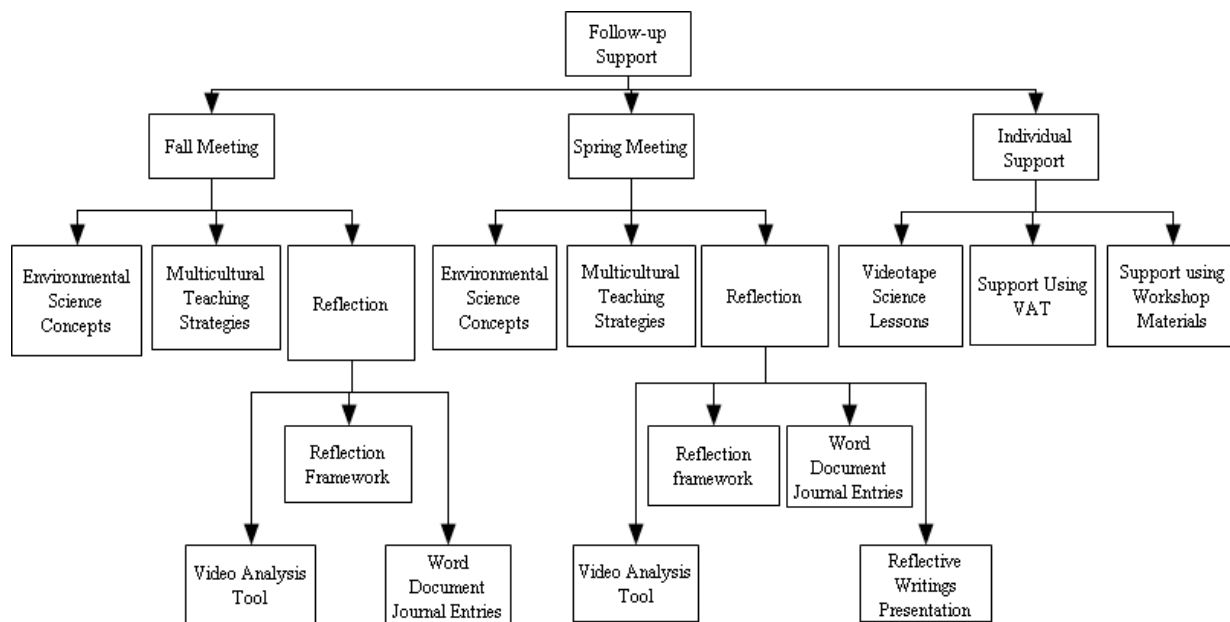
Figure 4. Follow-up support components.

Participating school system. In this section, state, district, and individual school facts are provided for the school system and schools participating in the professional development experience. The data emphasize the context in which the study took place and identifies issues faced in the classrooms of the study's participants. The four teachers participating in this study are located at three elementary schools in northern Georgia's Indigo County [pseudonym]. Indigo County has a population greater than 125,000 (georgia.gov, 2007). Furthermore, Indigo County is divided into two school districts, one city and one county district. The teachers participating in this study all work within the county school system. Further discussion and description of the participants is found in the Sample Selection section of this chapter. Each of the schools is located within approximately five miles of each other and is in a rural, industrial area. In Tables 2 and 3, state and district facts are provided.

Table 2

State and District Facts

	State of Georgia	District Facts
Number of Students	1,559,828	~ 22,000
Economically Disadvantaged	50%	49%
Limited English Proficient	5%	19%

Table 3

Demographic Data of State and District

	State of Georgia	District
Asian	3%	1%
Black	38%	5%
Hispanic	8%	31%
Native American	0%	0%
White	48%	60%
Multiracial	2%	2%

From the data, it is evident that Indigo County's demographics and subgroups are very different than the state of Georgia. In the early 1990's, Indigo County's population began to change with large growth in the Hispanic population. These changes are now clearly evident in Indigo County's demographic data. Their Hispanic student population over 30% is much larger than the state average of 8%. As expected, this change in population has led to a large number of students with limited proficiency of the English language. These issues are further highlighted in Tables 4 and 5, which provide school facts and student demographic data of the participating teachers' individual schools.

Table 4

School Facts of Participating Schools

	Tivoli Elementary	Crawford Hill Elementary	Turtle Creek Elementary
Number of Students	505	613	650
Economically Disadvantaged	94 %	97%	84%
Limited English Proficient	67%	83 %	50%

Table 5

Student Demographic Data of Participating Schools

	Tivoli Elementary	Crawford Hill Elementary	Turtle Creek Elementary
Asian	4%	1%	2%
Black	1%	0%	8%
Hispanic	89%	95%	66%
Native American	0%	0%	0%
White	6%	4%	22%
Multiracial	1%	1%	3%

The data in Tables 4 and 5 illustrate significant differences in the schools' student populations as compared to both Georgia and Indigo County Schools. The three elementary schools in which the research participants teach have student populations that are predominantly Hispanic, significantly higher than the state average of 8% and Indigo County's 31%. Each of the schools also has at least 84% of their students classified as economically disadvantaged. Additionally, at least 50% of each school's students have limited proficiency in English, with Tivoli (67%) and Crawford Hill (83%) exceeding this percentage. These data indicate significant challenges for the research participants in their daily teaching practices. They identified that school was the only place in which most of their students spoke English and heard English spoken. To address these issues, each of the schools has developed support systems to help their teachers. For example, Tivoli Elementary has established several programs to support the teachers and their students. Some of Tivoli's initiatives include parents visiting and observing their child's classroom and assisting in school activities (e.g., lunches and field trips), having English to Spanish translators in the classroom, and offering free English lessons to parents at night and on the weekends.

Professional development tools. In order to support teachers in their examination of their science teaching, the entire professional development experience utilized various tools and strategies to engage the teachers in reflection (See Table 6). Tools and strategies used by teachers during the professional development experience are (a) VAT, (b) the reflection framework (See Appendix B), (c) individual coaching from the professional development facilitators, (d) Weblog and Word document journal entries discussing their teaching beliefs and VAT analyses, and (e) presentations about their VAT analyses. VAT, the reflection framework, and journal entries were used by the participants to reflect on their practice. Coaching and the opportunities to

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present their VAT analyses to the other participants were strategies implemented by the

researcher to support the participants' reflection on their teaching. During the summer workshop,

the teachers were asked to develop and revisit a narrative of their teaching which was developed

as a Weblog journal entry. Their teaching philosophy narrative detailed their philosophy of

teaching and discussed their beliefs about teaching and learning science. This journal entry was

converted into a Word document and given back to each teacher. The participants were

encouraged to revisit this statement throughout the entire professional development experience.

They revisited their statement when answering specific journal entry prompts and questions

listed on the reflection framework.

Table 6

Tools and Strategies for Reflection

Course Phase	Tools and Strategies
Summer Workshop	Video Analysis Tool
	Weblog journal entries
	Reflection presentation
Follow-up Support	Video Analysis Tool
	Reflection framework
	Individual coaching
	Word document journal Entries
	Reflection presentation

During the summer and follow-up meetings, participants were encouraged to engage in group discussions about issues surrounding science teaching and learning. For the professional development, issues of science teaching and learning consisted of teaching situations or dilemmas that were of interest to or had impacted the participants' science teaching. As a part of the professional development experience, they were also asked to videotape seven of their lessons and analyze the videotaped lessons using the VAT. Four videotaped lessons were from the summer workshop and three videotaped lessons were from the academic year. During their VAT analyses, they were asked to identify practices that both resonate with and contradict their beliefs about teaching and learning. The teachers were encouraged to utilize the reflection framework as an aid when developing their VAT analyses.

The Video Analysis Tool. In order to help teachers examine their science teaching practice and develop better understandings of their beliefs about science teaching and learning, the professional development experience used reflection tools and individual feedback. One tool used to record teachers' analysis of their science teaching was VAT. This system provides avenues for teachers and teacher educators to develop and examine explanations of practice. This tool affords teachers the opportunity to collect and organize video of their teaching. Teachers are provided features for selecting sections of video and developing written analyses about each section of the video or the entire videotaped lesson. It is through this selection of video evidence and discussion of evidence that teachers are identifying evidence of their practice. By allowing teachers to systematically collect evidence of their practice, such as video footage of different lessons, within one system, VAT enables teachers to examine their practice to develop a better understanding of their teaching practice and to identify inconsistencies between their teaching beliefs and practices. Through VAT, teachers are able to break their video into smaller segments

in order to focus in on certain events. They can use the video segments of those events to focus on certain issues in their teaching practice. Along with looking at video of their teaching, the teachers are able to comment on each video segment using a comment box feature. For this study, each video segment and its' associated comments is called a clip. Teachers can use the comment feature of VAT to discuss how video evidence is linked to certain standards or to develop reflections about issues of their practice. It is the comments associated with the corresponding video segments that comprise a participant's written analysis on a videotaped lesson. Video of the participants' science lessons and the video segments they created in VAT were not gathered as data for this study. Video of the participants' science lessons showed both the teacher and the students in the classroom. I chose not to include video including students due to confidentially and privacy issues.

Reflection framework. During the academic year, the participants were encouraged to use another tool, the reflection framework, for reflecting on their lesson. The reflection framework included a series of questions and prompts to help the teachers reflect on specific issues of their practice captured in VAT. The participants were provided with a paper and digital copy of the reflection framework (See Appendix B). The framework was developed to guide teachers examination of their science teaching practice. The participants were encouraged to use it with VAT to guide them through reflecting on their practice. The teachers were encouraged to use VAT to record their responses to the questions and prompts. Additionally, the teachers were encouraged to use the video of their teaching in VAT to gather evidence about their teaching practice and answer questions on the reflection framework. The framework also encouraged the teachers to examine their current knowledge and beliefs. The purpose of the reflection framework was to support teachers' development of explanations about their teaching practice.

The participants were also provided with feedback on and opportunities to elaborate on or further refine their VAT analyses during the academic year. The facilitators of the professional development courses provided feedback on each of the participant's VAT analyses. The feedback was given to the participants in the form of Word documents and consisted of questions and comments that were developed by the professional development facilitator. The Word documents were then e-mailed to each participant and they were encouraged to use the comments and questions to refine their VAT analyses. The teachers could continue to refine their VAT analyses throughout the professional development experience.

Journal entries. Another tool used in the professional development experience was journal entries. The journal entries were in the form of weblog or Word document journal entries developed in response to questions (See Appendix C) developed by the professional development facilitator. The questions posed by the facilitators for the weblog or Word document journal entries prompted the teachers to discuss their beliefs about teaching and learning science, develop a philosophy of teaching, discuss their teaching, and provide feedback on VAT. The weblog was an Internet accessible journaling tool which the participants used to answer journal questions while developing their journal entry. Access to the weblog was provided to the participants to afford them a forum for uploading journal entries, posing questions to the other participants and facilitator, sharing resources or information. Due to research procedures, which were in place to secure the anonymity of participants' identities, the weblog was taken offline during the fall semester and replaced by using Word document journal entries. Instead of developing their entries in the weblog during the academic year, the participants developed their journal entries in Word and emailed them to the facilitators.

Role of Professional Development Facilitator

As well as being the researcher of this study, I also served as the professional development facilitator. The role of the researcher significantly changed throughout this study. Initially, the role was one of a developer and facilitator of the professional development experience. I took on this role from the inception of the professional development design process through the first phase of the professional development experience, summer workshop. During this time, the researcher was not the main facilitator of the professional development components focused on the use of VAT and reflection. The VAT and reflection components were initially under the direction of another facilitator. Through the continued development of the professional development experience and this study, the researcher took over more responsibilities for the VAT and reflection component of the professional development experience. These new responsibilities allowed me to provide support and feedback to the teachers on their VAT analyses and technical support on their use of VAT.

As the professional development facilitator, my role required me to (a) communicate with the participants about the professional development experience, (b) support them in their use of reflection, environmental science content, and multicultural teaching strategies, (c) collect video of their science teaching, and (d) provide feedback on their VAT analyses. I fulfilled this role by providing them with resources and modeling strategies, such as how to implement certain environmental science lessons and multicultural teaching strategies, during the summer workshop and follow-up meetings. Communication with the participants was maintained by phone, e-mail, and face-to-face meetings. I also provided the teachers with feedback on their written analyses in VAT as they completed them. My involvement with the entire professional development experience provided me with the opportunity to engage the teachers in learning

about VAT, reflection, multicultural teaching strategies, and environmental science. Additionally, my involvement allowed me to learn from the participants and adjust the professional development experience according to their needs.

My role as a facilitator of the professional learning experience afforded me the opportunity to be a participant observer in the study. As a participant observer, I took part in activities in the professional development experience. Taking part in the activities provided me with the opportunity to gain a deeper understanding of the explicit and tacit aspects of the participants' teaching routines (DeWalt & DeWalt, 2002) and their experiences in the professional development experience. The style of participant observation that I adopted for this study is that of moderate participation (DeWalt & DeWalt, 2002). In moderate participation, the researcher "is present at the scene of the action, is identifiable as a researcher, but does not actively participate, or only occasionally interacts, with people in it" (DeWalt & DeWalt, 2002, p. 20). "The nature and degree of my participation" as a participant observer (Patton, 2002, p. 266) was limited by my role as a facilitator of the professional development experience in which the teachers' were enrolled.

Sample Selection

The participants for this study were in-service elementary science teachers participating in the professional development experience. There were a total of 12 participants in the professional development experience. There were no additional requirements imposed on the participants in this study. They completed all of the same requirements as other teachers in the professional development experience. Through purposeful and convenience sampling (Patton, 2002), four in-service elementary teachers were selected as research participants from the professional development experience. Purposeful sampling was used to select teachers that were

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fulfilling the requirements for the professional development experience, by reflecting on their science teaching practice, using course materials, and using VAT in to analyze their science teaching. Additionally, these participants were completing the professional development experience requirements within the time frame set by the facilitators. Convenience sampling was then used in the selection of four participants who showed interest in using the professional development resources and completed their requirements in a timely manner. These teachers were the most willing to participant in the professional development experience. By using purposeful and convenience sampling, four teachers who taught is four different classroom situations in three different schools were chosen for this study.

In Fall 2005, four in-service elementary science teachers, Sarah, Brenda, Betty, and Patricia, were recruited from the professional development experience. These four participants were selected because of their high level of participation in the professional development course and their use of VAT. Specifically, these participants were selected because of their willingness to thoroughly use the videotapes of their lessons and VAT to analyze their science teaching practice. Once participants were selected, they were informed about the study and their role as participants. Specifically, they were informed about the focus of the study and the anonymity of their identities in this study. I also explained how this study could inform current science education literature on reflective practice, the development of explanations, and the use of VAT.

Participant descriptions

The following section provides a description of each participant, their philosophy of teaching statement, and their description of their classroom environment and relationship with students. These items provide insight on the focus and context surrounding their analyses of their teaching, the evidence they used, and their development of evidence-based explanations. To

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provide an accurate account of the participants' teaching philosophy and classroom environment they try to create, excerpts are provided from their weblog journal entries and interviews, respectively.

Sarah. Sarah, who is of European American descent, is an energetic, elementary teacher with over 30 years of teaching experience. She is an outdoor enthusiast, who provides volunteer support for the United States National Olympic Kayak team. She has a bachelors and master's degree in elementary education. Sarah taught at Tivoli Elementary School in Georgia for the first 13 years of her teaching career before moving to Illinois. In Illinois, she taught for three years at the elementary school level before becoming an instructor at the college level. She worked at a college in central Illinois as both a full-time and part-time instructor. After moving back to Georgia, Sarah took a part-time position at Tivoli Elementary School. She eventually took a full-time position and has been working at Tivoli Elementary School for the last 20 years. She states "it really has been wonderful and I really have seen it change."(Sarah, Interview 1, 3/28/06). Her teaching position during this study was that of a third grade teacher at Tivoli Elementary School.

As part of the professional development experience, Sarah developed a philosophy of teaching statement. The following quote is taken directly from her weblog journal entry.

> I try to relate as many things as possible to science every day, but I only formally teach science for two weeks every grading period.

> Being a science teacher means that I am constantly relating science to their everyday life. We teach in a block type system so that there is a special time for science. Science is a living topic and should not be pigeonholed. I really enjoy teaching science and using science books to teach reading. Some company somewhere would make

millions if they would package and widely promote these books as language arts/reading units.

The role of the science teacher these days is being deminished [sic] because of the emphasis placed of the reading and math test scores on the CRCT. Science teachers at the elementary level tend to be the same teacher that teaches reading and math. (we don't have a science lab and we don't departmentalize at our school.) Our children are second language learners and we have to emphasize reading, many are reading on a first grade level when they come to us in third grade. The role of the science teacher then becomes that of one who has to intergrate science and science concepts into the day as much as posssible [sic] or our science criteria will never get fully met.There truly is not enough time to get it done.

My philosophy of teaching is that I must always continue to be an advocate for what the children need and deserve in their educational process.It may not be popular with the powers that be , but I am in the trenches and I must advocate for not only the child but the parents. (Sarah, Weblog Entry 3, 6/29/05)

In her weblog entry, Sarah described how she believed science should be integrated daily and throughout other subject areas. She was concerned that science was not a priority at her school. Sarah believed her role as a science teacher was to help students receive science through integrating it into other subjects.

In her first interview, Sarah was asked to describe her classroom environment and relationship with her students. What follows is her description of her classroom, her students, and how she relates to them.

My classroom environment is really very interesting. I have an interesting mix of kids.

They are not very mature. I have so kids who have emerged as leaders but they are not

kind of the leaders that you want to have in your classroom. I have some little boys that

are pretty rowdy and I have to keep them in real close proximity with these guys. They

are very smart but they are the kind of kids that if you turned your back on them they

would be off in a different direction just about as fast as they could go. It is a real

interesting mix. The kids that I have that are really smart are also really shy. They are

really emerging as leaders like you would like them to for others to maybe to follow the

real good examples. I have particularly one little fellow that he has become a leader but I

do not know. I have to keep my eye on him. . . . I try to make sure that they, number one,

[know] that I really go care about them even though sometimes I really have to fuss at

them about one thing or another. Most of the time it is behavior or not doing their work

or not getting things done of time. You know those kinds of things. I want them to

understand that I really do care about them.   I really am grouchy with them just because I

know they can do better. I am not mad at them and that it is not that I don't think that

they are smart. It is because I know they are smart and I am upset with them for probably

not working as hard as they should be.

I guess I try to get them to understand what I am doing, my real purpose. I am

there and I tell them this all the time that I am there to make them as smart as I can in 180

days. It is very important for me that they listen when I am talking and they try very, very

hard. It doesn't have anything to do with them being bad or me being mean or it is just

that we have a lot of work to do. We really should try work hard and stay focused all the

time. I just try to get them to understand that it is serious and we are going to have fun.

Yet there are times when we have to settle down (Sarah, Interview 1, 3/28/06).

Sarah believed that her classroom environment was interesting due to her students. She did not think her students were as mature as they should be at their age. Even though they seemed immature, she still held high expectations for them. She consistently prompted them to behave appropriately and discussed why they should adhere to certain classroom guidelines.

Betty. Betty, who is also of European American descent, is a very outgoing, elementary teacher with 10 years of teaching experience. She has a passion for Environmental Education that she shares freely with her students and others. Betty has a bachelor's degree in Social Science and a master's degree in early childhood education. Before taking her first teaching position, Betty substitute taught at different middle and elementary schools. Ever since she started substitute teaching, she has worked in the same school system. Her first teaching job was as a third and fourth grade teacher at Turtle Creek Elementary school, where she currently teaches. In her second year of teaching, she took a position as a fourth and fifth grade teacher. She held this position for six years. Her last three years of teaching have been at the kindergarten level. Even though she has changed grade levels, she has still remained in Turtle Creek Elementary School.

Betty developed a statement about her teaching philosophy during the participation in this study. The following statement is directly from a weblog journal entry that she developed.

I believe that all students can learn and it is my job as an educator to help each student achieve success within my classroom. I believe that learning needs to be fun while meeting all the State & local standards. Overall my approach in my classroom in all subjects, including science, is to make as much of the presentation of material hands-on

and also relevant to the student. Many of our students, especially second language learners, do not have a large knowledge base from which to work. So I strive within my classroom to bring in as many resources in many different ways to help relate to all students learning styles. I present my units in a total immersion format. If we are studying "oceans" then my room becomes an ocean. All posters, art work, books, computer programs, videos, etc. are centered around oceans. I even bring in my scuba gear and share it with my students. My style of teaching allows students to experience science through research, experimentation and problem solving so that they may develop the knowledge base necessary to succeed in school and in life.

I was born to be a science teacher. I love anything in the environment and I love sharing it with others. In Kindergarten I have the rare opportunity in education to get students excited about learning. I use my past experience as a 4th & 5th grade teacher to help extend my lessons to my Kindergarten students. I believe that Kindergarten students are just as smart as older students but they just don't have as much of a knowledge base. My role as their science teacher is to help fill up this base and teach them how to reason & think. They are like little sponges and so eager to learn that I use it as an opportunity to instill a love of learning and specifically a love of science.

The role of a science teacher is to be a leader who prepares exempliary[sic] lessons to be presented. To be a cooperative learning partner and work WITH the students in problem solving. To be a facilitator and listen and lead students in discussions about science related topics and to be an inquirer and ask open ended questions that allow students to think and formulate their own ideas and answers to problems. As a teacher of any subject I believe that you must create a "safe environment" within your classroom

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where students are not afraid to take risks. Creative problem solving and creativity are often stifled when the students are afraid within the classroom. (Betty, Weblog Entry 3, 6/29/06).

Betty believed that all students should be provided with the opportunity to learn the required science standards in a fun and safe environment. She described how her "immersion" strategy provided students with multiple resources and experiences for learning science. Betty also discussed how students, regardless of grade level, can discuss and learn science.

When asked to describe her classroom environment during her first interview, Betty stated

I strive to make it a very comfortable place for children to come. That they feel very safe and a happy place. I always paint my room a real pretty color of blue because I think it helps bring out the best in kids and their behavior. My daughter refers to me as baneful dictator. I have lots of procedures that my kids do. Like Kerry Wong's philosophy of teaching your kids procedures, the way to do things and then you don't spend a whole lot of time the rest of the year worrying about behavioral or how they do things. The kids get very comfortable and they know what is expected. They basically, well, that kind of takes that out. Then you have more time to teach because you are spending time you know redirecting all the time, directing all the time why things should be done. I think my classroom environment is comfortable for my kids and I try to make it that way. I like to usually during lessons to play classical music and different times, different classes I used more lamps then overhead light. Kindergarten, I pretty much use more overheads lights. The older grades seem to do ok with a little bit of lower lighting.

Kindergarten it does not seem to be as effective with them. But I just try to make it a

place where they want to come to everyday. . . .

When I do a topic that is what I do and get totally immersed in whatever I'm

teaching. I use a lot of different ways of presenting material to kids to get them excited.

I try to, you know, sometimes it is hard depending on the grade level like with magnets to

kindergarteners. The whole concept of magnetic properties is really a little beyond them

but they can understand basically how they work. I try to make it fun and I try to make

hands on. I try to have a little science center left out where they experiment. I try to use

video that talk about magnets that is appropriate for the age I try to show that. Try to

make it appealing in a lot of different ways so they really want to learn things. I

encourage them to ask questions. I usually allow plenty of time when we are talking

about a topic for them to ask questions. My kids feel pretty safe asking any kind of

question . . . .But then, I do have pretty good structure. I tend to stay pretty much on the

topic. I try not to stay on something so long that the kids get bored with it. I figure if I

am getting bored with something that they are already passed bored. I try to minimize

any problems with a topic that I am teaching. But yet I am flexible enough say if we hit

on something that is going very well and it seems like I can actually expand it and get

deeper into the topic, then I will teach something a little longer than I expected, say like

the direction of the unit (Betty, Interview 1, 1/26/06).

Betty described her classroom environment as a safe haven for students. She also believed using

certain colors and music provide a comfortable environment. Her students are taught daily

procedures that allowed them to develop responsibility. Additionally, Betty believed her

classroom provided students with a comfortable setting to ask questions and become immersed in a subject.

Brenda. Brenda, who is of Native American and European American descent, is a very serious, elementary teacher with 29 years of teaching experience. She is quick to talk about her love of sports, especially baseball and softball. She has a bachelor's degree in Special Education, a master's degree in Learning Disabilities and a certificate in gifted education. She taught Learning Disabled resource for grades 7 through 12 for three years and was the Learning Disabled Resource teacher and lead teacher for one year. Once an opening became available in gifted education, Brenda applied for and received the position. She has been teaching gifted education for 25 years. During her first five years in gifted education, she was in a junior high/high school position. After that time, she took a position in various elementary schools in the county in which she currently teaches. Due to her position as the gifted teacher in schools for multiple years, she "has the same students year after year, which is a little bit of a different situation than a classroom teacher who maybe only has them one year"(Brenda, Interview 1, 1/26/06, Line 39-41). She is currently teaching at two different elementary schools, Tivoli Elementary School and Turtle Creek Elementary School. Tivoli Elementary School is the same school where Sarah holds her position as a third grade elementary teacher. Turtle Creek Elementary School is the same school where Betty holds her position as a kindergarten teacher.

During her participation in the professional development experience, Brenda had to develop a statement about her teaching philosophy. The following excerpt is taken directly from her weblog journal entry.

> I believe that all students can learn; however, they all learn at different rates and through different styles. It is important to connect all learning to real-life applications and

intergrate [sic] across curriculum to achieve maximum transfer of learning. Students need to be taught to question things, and should be acceptable of the fact that they might not know all the answers or even be able to discover the answer to a problem. True learning should be inquiry-based learning as much as possible, where students are discovering truths about the world around for themselves. Integrating subject matter dovetails nicely into this kind of learning. Students need to see the application of their learning into the real world. My role as a teacher is to help students discover truths about life and content material for themselves. I am to help facilitate their learning, guiding and coaching where appropriate and needed, instead of being a disseminator of knowledge. I need to equip my students with the tools necessary to become life-long learners, instead of imparting a specific body of knowledge to them. If they know how to solve problems, research information and apply these skills to their lives and the world around them, they will be able to learn and function in life. Students need an enviroment that is warm, caring, and allows them to make mistakes. I want my students to feel secure in my room and not be afraid of being a risk-taker. I am much more concerned with their social-emotional well-being and guiding them through life choices instead of focusing only on teaching a certain amount of content to be taught and learned.

To encourage questioning, examing [sic] items and conducting experiments is what it means to be a science teacher. Those same items can be included in any subject area. Therefore, a science teacher is the same as a regular teacher. A concerted point is made to include science content and should really be intergrated [sic]into all subject areas.

The role of the science teacher is to make students comfortable with the open-endedness of science; the unknowns, the search for answers without clear black and white answers. Helping students become more confident with the "how's", "why's", and the unexplained should be the focus of a science teacher along with the intergration [sic] into other subject areas (Brenda, Weblog Entry 3, 6/29/06).

Brenda believed students should be provided with the opportunity to apply their knowledge and participate in inquiry. She discussed how she viewed teachers as individuals who facilitate learning and provide students with a nurturing environment. Brenda also believed teachers should help students feel comfortable with science by integrating it into other subject areas and supporting students' understanding of science processes.

As with the other participants, Brenda was asked to describe her classroom environment and relationship with her students. The following excerpt is from her first interview.

I try to create a warm and caring environment because I am dealing with gifted students and it is in a resource setting. Basically they come out and they are with me for about an hour or two day. I also, sometimes, if I have been the same school for a number of years then I have the same students year after year which is a little but of a different situation than a classroom teacher, who maybe only has them one year or even a teacher that may have looped with them for two year. Most of them, like if I were to get a child in kindergarten I could have him for five years. But I try to create a warm and caring environment. I also try to push them in the fact that they learn differently. One of the things that I try to use each year especially for a new kid who comes into the program is to go into a thing like I don't want them to think their elitist. I do things like what we have this school for kids who have problems and special abilities. We talk about this that

we have an art teacher and we have a music teacher and we have PE. And then we have Speech teachers and resource teachers. That is very PR related that they need to understand and help convey to their classmates and teachers that they aren't different than any other student. They just learn differently therefore they require different types of teaching methods and/ or materials necessarily

We are leaving our gifted kids behind because we are focusing on the bare minimum. These kids already have the bare minimum but they need to move on. If they are not pushed and stretched then they are not going to grow. They are not getting their needs meet. I try to instill in them a sense that they need to take ownership of their learning but they need not to flaunt it. In regards to that then I also try to push their limits. A lot of these kids don't know how to deal with failure because they have always just known things. They don't know how they learned things. They just know it. Or it is said one time and it is picked up. Then, characteristically either in the 5th grade or 9th grade or sometimes the freshman year of college, some of these kids hit a wall because all of a sudden it is harder than they thought it was going to be. They never developed study skills because it has always just been there where they could just remember it or photographic and they don't know how to study. One of the things I try to do is that I try to push them enough that they are frustrated but they learn how to deal with failure. It is only when you make mistakes and fail is when you learn. That is when growing and learning takes place (Brenda, Interview 1, 3/28/06).

Brenda described her classroom as a caring environment where students are challenged. Her classroom provided students with support by reassuring them of their abilities and providing

them with resources and challenging activities. Her main goal was to help her students continue to engage in intellectual pursuits.

Patricia. Patricia, who is of European American descent, is an outgoing, elementary science teacher with seventeen years of experience. She is an advocate of strong elementary science programs and is very involved in working with other science educators on the state and county science curriculum. She has a bachelor's degree and master's degree in education and at the time of this study, she was working on her specialist degree in education. The first ten years of her teaching career were spent in second grade. Then, she took a position as a third grade teacher. She was a third grade teacher for three years before she took the position of science laboratory teacher. Since that time, she has been the school science coordinator and Kindergarten through fifth grade science laboratory teacher at Crawford Hill Elementary School. In this position, she teaches science to every student in her school. Her position also allows her to collaborate with all of the other kindergarten through fifth grade teachers in her school. "There is probably not a day that goes by that I am not talking to at least a handful of teachers concerning their classes" (Patricia, Interview 1, 4/14/06, Line 169-170).

For the professional development experience, Patricia developed a statement about her teaching philosophy. The following narrative was taken directly from a weblog journal entry she created for her participation in this study.

> I believe that science should be a daily part of every classroom. Science is life skills. The ability to observe your environment and take that knowledge to help you use your environment is priceless. No matter what we do (cooking, car care, cleaning, building, health care,) science is being used. I feel as a profession we are failing our students because we try to teach science in isolated units. Students fail to ever see the fact

that science is what is happening around them. I feel strongly that every subject can be taught through science. In any story, science is happening. Unfortunately, elementary teachers are being directed to teach reading and math. All other subjects are to be worked in "as you have time." We are failing our students if our goal is to create well rounded independent adults.

My role is to help these students develop into well rounded adults who can think for themselves. I teach science eight hours a day. I felt so strongly that our system was failing our students when it comes to science that I went to our principal and requested a fully staffed science lab where the children would be exposed to science at least once a week. Most students in the school were getting very little science instruction. When they did have a science lesson it was out of a book. We all learn by doing. I hated hearing students express how much they hated science. After years of teaching second language learners from low income families, I noted that the students never take notice of the world around them. They always want the answer handed to them. Because they had only had science instruction from a book, they had no idea that the things they do daily is science. My goal is to teach them to see that science is life. If they are to be the responsible adult, they need to know how things work. If they are to care for families, they need to understand their world around them

A "science" teacher is being a good teacher. You have to teach children how to look at a problem, collect the information needed to solve the problem, and use the knowledge to try to find an answer. Once students can learn to think using the scientific process, any problem can be addressed. My role as the "science teacher" is to teach students how to think for themselves. They also need to be taught how to observe what is

going on around them. I want students to really see the world and how to use it. Finally students must know how to process what they know to create their desired outcome. Once students can think like a scientist, they can achieve any goal (Patricia, Weblog Entry 3, 6/29/05)

Patricia viewed science as an integral part of classroom instruction. She believed science is used everyday and students should understand how science is always around them. Patricia believed science teachers should encourage students to make observations of their environment, problem solve, and analyze. She believed that by teaching students the processes of science, she can help them be successful in life.

In her first interview, Patricia was asked to describe her classroom environment and her relationship with her students. What follows is her response to those questions in her own words.

I guess I am a lab setting. The children come to me for basically 45 minutes blocks once a week. This year my 5th graders come to me for two blocks of time and I solely teach their science this year.

The younger grade, K through 2 is pretty much well is mostly hands on experiences. We go outside to learn about plants. We actually do and make everything we talk about. We may, do like, one class set of notes where the kids can see the vocabulary words or carry them back to their classroom to review throughout the week. The teachers are responsible for reinforcing the terms and concepts that I have introduced to through the actual experience. My 3rd through 5th graders are a mix of hands-on experiences and note taking and there are some written evaluations that they do also to hold them accountable for their information. They are still doing but yet there is much more note taking and a day per unit is dedicated to assessment.

I think [my relationship with my students is] very good. I am very strict as far as

my structure. I have a definite routine that the kids have learned from kindergarten up.

So they tend to come in and they know the routine. I have high expectations for their

behavior. They are very well aware of that. However, it is done in a very loving manner.

The kids often will come to me outside of class if they have a problem and ask for my

advice or help. I feel like even though I am very structured and strict, they realize that

the love is also there and that the trust is there. So, they can come and discuss problems

with me outside of class (Patricia, Interview 1, 3/06/06)

Patricia viewed her classroom environments as a lab setting. It was a place where students were

provided with hands-on and noting taking activities. She believed she created a caring

environment where students were held to high expectations.

Research Tools

In this study, VAT and Microsoft Word were used as data collection tools. The teachers

utilized VAT as a tool for analyzing their teaching practice. As a researcher, I utilized VAT as a

tool to collect the participants' written analyses of their science lessons. Video and video

segments developed in VAT were not gathered as data for this study. Only the written

components of participants' VAT analyses were collected. Weblogs and Microsoft Word

documents were used by teachers to answer journal questions posed by the professional

development facilitator. I collected all of the journal entries, the Weblog journal entries that were

converted into Word documents as well as the other Word document journal entries, which were

made during the summer workshop and follow-up support.

Data Collection

In this naturalistic qualitative design, I examined in-service elementary science teachers' reflective practice in the setting in which the reflections occur without attempting to manipulate the reflections in any way (Patton, 2002). Basically, I examined the teachers' reflective wrtings that were developed during their participation in the professional development experience. Data selected for this study were used to develop a deeper understanding of elementary science teachers' reflections on their science teaching practice.

Three main forms of data were collected for this study. The first form of data was audio recordings of each participant presenting her reflection in VAT to the other professional development participants. The second form of data was two types of text written by the teachers, journal entries and VAT analyses. The third form of data was interviews where each participant discussed her VAT analyses.

The data were collected in two phases: summer workshop and follow-up support (See Figure 5). During the summer workshop phase, journal entries, written analyses in VAT, and audio of presentations of VAT analyses were collected. The academic year phase consisted of journal entries, VAT analyses, refined VAT analyses after coaching, interviews, and audio of presentations of the participants discussing their VAT analyses.
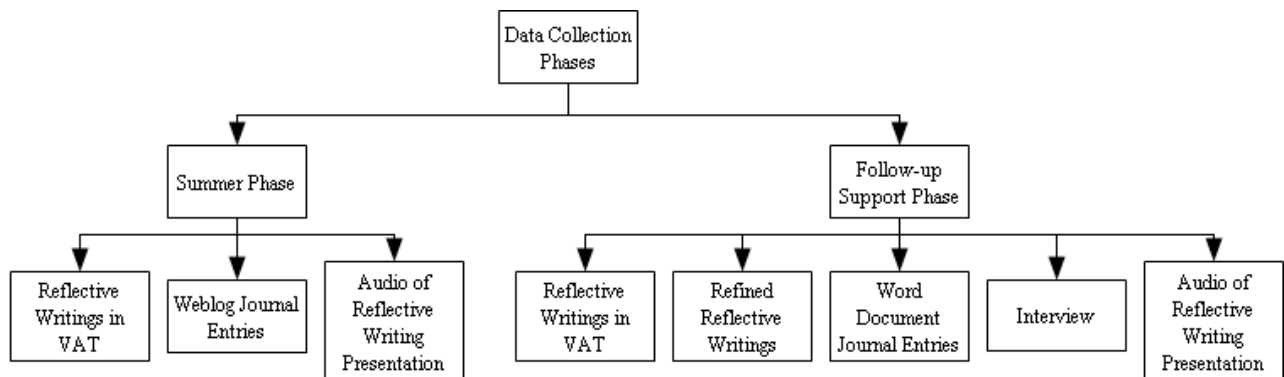

Figure 5. Data collection phases.

Audio data. In order for the participants to develop written analyses in VAT, the participants chose science lessons to be videotaped. During the summer workshop and the spring follow-up meeting, the participants were asked to present one of their VAT analyses, which were their written analysis developed in VAT, to the other participants in the professional development experience. The facilitators of the professional development experience videotaped the presentations. Audio from the videotaped presentations was collected for each participant. The audio from each participant's presentation was transcribed.

Written data. The first form of written data was the teachers' VAT analyses on their videotaped lessons. There were seven videotaped science lessons for each participant uploaded into VAT. Four videotapes were from the summer workshop and three were from the academic year portion of the professional development. Throughout their participation in the professional development experience, the teachers examined video of their science teaching practice and developed written analyses in VAT about their science lessons. Each participant developed at least four written analyses using VAT. In VAT, the participants developed clips from their videotaped lesson. To do this, they broke their video into specific segments and used the comment feature of VAT to write about each video segment. Through this feature, they were able to connect comments about their teaching to specific segments of video. In this study, the segments of video and their corresponding comments are called clips. Through the process of clipping the video, the teachers were able to develop reflections in VAT. For this study, VAT analyses or written analyses in VAT will be defined as the clips a participant developed on one videotaped science lesson. Word documents from each VAT analysis were created by copying and pasting (see Appendix C).

From the summer workshop portion of the professional development experience, all of the written analyses developed through VAT were collected. During the camp component of the summer workshop, four videos, which consisted of four different days of teaching during camp, were uploaded into VAT. The number of written analyses developed by the participants during the summer workshop varied from two to four VAT analyses. The number of VAT analyses varied due to the participants' interests and level of comfort with VAT. Various reasoning, such being a novice on VAT and wanting to focus on certain lessons, influenced the length and number of VAT analyses developed by the participants during the summer workshop. In the follow-up support component of the professional development experience, each participant reflected on three different science lessons using the reflection framework. There were three VAT analyses developed, one for each videotaped lesson. The participants refined each VAT analysis after receiving feedback on it from the professional development facilitators. The feedback provided to the participants was in the form of questions or comments, to encourage elaboration or clarification on certain issues, about the initial VAT analyses. The questions and comments used prompted the participants to (a) answer reflection framework questions they did not respond to in their initial VAT analysis, (b) clarify statements that were not clear to the professional development facilitators, and (c) elaborate on answers they provided to the reflection framework questions. There were a total of three refined VAT analyses, one for each video. In all, six VAT analyses, three initial VAT analyses and three refined VAT analyses for each video, were collected during the follow-up support

The second form of written data collected was the participants' journal entries. The journal entries were in the form of weblog or Word documents. Weblog journal entries were turned into Word document through cutting and pasting text from the original weblog entry. All

of the journal entries were developed in response to guiding questions posed by the professional

development facilitators. The questions prompted the participants to discuss their teaching

practice, their beliefs about teaching and learning or provide feedback on VAT (See Appendix

D).

Interviews. Each participant was interviewed during the study. Formal interviews were

conducted throughout the Fall 2005 and Spring 2006 semester. Since each participant

constructed three VAT reflections during the Fall and Spring semesters, there were a total of

three formal interviews for each participant. Three interviews were conducted with each

participants after they finished each reflection. Recordings of these interviews were collected as

data.

The interview plan used for the formal interviews was a conversational strategy within an

interview guide approach (Patton, 2002) incorporating open ended questions. A set interview

protocol (see Appendix E) was used with all participants. The use of a predetermined interview

guide, which consisted of specific open ended interview questions, allowed me to focus on

certain concepts while building in conversation throughout the interview (Patton, 2002).

Standardized open-ended questions (Patton, 2002) were developed and integrated into the

interview guide. The use of standardized open-ended questions focus the interview, reduce

variation between interviews, produce an interview instrument for evaluation, and make is easier

to find and compare information during data analysis (Patton, 2002). Each formal interview was

audio taped. All audio of the formal interviews was transcribed and the transcriptions were

analyzed.

Data Analysis

The framework guiding data analysis in this study was an open coding data analysis method. This framework allowed me to use both the participants own words as well as themes that emerged to categorize the data. Open coding (Cortazzi, 2001; Polkinghorne, 1995) was used in order to identify specific themes throughout the data. Open coding allowed for critical themes to emerge from the data (Patton, 2002; Hoepfly, 1997) through the development of patterns in the participants' data. As stated by Charmaz (2002), "the use of open coding, a grounded theory data analysis method, created succinctness between the collection and analysis of data" (p. 676). The examination of each VAT analysis created by the participants focused on the function of the reflection (Coffey & Atkinson, 1996), which was the focus and nature of the evidence and explanations developed in their reflection.

Once specific concepts were identified and defined through open coding (Charmaz, 2002; Strauss & Corbin, 1990), the themes were further organized into subcategories. Properties of each category were identified (Dey, 1999) and a description was developed for each category. Patterns, the alignment of properties "along various dimensions" (Strauss & Corbin, 1990, p. 101), were explored and used to make within and across case comparisons.

Data were analyzed throughout the study. Analyzed data were used to guide future data collection. For example, the data analysis of a teacher's reflection guided the development of interview questions for the next interview. Once all data were analyzed, a "reconstruction of the social phenomena" (Coffey & Atkinson, 1996) in which the teachers' participated was developed. A social account of the teachers' reflective practice was organized into cases. Each teacher was presented as an individual case (Patton, 2002) using only her data. Cross-case

analysis (Patton, 2002) was used to conduct comparisons across cases and to identify similarities

and differences in the teachers' reflections.

CHAPTER FOUR

SARAH, BRENDA, BETTY, AND PATRICIA

This chapter narrates the experiences of four elementary teachers in a one-year professional development experience. The individual cases of this study's four participants, Sarah, Brenda, Betty, and Patricia, are organized in the following manner:

1) Case Study Element 1: Summer Reflective Writings, which are comprised of the participants' VAT analyses developed during the summer,

2) Case Study Element 2: First Academic Year Reflective Writings, which are comprised of the participants' first and first revised VAT analysis developed during the academic year,

3) Case Study Element 3: Second Academic Year Reflective Writings, which are comprised of the participants' second and second revised VAT analysis developed during the academic year, and

4) Case Study Element 4: Third Academic Year Reflective Writings, which are comprised of the participants' third and third revised VAT analysis developed during the academic year (see Figure 1, located in Chapter 3).

Within each case study element, I discuss and provide examples of each participant's evidence-based explanations and the supporting evidence. I also present an account about each participant's use of VAT and the reflection framework. Through these discussions, I provide data for the following research questions

- What is the nature of the evidence that elementary science teachers use to develop their explanations?

- How do elementary science teachers develop explanations of practice using Video Analysis Tool?

- How do elementary science teachers develop explanations of practice using the reflection framework?

Sarah

Throughout her participation in this study, Sarah used evidence to support explanations on her science teaching practice. In this section, I will discuss four case elements about Sarah's explanations and nature of evidence to support her explanations. The evidence Sarah used while reflecting was categorized as being related to (a) observations of her classroom, (b) teaching experiences and knowledge, and (c) preparation. Respectively, the categories were named, observatory evidence, experiential evidence, or preparatory evidence (see Table 7). Sarah's observatory evidence is organized into three types, (a) personal observations of the classroom while in the classroom, (b) video observations of her classroom loaded into VAT, and (c) others' observations of her classroom. The experiential evidence she used is organized into two types, previous teaching experiences and knowledge of students. Her preparatory evidence is also divided into two types, personal planning and external planning. Each of these is explained in further detail below. Sarah used multiple combinations of these categories of evidence to support her explanations of her teaching practice in all of her reflections throughout the entire professional development experience.

Table 7

Sarah's Evidence

Category	Type of Evidence	Description of Evidence	Case Study Element
Observatory	Classroom Observations	Observation in classroom	1, 2, 3, and 4
	Video Observations	Video footage of classroom	1, 2, 3, and 4
	Other's Observation	Peer's observation of classroom	2
Experiential	Previous Experiences	Previous teaching with former students	1
		Previous teaching with current students	1, 2, 3, and 4
	Knowledge of Students	Student demographics and background	1 and 4
		Student scores/assessments	1
Preparatory	Personal Planning	Teaching strategies	1, 2, 3, and 4
		Activities	1, 2, and 4
		Assessments	2
		Supplies & Resources	3 and 4
	External Planning	Class schedule	1 and 3
		Teacher's schedule	1
		School Schedule	2

Case Study Element 1: Summer Reflective Writings

Evidence and Evidence-based Explanations

In this section, I examine the evidence and evidence-based explanations Sarah used in her summer VAT analyses. Sarah developed several evidence-based explanations in her summer VAT analyses, weblog entries relating to her summer reflective writings, and a presentation on her summer reflective writings. The evidence-based explanations she provided in her summer VAT analyses focused on (a) teaching strategies, (b) integrating science, (c) limitations, (d) comfort level and (e) the process of developing reflective writings in VAT. These themes are summarized in Table 8.

In her VAT analysis, Sarah focused on teaching strategies she used during her science lessons. Specifically, she was concerned with her monitoring of student understanding. In one of her weblog entries, she stated

> I want to see that I continue to use a variety of strategies and monitor progress. Why?
>
> Children learn in different ways and connections have to be made to make learning real.
>
> Using a variety of strategies insures that you have reached the maximum amount of
>
> children and monitoring the progress through student feedback –verbal or thru drawing
>
> lets you know if a connection has been made. (Sarah, Summer Weblog Entry 1, 6/28/05).

This weblog entry described a focus Sarah would take in her VAT analyses. In her VAT analysis about a lesson on tree cookies, Sarah stated

> We were modeling carefully how to read the handouts because we are going to expect
>
> them to repeat this process with their lives as an example . We are making
>
> sure they can transfer that knowledge into a product that demonstrates their
>
> understanding. Monitoring their behavior closely in a small group setting lets you see that

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what looks like off task behavior is not off task at all. Kayla was actually transfering

learning fromthe [sic] paper handout to her actual tree cookie. (Sarah, Summer VAT

Analysis 2, 6/29/05, Clip 732)

Table 8

Sarah's Evidence-based Explanations Themes

Location of Explanation	Evidence-based Explanation Themes
Case Study Element 1	Teaching strategies
	Integrating science
	Limitations of the lesson
	Comfort level
	Developing reflective writings in VAT
Case Study Element 2	Teaching strategies
	Science activities
	Focus of reflection
Case Study Element 3	Teaching strategies
	Student engagement
	Organizing the Curriculum
Case Study Element 4	Teaching strategies
	Student understanding
	Student behavior
	Developing reflective writings in VAT

Sarah discussed her team teaching experience, where she collaborated with another teacher to develop and implement science lessons during the camp portion of the summer workshop. She explained why her team used modeling and monitoring as teaching strategies. Observatory evidence was used to support her explanation. Specifically, she used video observations, video footage of her classroom in VAT, to support her discussion of when and why they used certain teaching strategies. The use of video observations was Sarah's primary form of evidence for supporting the explanations she created in VAT.

In her summer weblog entries, Sarah's responses corresponded to writing prompts presented on the weblog by the professional development facilitators. Based upon the weblog's prompts, the evidence-based explanations that she developed focused on how her teaching would differ during the academic year, how she would use VAT, and what she would like to focus on as she completed her reflective writings. Similar to the explanations Sarah developed in VAT, the explanations developed in the weblog were also supported by multiple forms of evidence. In one of her webblog entries about the development of her Summer VAT Analysis, Sarah stated

> There are so many levels in my class and so many that don't have background experiences. I wondered if I was over killing the background building. I wanted the flow of the lesson to follow the comprehension of the class without leaving them behind but not interrupt the lessons flow. Last year the comprehension levels of my class based on IRIs was from 7.5 down to K.8. The range was unbelievable. This complicates the process of teaching these kids. Some are ready to go, the others have no clue. Hands on, partner activities, peer tutoring etc. is wonderful but there has to be some direction and focus for the class. I wanted to make sure I wasn't losing anyone... the lower level kids or the advanced ones! Sometimes no matter how well I plan I will be in the middle of a

lesson and someone asks a question that lets me know that they have no connection to what I am talking about and I must back up and try to make connections for them. If they can't make connections, they will not learn or ever use what I am talking about ever again. This is the main area of concern for me because I can lose half my class and the flow of the lesson. (Sarah, Summer Weblog Entry 4, 6/29/05)

In this explanation, Sarah discussed why she wanted to focus on helping all students learn the science content. This explanation restates, and is connected to, a concern she noted in her VAT analysis. In her VAT analysis, she wrote "I am continuing to check for understanding to make sure the lesson flows for the children, we have different age levels in our group and I wanted to make sure that everyone was on board" (Sarah, Summer VAT Analysis 3, 6/29/05, Clip 763). To support her explanation on why she was concerned with monitoring students, Sarah used two types of experiential evidence, previous experiences and knowledge of students. Previous experiences, which were her previous teaching experiences with her former students, and knowledge of students, which is her knowledge of her former students' test scores, helped illustrate how important it was for her to focus on making connections with her students and making information accessible to all of her students. This evidence supported her need to work on her teaching strategies due to the type of students she has worked with in the past and may work with in the future. This evidence, along with her knowledge of her school's demographics, guided her to look more closely at making the classroom information more accessible to her students.

During the Summer Workshop, Sarah, like the other participants, was provided with training on and access to VAT. She was not provided with a framework or guidelines on how to develop her summer reflective writings. During the summer workshop's camp component, four

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of the lessons she facilitated were captured, digitized, and made available to her in VAT. Of the four videos, Sarah chose to analyze three of the four videotaped lessons that were captured during the camp component of the summer workshop. Within the VAT analyses of those three videotaped lessons, she only developed evidence-based explanations on two of the videotaped lessons.

In the first videotaped lesson that she worked on, Sarah created seven video clips. Each clip consisted of only one or two typed lines of text, which were used to narrate the lesson. In the second videotaped lesson she worked on, Sarah created five video clips. The typed comments on each clip ranged from one line to six lines of text. In these clips, Sarah narrated the lesson, discussed her reasoning for using certain teaching strategies, and developed one evidence-based explanation about her team teaching experience. In the third videotaped lesson, Sarah created nine video clips. The text in these clips ranged from two to six lines of text. The text was used to narrate the lesson, discuss her reasoning of using certain teaching strategies, and develop three evidence-based explanations. Sarah's use of VAT during the summer varied from strictly using it to narrate the lesson to narrating the lesson, proving reasoning for her teaching strategies, and developing evidence-based explanations of practice.

Case Study Element 2: First Academic Year Writing Reflection

This section examines the evidence and evidence-based explanations Sarah used in her first academic year VAT analysis. For this reflective writing, Sarah videotaped and reflected on a science lesson she facilitated in her classroom. The evidence-based explanations she developed focused on (a) teaching strategies, (b) science activities, and (c) the focus of her reflection (see Table 8). In her VAT analyses, Sarah's primary focus was on her teaching strategies she used

during her lesson on trees. The clips she created identified her concerns with managing her classroom and making the information accessible to her students. Sarah stated

> . . with this group, because they have you know, I have to kind of change my style a little bit and really tone down some of the things that I do. I love to have lots and lots of fun with them but these little kids get very keyed up. I have to be careful about how I present things and how crazy I act (Sarah, Interview 1, 3/28/06, Line 104-106).

In another clip, she describes how she adjusts the lesson based upon her students' behavior. Sarah stated

> I introduced great describing words (adj./lang arts) into science lesson teaching across the curriculum. [breaking down the lesson on tree identification into multiple parts] shows how I have to simplify instruction and activity to off set the immaturity of my group. Normally with a third grade class you would give them more responsibility and freedom and not have to deliver information in such a way.the pressentation [sic] of the material in such a chunked way really oversimplifies the material and slows down the pace of my teaching It really shows the challenge that I have ahead of me. (Sarah, Academic Year VAT Analysis 1, 10/25/05, Clip 3255)

This clip emphasized her need to scaffold her lesson to meet the learning needs of her students. In addition, this statement illustrated Sarah's belief that her students were not on the same level as traditional third grade students. "Usually, third graders would be able to spell and think of these adjectives on their own without being slowed down by having to sound out the spellings of the words" (Sarah, Academic Year VAT Analysis 1 after Feedback, 10/25/05, Clip 3255). In this VAT analysis, Sarah used observatory evidence, video observations, and experiential evidence,

which is evidence of previous teaching experience with current students, to support her

explanation about why she scaffolds her lessons.

In a post reflective writing interview, Sarah continued to focus on her teaching strategies,

especially her classroom management strategies. She wanted to take a "supportive but firm

approach" with her students.

> Some of them just have just really big problems to be so young. But yet I cannot say,
> 'Oh bless your heart." I feel like I am trying to empower them with other ways of trying
> to handle what is going on. I certainly cannot change anything that is happening to them.
> (Sarah, Interview 1, 3/28/06, Line 136-139).

While watching the video of her lesson in VAT, she was pleased with the classroom

management strategies she used with her students. Sarah stated

> You know one of the things that I really learned from being taped and having to watch
> myself over and over again, I really like the way I talk to my class. I really care about
> them. I do and it shows in my voice and the things that I say to how I get their attention
> when they are off task. I know when you were taping the last time they were just
> completely off in the wrong direction. They were all talking about something else. I just
> said well I know if I started taking names right now I would have so many names. You
> would be really very upset with yourself for doing this. That just calms them all down. I
> did not take anybody's name. I knew they were kind of keyed up because of the things
> that were going on as far as the boycott that day that the Hispanics were having on
> Friday. So, I knew they were keyed up and I just kind of brought them right back into
> focus without really punishing anybody. I did let them know that I didn't like what was
> going on. They need to settle back down. I really liked that. I thought that was really

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well that has become my style with that class. I don't get angry at some class you can see

seem a little upset and that will calm them down. Or these kids, they, it almost hurts their

feelings if you get upset with them. So, I try to just calm them down in a way so that

they know I am little bit disappointed and I think they can do a lot better. And they

usually come around for me. (Sarah, Interview 1, 3/28/06, Line 67-83).

Because of external issues surrounding her students' lives, such as a local boycott impacting her

students' families, Sarah knew she must be sensitive to her students' needs due to issues

surrounding them outside of the school. She used observatory, experiential, and preparatory

evidence to support her explanation. Specifically, she used video observations of her classroom,

previous teaching experiences with her current students, and the planning of her teaching

strategies to support her explanation of her classroom management strategies. Her video

observation allowed her to assess how well she used her previous experiences with her students

and her teaching strategies to effectively and sensitively manage her classroom.

Sarah's need to assess her teaching and make information accessible to all students is

evident in another evidence-based explanation she developed about her teaching practice. This

explanation focused on a past teaching experience that was observed by another educator. Sarah

stated

[An education student doing observations] was sitting in the back and I was doing

language lesson with the difference in plural and possessives. I mean I did the most

beautiful job in the world explaining plural and possessive. Plurals means more than one.

So, I wrote girls, you know, with an s. The possessive means belong to. So I did just

millions of examples of, and went all through the room with you know, Dante's coat,

Sancho's cat and did the 's on the board. Sancho's cat and Dante's coat and wrote all

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this. And then we just talked and talked and talked and I wrote on the board. When I told them to do the lesson right off the page, they missed every single one. [the education student] and I were like wow they did not get it. Well, what I had done is I talked to them about it, I did the writing on the board. And if I had said do problems 1, do numbers 1, 2 and 3 and raise your hand when you are done and let's check it. See, I could have prevented them missing them all. (Sarah, Interview 1, 3/28/06, Line 338 - 348)

To support her assessment of her own teaching, she used observatory evidence. She used a peer's observation of her lesson and her own personal observation of her classroom to develop an explanation of her teaching practice. This explanation illustrates her need to assess and adjust her teaching based on her students' understanding. In following statement, Sarah identified her realization that she should have used strategies that would allow her to work on small groups of problems with her students.

If they do not understand it, I don't think I am doing my job. So, my job is really to present the material in a way that they make a connection that they are going to remember. If I can do that with them and if I can present material to them in such a way that they can really understand it before I inundate them with it, then I think their success rate is going to be a lot higher. (Sarah, Interview 1, 3/28/06, Line 353-354).

For reflections developed during the academic year, Sarah was encouraged to use the reflection framework to guide her VAT analyses. When developing Academic Year VAT Analysis 1, she created seven clips. The typed text for each clip ranged from one to 24 lines of text. In these clips, Sarah narrated the lesson, stated "no comments" (Sarah, Academic Year VAT Analysis 1, 10/25/06, Clip 3245), and developed two evidence-based explanations. In the final two clips of her VAT analysis, she answered questions from the reflection framework.

After she completed her VAT analysis, feedback was given to her on her VAT analysis. The feedback I provided Sarah consisted of (a) questions meant to help her clarify certain statements and (b) questions that reiterated questions found on the reflection framework that she did not address in her original VAT analysis. One of the framework questions Sarah did not respond to was the reflection framework question about the standards that related to the events in her VAT analysis. Thus, I prompted her to discuss relevant standards. Specifically, the feedback asked her if there were any standards that related to an issue, which was using hands-on activities, she discussed in her clips. After receiving this feedback, Sarah answered the questions and prompts by adding text to the clips that related to the feedback. By using my feedback to revisit her clips, Sarah developed one additional evidence-based explanation. She did not create any additional clips in VAT.

Case Study Element 3: Second Academic Year Reflective Writing

In this section, I examined the evidence and evidence-based explanations Sarah used in her second academic year VAT analysis. For this VAT analysis, Sarah videotaped and reflected on a science lesson that she facilitated in her classroom. The evidence-based explanations she developed focused on (a) teaching strategies, (b) student behavior, and (c) organizing curriculum (see Table 8). In one of her VAT analysis comments, Sarah discussed how her actions and the actions of the students impacted the lesson.

> I move through the room and try to keep the kids engaged in learning and on task. I end up on the left side of my class because that is where the rowdy group is sitting and they did not bring their permission slips to be video taped. I don't seem to be spending much time with the group on my left, they are on task. I did not realize that I was spending so little time with them. There seems to be a lot of talking and very little writing. This could

stem form [sic] the fact that they do not understand what to do or they can't read the

highlighted areas, either way it seems now that they were not on task. If I had thought

that I would have moved the lesson along more quickly or had them report to their group

when they found and wrote down 3 things.&;[sic] usually I have them move to the floor

or to a different spot in the room and share the information that they have. This gives the

kids who are on task something to do without making them do extra and hurries up the

ones that are not on task and lets them know others are finishing their work ahead of

them. (Sarah, Academic Year VAT Analysis 2, 2/16/06, Clip 5341).

Sarah can see how her movement in the classroom and the regulations, such as permission slips,
can affect her lesson. She also wrote,

When my students are not engaged in a lesson I just try to reel them back in. They are

off task for a reason and I don't take it personally. When I am teaching I monitor

constantly as I go so I tune in to all their conversations. When I watched the video I felt

differently than when I was teaching it. They really sounded off task to me and I didn't

seem troubled by it when I was teaching. This may just be me reacting to a noise level

that may or may not seem appropriate at the time. (Sarah, Academic Year VAT Analysis

2 after Feedback, 2/16/06, Clip 5341).

The off task behavior of her students, coupled with her interpretation of why the students were

not able to understand the lesson, led her to review her teaching approach and also think about

ways she could have improved the lesson. To support this explanation of her practice, Sarah used

observatory evidence, video observation of her classroom, and preparatory evidence, planning

her teaching strategies. She realized that an issue related to her advanced planning, the lack of

collecting certain permission slips, affected her usual teaching practices and the classroom environment.

For her second academic year VAT analysis, Sarah was again encouraged to continue using the reflection framework to guide the development of her VAT analysis. When developing her second academic year VAT analysis, she created eight clips. The text for each clip ranged from three to thirteen lines. She used the text for each clip to narrate the lesson, describe and provide reasoning for her teaching strategies, develop three evidence-based explanations, and answer questions from the reflection framework. In an unexpected use of VAT, Sarah allowed her students to see the video of their classroom and also allowed the students to contribute to her VAT analysis. In her analysis, she noted how she used the VAT with her students and provided student quotes from their observation of the video in VAT.

As with her first VAT analysis, I provided Sarah with feedback on her analysis. Even though she used the framework to guide the development of her VAT analysis, Sarah did not include answers to questions relating to her feelings about the events, how the clipped events influence student learning, standards that related to the event, her beliefs about teaching, and actions she will take to further examine the event. The feedback prompted Sarah to revisit her VAT analysis, clarify some of her statements, and answer framework questions that were not discussed in her initial VAT analysis. She used the feedback to add text to her VAT clips. And, while no new clips were created as she responded to the feedback, the refinement of her clips resulted in the development of two new evidence-based explanations. Her new evidence-based explanations were developed in her response to feedback questions which asked her to discuss how she felt when her students were not engaged in the lesson and discuss any standards that relate to her teaching issue, which was engaging her students in the science content.

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Case Study Element 4: Third Academic Year Reflective Writing

In this section, I examined the evidence and evidence-based explanations Sarah used in her second academic year VAT analysis. For this reflection, Sarah videotaped and reflected on a science lesson about geology. The evidence-based explanations she developed focused on (a) teaching strategies, (b) student understanding, (c) student behavior, and (d) using VAT (see Table 8). In one of her VAT clips, Sarah discussed why she chose to use certain teaching strategies during her lesson on rock identification. She typed,

> We are reviewing the different types of rocks and reviewing the rocks we looked at. They do not remember two of the rocks that we talked about so I am going to wait and let them see the rocks and I know that someone will remember because they have it in their notes. I am also setting the stage for them to have a variety of rocks at their group. I want it to be obvious which rocks are which. I intentionally picked the rocks so that the layers show up or that they can see that the rocks have shells or other materials in them. They will remember obsidian and pumice as soon as they see them because everyone thought that obsidian was beautiful and pumice is very unusual looking and very light (Sarah, Academic Year VAT Analysis 3, 3/22/06, Clip 5774).

Sarah tried using wait time and visual clues to help students remember the rocks they talked about in the previous science lesson. As she stated, she purposively picked her samples to guide students to the correct answers. This strategy was based on one of her previously taught science lessons, an activity, and her classroom observation of the students during that lesson. In another clip about her teaching strategies, she stated

> We have been waitiing[sic] to crack the geode until our last taping. We have tried to predict what color minerals will be inside. I used the term clerk in my description of

buying the rock because it is one of our spelling words for this week. I model the process of thinking so they will be successful in determining which category it belongs into. The clues that I am giving do not seem to help so I go to the board and write some clues to help them determine the group. I am encouraging the use of the notes jthat[sic] we took yesterday (Sarah, Academic Year VAT Analysis 3, 3/22/06, Clip 5775).

In reference to this clip, Sarah discussed how she assessed her teaching during the lesson. In addition, she discussed how she altered her teaching based on her students' behaviors. Specifically, she tried to adjust her teaching to mirror activities that she did with her students the day before. To support this explanation, Sarah used observatory evidence, her classroom observations, and preparatory evidence, planning of the activity, to support her explanation. It was her on-the-spot assessment during the lesson and her planning of the activity in sequence with other lessons that allowed her to adjust her lesson in a way that help her scaffold students' development of knowledge about rocks.

During an interview on her third VAT analysis, Sarah discussed how she continued to reflect on the lesson using VAT. She reiterated her surprise when students were not able to complete the activity as easily as she had intended. Sarah stated,

As I was reflecting on it and watching the videotape, it just seems like they just were not referring back to their notes. We had made a notebook just out of stapling together pieces of notebook paper. We had a couple of white sheets of printing paper that we had them draw some things. I was mixing it up that way. I was thinking we had already done this the day before. We had one, the three different types of rocks. We had just written some very brief descriptions of the rocks and how they were formed. Then, we had used our textbook. There was some pictures of rocks and besides the name of the picture it had

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whether it is sedimentary, metaphoric or igneous. I had them take those names and just

put them in the right box. I had monitored all that. And then my activity that I thought

would be easy for them was that I was going to have them look at their notes and use just

the very brief description. Then, they would look at the rock that was obviously

sedimentary or obviously igneous. And be able to look at the rock and say there is a line

in it so it sedimentary or there are lot of little particles stuck together and it sedimentary.

I think when I was walking around and looking their notebooks, even though they had the

correct information, they were all kind of jumbled up. It may just have been hard for

them to read. I think next time what I am going to do is give them a paper that I have

made little headings on. I may have the definition in the box and then I might have the

names of the three or four rocks that they could see in their book on lines or just set it up

so it was really easy to retrieve the information. I think that may solve the problem.

(Sarah, Interview 3, 3/31/06, Line 46-65)

In this discussion of her lesson, Sarah used two forms of observatory evidence, classroom

observations and video observations, and preparatory evidence, planning of activities, to support

her explanation of why she thought the students would be able to successfully complete the

activity and why they were not able to successfully complete the activity. Her classroom

observation supported the video observation that she made in VAT. Even though she planned the

two lessons to support one another, the students were not able to make a clear connection

between the notes they took on one day and the activity they completed on the following day.

She noticed that her students did not use their notes from the previous science lesson. Sarah

believed that the formatting of her students' notes played a large role in their inability to connect

notes from one lesson to an activity during another lesson. She stated, "I am thinking that maybe

it is just the format. Maybe with them doing it in their own writing, maybe their notes were jumbled up and maybe they actually could not read what they had" (Sarah, Interview 3, 3/31/06, Line 106-108)

Sarah was encouraged to use the reflection framework, along with VAT, to analyze her lesson. When developing her VAT analysis, she created six clips. The text typed for each clip ranged from five to nine lines. She used her text to narrate the lesson, discuss the topic of her lesson, provide reasoning for teacher actions, provide reasoning for student actions, answer questions from the reflection framework, and develop two evidence-based explanations.

As previously, Sarah was provided with feedback on her VAT analysis. The feedback encouraged Sarah to revisit her VAT analysis, clarify some of her statements, and answer framework questions that were not discussed in her analysis. Even though she used the framework to guide the development of her VAT analysis, Sarah did not include answers to questions relating to her feelings about the events, her knowledge of this teaching issue, standards that related to the event, her beliefs about teaching, and actions she will take to further examine the event. She used the feedback to add text to clips that related to the feedback. By responding to the feedback questions, Sarah created two more evidence-based explanations of her practice. The explanations were developed in her response to feedback questions which asked her to discuss (a) how she knew her students learning the rock concepts presented in her last science lesson, (b) the expectations she had about her students' engagement in and success with the geology activity, and (c) discuss how she felt about her students' lack of success with the lesson. Although she added text to her existing clips to respond to feedback questions, she did not create any new clips.

Interpreting Sarah's Explanations

Through her participation in this study, Sarah used a variety of evidence types to support her evidence-based explanations. She also varied the focus of her reflections. Most of the evidence she used to support her evidence-based explanations related to classroom observations, video observations, previous teaching with current students, and her use of teaching strategies. The issues Sarah focused on were often very broad issues. She did not always narrow the focus of her VAT analyses on a specific aspect of her teaching. A peer's observation of her classroom, her previous teaching experiences with former students, students score/assessments, use of assessment, and class and teacher's schedules were forms of evidence that she used least during her explanations. However, all of the evidence allowed her to focus her efforts on the examination of her own teaching strategies. Specifically, she chose to focus on how she monitored and engaged students in the lesson. She even used VAT and one of her videos with her students. She allowed her students to see how she uses the system to evaluate her teaching and their behavior. The students even provided feedback on the video, which Sarah included in one of her VAT analyses.

Even though Sarah used VAT to analyze her teaching practice, she did not develop evidence-based explanations in each clip. She used the clips for many different purposes, such as narrating the lesson, providing reasoning for teaching and student actions, and recording student comments after they watched their lesson in VAT. While the reflection framework may have helped guide her VAT analyses, Sarah did not use all of the questions listed in the framework. As noted above, feedback was used to help Sarah add information about specific standards that related to her lesson and her feelings about the issue on which her VAT analyses focused.

Through her response to those feedback questions, she developed additional evidence-based explanations.

Brenda

During her participation in this study, Brenda developed multiple evidence-based explanations using different types of evidence. Like Sarah, the evidence used to support Brenda's explanations was categorized as observatory, experiential, and preparatory evidence (see Table 9). However, the description of the evidence she used differed from Sarah's. Brenda's observatory evidence is organized into video observations and classroom observations. The experiential evidence she used is broken into two types, previous experiences and knowledge of students. Her preparatory evidence is also organized into two types, personal planning and external planning. Throughout this study, Brenda used various combinations of these types of evidence to support evidence-based explanations that she created during her VAT analyses, weblog entries, and interviews. The following elements provide examples of her evidence-based explanations and supporting evidence, which was used to develop her explanations.

Case Study Element 1: Summer Reflective Writings

This section examines Brenda's evidence-based explanations and their supporting evidence developed during her summer reflective writings. Additionally, this section will examine how she used VAT to develop her evidence-based explanations. Brenda's summer reflections focused on (a) teaching strategies, (b) student understanding and (c) the focus of her reflection (see Table 10).

Table 9

Brenda's Evidence

Category	Type of Evidence	Description of Evidence	Case Study Element
Observatory	Classroom Observations	Observation in classroom	1, 2, 3, and 4
	Video Observations	Video footage of classroom	1, 2, 3, and 4
Experiential	Previous Experiences	Previous teaching with former students	1, 2, and 4
		Previous teaching with current students	2, 3, and 4
		Previous learning experiences	1 and 3
	Knowledge of Students	Student demographics and background	2
Preparatory	Personal Planning	Teaching strategies	1, 2, 3, and 4
		Activities	2 and 3
		Supplies and Resources	1, 2, 3, and 4
		Using research	3
	External Planning	Class enrollment	2

During the development of her first VAT analysis in the summer, Brenda discussed the
focus of her reflective writing. Her focus was providing students with clear instructions during
activities. In her presentation at the end of the summer workshop, she stated

Two of the things that I was really going to look at was modeling and visual clues. I

think I do a lot of verbal of telling the directions but I wanted to make sure I was focusing

on modeling and visual clues (Brenda, Summer Presentation, 7/01/05, Line 10-12).

Brenda discussed her reasoning for choosing this focus and how she used her previous teaching

experience to examine this aspect of her teaching practice.

Table 10

Brenda's Evidence-based Explanations Themes

Location of Explanation	Evidence-based Explanation Themes
Case Study Element 1	Teaching strategies
	Focus of reflection
	Student understanding
Case Study Element 2	Student understanding
	Assessing her teaching
	Teaching strategies
	Student participation
Case Study Element 3	Teaching strategies
	Student engagement
	Using certain activities and resources
	Student success
Case Study Element 4	Teaching strategies
	Beliefs about teaching
	Student behavior

Sometimes students have not completed assignments in the exact manner that I was anticipating. I am not sure if they did not clearly understand the directions and exactly what they were to accomplish, or if the misunderstanding resulted from their lack of direct attention to directions and instructions. Therefore, I wanted to start using visual aids and modeling, along with verbal cues, to ensure that students were perfectly clear on the expectations, both for the assignment (to be completed) and for the work which was to be turned in to the teacher. I teach gifted students and do not "spoon feed" them. I expect them, after initial directions and instructions are given, to be able to again read the directions to complete the activity. Somewhere, there has been a slight breakdown in the past. While I believe the majority of the problem is their tendency to believe that they already know everything and do not need to pay attention to directions, I want to ensure that I have done everything possible, modeling and using visual aids, for students to understand the expectations (Brenda, Weblog Entry 4, 6/30/05).

Brenda was using the summer experience to focus on teaching issues she has encountered in the past. In her first summer VAT analysis, she typed:

My point of impact focus is establishing clear expectations. In the past, I have sometimes felt after giving directions that students sometimes did not seem to have a clear idea of what was expected or what they were to accomplish. I was not sure if the problem was in following directions or if the directions were not clear. Therefore, I wanted to focus on making sure that the students clearly understood the expectations and directions. Modeling and visual clues are two areas I will look at to help determine if students are receiving clear expectations. This is the introduction to our week's study. Before going outside to talk about trees I wanted to see what the students already knew about trees.

Clear expectations are established here by asking the students to draw a picture of a tree. Pointing to the paper is a visual clue. This alerts them that they are to draw a picture on the paper. Pointing to my head is a visual clue for them to think or "imagine" what a tree looks like before actually drawing on the paper. Additional strategies I could have used: before handing out the paper, I could have said "imagine a tree" then have them list everything that came to their mind when the word "tree" was said. Drawing a picture then could have been an addition they made, if desired. After the drawings, we could have shown their pictures to help emphasize the differences in their drawings and perceptions of trees. (which was our pre-assessment) (Brenda, Summer VAT Analysis 1, 6/27/05, Clip 664).

In this VAT clip, she discussed how her previous teaching experiences influenced the focus of her summer reflective writing. Brenda also discussed how she used her experiences to adjust her teaching strategies for the activity that she was facilitating.

I use a lot of praise and encouraging of the students. I try to model and set clear expectations of the assignment, making sure students understand the directions. I call students by name frequently and offer choices for the students (Brenda, Weblog Entry 2, 6/28/05).

She used her previous experiences and knowledge of students not being able to understand her directions to influence her use of visuals while giving instructions. These previous experiences and the activity she was facilitating prompted her to think about additional teaching strategies she could incorporate into her teaching repertoire. Brenda used observatory evidence, which was video observations, and experiential evidence, which was previous teaching experiences with former students, to support this evidence-based explanation.

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In her summer presentation, Brenda discussed an activity that she and her teaching partner facilitated with her summer camp students. The goal of this activity was for the students to learn about the various tree products. In her description of the activity, she stated, "[the students] each had a picture on their back and they had to figure out the picture on their back was by asking questions with yes or no answers" (Brenda, Summer Presentation, 7/01/05, Line 80-82). When presenting her VAT analyses to the rest of the professional development participants, Brenda stated:

> One of the boys ended up with a baseball bat and he never figured out what he was. We had two that never figured out what they were. So, we just took the picture off and showed them. And he was a man. It was a picture of a man holding a bat. [The students stated] it was bat, an ugly man. I said no. You are a baseball bat. . . .And we did have a picture of figs. We did have a little bit of trouble. Some thought they were strawberries. . . . If we had more common pictures, that would also make it more relevant and easier. . . . In addition to the pictures, we could have brought in some real life examples to make the connections. (Brenda, Summer Presentation, 7/01/05, Line 102-113).

Through her classroom observations, Brenda noticed that the resources her group used during the activity did not support the students' understanding of tree products. The students' lack of knowledge about some of the objects hindered their ability to successfully complete the activity. Even though Brenda may have given clear instructions for the activity and modeled it for the students, she noticed that the students still had problems completing the activity. Through observatory evidence, which was classroom observations, and preparatory evidence, which was her choice of resources, Brenda realized that factors, other than instruction, influenced her

students' performance. Additionally, she discussed how different resources could have supported the activity better.

Brenda used VAT to analyze video of her summer camp lessons. She was provided with basic training and access to four VAT videos, which corresponded to four lessons she facilitated with her partners during the summer camp. The reflection framework was not a tool provided to her during this portion of the professional development experience. Of the four videos available in VAT, Brenda chose to analyze only two of the videos. In both VAT analyses, Brenda developed evidence-based explanations, which discussed her teaching strategies, the focus of her reflection, and her students' understanding.

For her first summer VAT analysis, Brenda created nine clips. Each clips consisted of one to 24 lines of text. She used the text to discuss the focus of her reflection, discuss teaching strategies, narrate the lesson, provide reasoning for her teaching strategies, and develop four evidence-based explanations. In her second summer VAT analysis, Brenda developed three clips. The text of the clips ranged from four to 17 lines and was used to narrate the lesson, develop a plan of action to solve issues of practice, and develop one evidence-based explanation. In both summer VAT analyses, she developed at least one evidence-based explanation.

Case Study Element 2: First Academic Year Reflective Writing

This section discusses the evidence-based explanations and evidence used by Brenda during her first academic year VAT reflective writing. This reflective writing centered on a lesson that she facilitated in her classroom during the academic school year. The evidence-based explanations she developed focused on (a) student understanding, (b) assessing her teaching, (c) teaching strategies, and (d) student participation (see Table 10). In her VAT analysis, Brenda focused on examining student understanding. In one clip, she typed

Luis summarizing information from his article; they both seemed to have some trouble

discussing the information. They easily found the information, but had trouble trying to

share.Even with the advanced reading skills of the boys, the article seemed to be written

at a higher level, making it a little difficult for them to understand. Javier seems to have a

little more time understanding informational texts, especially with all the subtleties our of

[sic] language, due to his Hispanic heritage. Having them take notes about the

information as they were reading might also have helped them communicate the

information better with each other. In addition, the activity is designed for four parts of

information, requiring the boys to each have two articles, instead of one, to read,

comprehend and discuss. I am always conscious of assistance students might need within

class lessons. Many times adaptions [sic] of the lesson are necessary with different types

of classes. (Brenda, Academic Year VAT Analysis 1 after Feedback, 10/13/05, Clip

3303).

In this clip, Brenda was able to examine how her students' understanding of the language may

have affected their participation in the activity. She even noted that they "missed something in

the article" (Brenda, Academic Year VAT Analysis 1, 10/13/05, Clip 3309) while watching them

on the video. She was able to identify a moment where they were either not able to understand or

they skipped certain information in the text. For this explanation, Brenda used (a) observatory

evidence, which was evident in her video observations, (b) experiential evidence, which was her

previous teaching experiences with these students, and (c) preparatory evidence, which was her

knowledge of the activity, to support her explanation. Through her video observations, she

realized that the design of the learning activity had influenced the students' success. The

combination of multiple article readings and their struggle with some of the English language did not allow the students to complete the activity as she originally expected.

In her interview following her first academic year VAT analysis, Brenda continued to discuss her concern of making sure her students were able to understand the lesson. However, instead of focusing on the understanding of specific lesson materials, she focused on students' abilities to express their understanding during class discussions. In a discussion of issues she would like to examine in the future, Brenda stated:

> It still concerns me some that, like I said, that because Javier tends to be shyer. And I don't know if he necessarily lets Luis do it or Luis is just so fast on the draw that he jumps in there and does it anyhow. I think that is what threw me to that in particular because I think, and I have had the two of them for my 2nd year of having them together. So, I think it is something that I have seen over the last year and half. Luis gets it and sometimes answers before Javier can, which you know I have to really watch to make sure Javier has the understanding. Like in any class, if one person is doing all the answering then you don't know if the others know it. Sometimes, I have to tell someone that I know you know but I don't know if he knows it. That would be something that I would, you know, I always try to aware of if he is doing his fair share as far as contribute to the discussion. Not letting someone else do all the work. . . . I guess the main thing that I was focusing on . . . a pattern. It just came real evident looking that Luis tends to have strong leadership skills. He just jumps right in there. Then, I know as a teacher that I have to be aware and make sure that he is not overshadowing Javier. To make sure that Javier does have the understanding and knowledge that he needs and that he is growing on his own. (Brenda, Interview 1, 1/26/06, Lines 332-352)

Through her previous teaching experiences with these students and her classroom observations, Brenda was able to recognize a pattern of behavior that affected Javier's participation in the classroom. Luis continued to be the first to answer questions and lead the activities. Brenda realized that it was important to further examine this issue to ensure that Javier is also continuing to grow as a student and participate more actively in the lessons.

For the academic year VAT analyses, Brenda was encouraged to use the reflection framework along with VAT. For Academic Year VAT Analysis 1, she developed 25 clips with text. The text she typed ranged from one to 36 lines. She used this text to narrate the lesson, suggest alternate teaching strategies, answer the reflection framework prompts, discuss student understanding, and discuss comfort level with being videotaped. She used one clip to answer questions from the reflection framework. During the development of her VAT analysis, she created one evidence-based explanation.

Feedback, in the form of questions asking her to clarify statements, was provided to her on this analysis. She used the feedback questions to add text to specific clips and expand upon what she had previously written. Even though she added text to the VAT analysis, she did not develop any new clips. In responding to the feedback, she created one additional evidence-based explanation. This explanation was developed in her response to a question on why she thought her students were having problems understanding the articles she used in her lesson.

Case Study Element 3: Second Academic Year Reflective Writing

In this section, I examine the evidence-based explanations and supporting evidence found in Brenda's second academic year VAT analysis. The evidence-based explanations she developed focused on (a) teaching strategies, (b) student engagement, (c) selecting certain activities and resources, and (d) student success (See Table 10). Her second academic year VAT

analysis focused on an outdoor activity, which required students to collect and identify leaves, which was a lesson she was introduced to in the summer workshop. Her in-classroom perceptions of the lesson differed from her perceptions of the lesson after viewing it in VAT. In one of her VAT analysis clips, Brenda stated:

Students have gathered leaves for our inquiry based leaf identification activity. We are discussing the leaves they have gathered and comparing and contrasting to our original list of characteristics which scientists might use for classifying and identifying leaves. There seems to be lots of student participation. They seem genuinely interested and excited about the activity. I was pleased that the students seem engaged in the activity. It was somewhat surprising because I felt during the lesson that there seemed to be a lot of dead time (Brenda, Academic Year VAT Analysis 2, 11/9/05, Clip 4441).

After watching the video of this lesson, Brenda was pleased at the students' engagement in and success with the lesson. She stated:

I had thought they might have some major problems, but they all seemed quite capable of utilizing the leaf identification books for proper identification. Again, by selecting an area where I knew which types of leaves were available made it easier for me to check their work and contribute to their success. . . The intellect level of these students probably contributed greatly to their ability to effectively use the leaf identification books. The descriptions within the books were well-written and probably also contributed to the easy identification. The descriptions and pictures in the books also contributed to the students' success. My fear, since I have to work hard at identifying leaves, was that they would have a leaf that I would not be able to identify. Again, the area contributed to this

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success, because I knew which leaves were in the area. (Brenda, Academic Year VAT

Analysis 2 after Feedback, 11/9/05, Clip 4457).

Brenda realized that her preparation for the lesson and previous learning experiences with leaf

identification helped her organize the lesson for student success. In her post VAT analysis

interview, she stated

I think it was successful because partially because I limited them into as far as they could

go to pick up leaves. Therefore it was not like they were on a complete scavenger hunt

and getting leaves from all over the world. Or even different parts of the county. They

were in a limited area (Brenda, Interview 2, 3/29/06, Line 125-128).

She used three categories of evidence, observatory, experiential, and preparatory evidence, to

support her explanation about students successfully completing the activity. Her classroom

observations illustrated that her planning of the activity, which was based on her previous

learning experiences and knowledge of available resources, as well as the context of the

activities, were two factors that contributed to a successful, effective lesson.

As with her first academic year VAT analysis, Brenda was encouraged to use the

reflection framework along with VAT to analyze her video. For this VAT analysis, she

developed 39 video clips with text. The text ranged from one to 49 lines. In her VAT analysis,

she discussed her concerns about the lesson, narrated the lesson, answered questions from the

reflection framework, described the activity she used, discussed why the activity was successful,

and listed thoughts she had about the lesson. This led to the development of three evidence-based

explanations. Brenda answered all of the reflection framework questions in one of the clips she

created.

After developing her VAT analysis, she was again provided with feedback. The feedback took the form of questions, which prompted and encouraged her to clarify or elaborate on comments found in her clips. Brenda responded to this feedback by adding text to the clips she created in the initial VAT analysis. By answering the feedback questions, Brenda developed two more evidence-based explanations. Those explanations where developed in her response to feedback questions, which asked her to (a) describe what she meant by saying that her students were learning on a higher level, (b) discuss how she knew that the context of and resources used in the lesson added to the students ability to transfer the information from one activity to another, and (c) discuss why she thought her students were able to use the leaf identification books successfully.

Case Study Element 4: Third Academic Year Reflective Writing

In this section, I focused on the explanations Brenda developed about her science lesson on speed. This lesson was originally supposed to be conducted outside. However, due to inclement weather conditions and her lack of classroom space, Brenda was forced to hold the lesson in the hall of the elementary school. The evidence-based explanations she developed centered on (a) teaching strategies, (b) beliefs about teaching, and (c) student behavior (see Table 10). From the video, Brenda realized how the lesson was much more teacher-directed than she originally thought. In one of her clips, she typed,

> Did I provide too much assistance? Should I have just let them conduct the experiment
> and then see if they were able make adjustments as necessary? If I was not being filmed,
> the entire class divided into groups of 4 would be conducting this experiment. This
> would prevent me from having as much direct assistance with this group as I did
> provide. It could have been a combination of being filmed and making sure I was

conducting enough of the lesson for the filming as to why I was more directly involved. Generally, the directions and set-up for the experiment would have been discussed and reviewed and then the groups would have proceeded on their own to conduct the experiment. I would have circulated between groups, but would not have been leading this group as closely as I did in this instance. That would have allowed for me to view their group interaction skills, how they handled problems, the dynamics of the group, and solutions they utilized in resolving issues or problems that arose. It is both surprising and frustrating to realize that I directly lead this experiment to the extent which I did. I beleive [sic] that a major contributing factor was that I wanted to make sure the filming showed me teaching a lesson. Did I not think that guiding and assisting the students is also a method of teaching? Was I afraid that without the direct involvement it would be hard to determine the teaching of the lesson? (Brenda, Academic Year VAT Analysis 3, 2/23/06, Clip 5854).

Through the video observation, she realized that, in addition to the presence of the camera, her planning and her teaching strategies resulted in the lesson being more teacher-centered and less student-centered than she desired. Brenda stated,

By leading them directly step-by-step through the experiment, I was not acting as a coach and guide. I should have reviewed the guidelines and goals for the experiment, helped them mark the initial measurements along the walking path, and then stood by and watched the students conduct the experiment (Brenda, Academic Year VAT Analysis 3, 2/23/06, Clip 5854).

The observatory evidence (i.e. video observations) she used in her explanation illustrated how she changed her normal instruction for this lesson. Additionally, her planning for the lesson also

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resulted in the activity being teacher centered. By planning to be the focus of the video, she altered her normal teaching approach and made her use more teacher-centered teaching strategies.

In her post VAT analysis interview, Brenda reiterated her concerns about the lesson. She stated

Providing too much assistance contradicts my philosophy because I would like to see me as the guide and the coach and the facilitator. Normally if, there were several factors that entered in. Number one was that we had new kids join the program that probably had their permission slips from another teacher but I did not take the time to hunt those up. Also, we were going to do the activity outside and it had rained the day before which made it inherent that we do the activity inside. Therefore, we focused on just one group of kids for the experiment that we knew had their permission slips. Then because of that and I wanted to make sure that there was teaching lesson to videoed, then part of why I lead them step by step through the procedure instead of having them review and said ok here it is and go for it. Then they are to answer questions. I think that is part of why I lead them step by step. I don't think it was extremely detrimental. I mean they got the lesson. They still were attentive and had fun and enjoyed it. It just would have been nice for me to sit back and watch them perform instead of like I said. The, when I really went back the second time and watched it I was like oh gosh I am telling them step by step. Do this. Write it down. Do this. Write it down. I would have liked to have seen me stand back and said ok. Start. I will observe. (Brenda, Interview 3, Line 130-145)

From this statement about her VAT clips, it is evident that Brenda was not entirely pleased with the direction of her lesson and her teaching strategies. Like the VAT clip, her video observations

and planning of the lesson, which was her use of certain teaching strategies, supported her explanation that the lesson was more teacher-centered than she would have liked.

In her third academic year VAT analysis, Brenda used the reflection framework to guide her analysis in VAT. When developing her third VAT analysis for the academic year, she created 60 clips. The text she used ranged from one to 96 lines and was used to discuss her concerns about the lesson, narrate the lesson, list realizations from watching the video, and develop a clip to answer the reflection framework questions. Her VAT analysis led to the development of five evidence-based explanations.

After receiving feedback on her VAT analysis, Brenda added text to the preexisting clips on her third video. She did not create any new clips. Questions asked of Brenda led her to clarify and expand upon statements made in her original analysis. The text she added was developed in response to questions about her initial VAT analysis. Although she may have added text to her VAT analysis, she did not make any new evidence-based explanations about her teaching practice.

Interpreting Brenda's Explanations

During this study, Brenda used a variety of evidence and foci for her evidence-based explanations. Most of the evidence she used was classroom observations, video observations, planning of her own teaching strategies, and knowledge of her resources. Knowledge of her students' background and demographics and research were forms of evidence she used least in her explanations. However, all of the forms of evidence allowed her to focus on her instruction and students' understanding, which are two issues she discussed in her reflections. Like Sarah, Brenda used the reflective tools, especially her VAT clips, for multiple purposes, which include developing a plan of action to solve issues of practice, narrating the lesson, discussing her

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comfort level with being videotaped, and discussing student understanding. To develop her VAT analyses with the refection framework, Brenda chose one of her VAT clips to answer all of the questions provided by the reflection framework. During her response to feedback used to clarify statements she made in her initial analysis, Brenda developed additional evidence-based explanations.

<center>Betty</center>

This section discusses the four case elements that comprise Betty's case. During her participation in this study, Betty developed multiple evidence-based explanations. Forms of observatory evidence, experiential evidence, and preparatory evidence were used to support her explanations. The types and description of evidence used by Betty is summarized in Table 11. For this study, Betty's observatory evidence was classified into three categories, video observations, classroom observations, and others' observations of her teaching. Like Sarah and Brenda, her experiential evidence is divided into previous experiences and knowledge of students. Her preparatory evidence is also organized like Sarah and Brenda's. It is classified as being related to personal planning or external planning. Multiple combinations of the evidence categories were employed to support her evidence-based explanations. Although the categories of evidence reiterated those of Sarah and Brenda, Betty's choice of evidence categories varied.

<center>Case *Study Element 1: Summer Reflective Writing*</center>

During the summer component of the professional development experience, Betty developed multiple evidence-based explanations in her VAT analyses, weblog entries, and summer presentation. The explanations she created focused on teaching strategies, student behavior, beliefs about teaching, student participation and the focus of her reflective writing (see Table 12). In her first summer VAT analysis, Betty described the students she worked with

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during the summer camp. More specifically, she focused her efforts on one student, who stood out because she was shyer that the other students. Betty typed:

> First day of classes and we have 3 students. One is going into middle school, one is going into fifth grade and one student, Kayla, is going into second grade. The age range is very broad. While watching Brenda & Sarah during their lesson it became evident that Kayla was very shy and not joining in the discussions with the teachers or with the other students. I decided prior to this lesson to try to engage Kayla more by asking her questions and allowing her time to answer (Betty, Summer VAT Analysis 1, 6/27/05, Clip 804).

In this clip, Betty expressed her concern about engaging Kayla in the lesson. She reiterated her concern in her second weblog entry.

> The youngest girl in our group, Kayla, has been reluctant to engage in the activities. She is going into 2nd grade and the rest of the students in our group are either middle school age or upper elementary. I think she is somewhat intimated by the older students even though they try to include her. . . . It takes Kayla a lot longer to respond during activities which make it necessary for her to give an answer. I don't know for sure if it is just shyness or a fear that she will give a wrong answer. I would like to learn some new ways to help her engage (Betty, Weblog Entry 2, 6/28/05).

This concern over Kayla's lack of engagement was of the central component of Betty's first summer VAT analysis. The use of observatory evidence, her observations of other team teachers and their interactions with Kayla, was used to support her explanation. She used this evidence to start planning teaching strategies that would encourage Kayla to participate more actively in the lesson.

Table 11

Betty's Evidence

Category	Type of Evidence	Description of Evidence	Case Study Element
Observatory	Classroom Observations	Observation in classroom	1, 2, 3, and 4
		Observation of someone else	2
	Video Observations	Video footage of classroom	1, 2, 3, and 4
	Other's Observation	Peer's observation of classroom	1
Experiential	Previous Experiences	Previous teaching with former students	1 and 2
		Previous teaching with current students	1, 2, and 3
	Knowledge of Students	Student demographics and background	1, 2, and 3
		Student testing/assessment	2
Preparatory	Personal Planning	Teaching strategies	1, 2, 3, and 4
		Classroom organization	1 and 2
		Lesson	1, 3, and 4
		Supplies and Resources	1 and 3
		Personal Goals	2 and 4
	External Planning	Class schedule	1
		Classroom design	2

Table 12

Betty's Evidence-based Explanations Themes

Location of Explanation	Evidence-based Explanation Themes
Case Study Element 1	Teaching strategies
	Student behavior
	Beliefs about teaching
	Student Participation
	Focus of Reflection
Case Study Element 2	Teaching strategies
	Classroom environment
	Students' behaviors
	Assessing students
	Teaching resources
Case Study Element 3	Teaching strategies
	Teaching resources
	Plans for solving issues of practice
	Assessing her teaching
	Assessing students
Case Study Element 4	Teaching strategies
	Beliefs about teaching
	Student behavior

Betty's interest in getting her students more involved in the lessons continued throughout the summer camp as she discussed her concern about Kayla's participation during her summer presentation to the other professional development participants. During her presentation, Betty stated

>it became evident that Kayla is very shy and not joining in any discussions. We started, prior to this lesson, that we would try to engage Kayla more by asking her questions and allowing her time to answer. . . It really dragged out that first day. . . .We were looking at our watches and Kayla had more patience than we did. At somewhat times you just began to know that you give it a limit and then you just have to go long. The other kids are beginning to lose, you know. And we will see that here. Moving Kayla with the other students we thought would be a good idea. So this is something we did in the middle of the first lesson. We moved her around. So this gives her an opportunity to feel included in discussions with the other students. . . Kind of helped bring her around where she could see them so she was like not having people look at the back of you. . . . Everyone else begins to move [manipulatives used for the lesson] around and she is kind of just sitting there. We are trying to stay back because you do run that danger of giving them answer and doing too much for them. (Betty, Summer Presentation, 7/01/05, Line 12-32)

Here, Betty discussed her first VAT analysis with the other participants in the summer workshop. She used observatory evidence and preparatory evidence, which was her plans to use certain teaching strategies, to support her explanation. During her presentation, she restated her focus of wanting to engage all of the students in her room. Not only was Kayla's shyness evident in Betty's observation of the other teachers' lesson, it was evident it Betty's lesson as well. Betty identified her struggle with her use of wait time and her need to engage Kayla in the lesson.

For her summer reflective writing, Betty was provided with training on and access to VAT. She was not introduced to the reflection framework at this time. Of the four videos available in VAT, she chose to view and develop VAT analyses for each video. In her first summer VAT analysis, Betty created four clips. The text in each clip ranged from four to 13 lines of text, which was used to state the focus of her reflection, discuss lesson concerns, narrate the lesson, develop one evidence-based explanation, and provide reasoning for teaching strategies. The second analysis she created in VAT consisted of five clips. The clips ranged from four to seven lines of text. She used her comments written in the clips to narrate the lesson, describe teaching strategies, and provide reasoning for teaching strategies. Betty's third VAT analysis, which consisted of three clips, ranged from four to six lines of text. She used her clips to discuss teaching strategies, pose concerns with the lesson, and narrate the lesson. In her fourth, and final, summer VAT analysis, Betty developed seven clips. The clips ranged from one to eight lines of text. She used these clips to narrate the lesson, list the type of activity they are using, describe student actions, and voice successes of both her lesson and her teaching. One factor that remained constant throughout the development of her four VAT analyses was Betty's need to narrate the events in the video.

Case Study Element 2: First Academic Year Reflective Writing

This reflective writing centers on Betty's first academic year VAT analysis. The evidence-based explanations she developed focused on her teaching strategies, classroom environment, students' behaviors, assessing students, and teaching resources (see Table 12). In her VAT analysis, she primarily focused on monitoring her students and keeping the students engaged in the lesson. In one of the clips she created in VAT, Betty noticed that one of her shyer

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students', Maria, was trying to participate in class discussions but was getting overlooked. Betty typed

> This is my issue that I need to examine more closely. I need to look around more - Maria finally has her hand up and I missed it! She is one of the students that I really need to pay more attention to. I feel like I have failed her. She speaks very little english [sic] and for her to raise her hand and then I basically ignore her is not a good thing. I think the reason it happened is that I am not scanning the room often enough to pick up on very small hands that are raised. I know I missed a wonderful opportunity to boost her confidence and to allow her to share what she had on her mind. Shame on me! If I don't pay better attention she will just give up and not try anymore.I understand why this happens - there is a great deal of movement and talking going on in Kindergarten. The students are also very needy of teacher input since they do not have a great deal of background knowledge concerning what school is all about. All students need feedback from their teacher in order to learn but I think Kindergarteners need the most. The 4th & 5th graders I use to teach were much for self-sufficient. I know that these Kindergarten students will be that way someday - but for now I must scan the room more often and move around much more in order to not miss those little hands that go up and down so quickly (Betty, Academic Year VAT Analysis 1, 10/25/05, Clip 3269).

Here, Betty illustrated her need to monitor her students and their participation more closely. Additionally, the clip identified how she values and expects to support her students' active engagement in lessons. In a following clip, Betty displayed her frustration with not monitoring her students as well as she thought she had.

Maria is holding up her paper - and still no response - how dense can I be! I am

violatiang [sic] my beliefs about teaching when I fail to recognize her effort. She is

beginning to be brave enough to show her desire for learning and I am not being attentive

enough.I believe that it is essential for a teach [sic] to be familiar with the topic being

taught but another thing I did not include in my initial belief statement was the belief that

a teacher needs to be attentive always.I talked about in my statement how I love teaching

science and how I wanted to create a safe environment in my classroom in which a

student would not be afraid to learn. I don't think Maria is afraid to learn but she will

probably quit trying since she will begin to think I don't care since I miss her attempts to

connect with me (Betty, Academic Year VAT Analysis 1, 10/25/05, Clip 3271).

Through her video observation of the lesson, she was able to identify when Maria tried to

participate but was not called on. This observation, coupled with Betty's previous teaching

experiences with her current students, made her realize that she may need to adjust her teaching

to ensure that all of her students are engaged in the lesson. To support her explanation of why

she needed to develop a better method of monitoring her classroom, Betty used observatory and

experiential evidence.

Betty was also concerned with assessing her students' understanding of science content.

Due to her students' lack of knowledge about the English language, she is concerned with

assessing them in multiple ways and providing them with a sense of success. During her first

interview, she stated

GCAP was the state, kind of, benchmark assessment for us given in the first ten days of

kindergarten. And then it is given in the month of January and then at the end of the

school year. You see progress in that. A lot of time if we feel we are not getting

somewhere with someone, I will pull out the GCAP. Like, it is the first year they have to write their name. And a lot of ours, who have not been to pre-K, don't even know how to hold a pencil. So, I usually get a little squiggle. Then January, I give them the sheet and they write their name and I can see they have come a long way. I often do journaling. I can go back and look at their journals they did in August and look at now. I like to do that with the kids. I pull them in, conference with them. Now, look what you did at the first of year and look what you are doing now. You are writing sentences, words, and drawing pictures. And the kids get a real kick out of it. They often say I did not draw that, with the ones in August. And I tell them that they did and I tell them it was at the first of school. It is good to let them see (Betty, Interview 1, 1/26/06, Line 377-389).

From this statement, it is evident that she provided her students with opportunities to show and evaluate their own growth throughout the year. Betty planned journal assignments and conferences with students to provide them with feedback on their work because as she stated in her interview, in "kindergarten you usually don't do paper and pencil tests. All of our pre- and post tests are pretty much oral and show us how to do things" (Betty, Interview 1, 1/26/06, Line 397-398). By observing her students, she is able to identify opportunities where she can conference with her students and allow them to evaluate their progress. The observatory evidence and preparatory evidence she used provided her with a chance to collect data from and showcase her students' growth.

During her academic year VAT analyses, Betty used the reflection framework along with VAT to analyze her video. For her first academic year VAT analysis, she created 21 clips in VAT. Comments written in each clip ranged from one to 16 lines of text and were used to discuss positives of the lesson, list concerns with her teaching, narrate the lesson, describe her

teaching strategies, describe the focus of her reflective writing, discuss her teaching beliefs, develop an evidence-based explanation, and respond to questions on the reflection framework.

After completing this VAT analysis, I provided Betty with feedback on her reflection. The feedback provided to Betty was in the form of questions, which encouraged her to clarify certain comments in her VAT analysis or address reflection framework questions that she did not answer. In her initial VAT analysis, Betty did not address the reflection framework questions about standards related to her teaching issue or further examine her teaching issues. Once she received this feedback, Betty added text to her original VAT analysis. She did not create any new clips. However, she did respond to all of the questions found in the feedback on her VAT analysis. In her response to feedback questions, which asked her to discuss (a) how she knows when her students acquire new skills and learn concepts and (b) how she helps make her students self-sufficient in school, Betty developed two additional evidence-based explanations.

Case Study Element 3: Second Academic Year Reflective Writing

In her second academic year VAT analysis, Betty's evidence-based explanations focused on her teaching strategies, teaching resources, plans for solving issues of practice, assessing her teaching, and assessing students (see Table 12). Her teaching strategies were the main focus of her VAT analysis.

In one of her VAT analysis clips, Betty discussed her need to group students. She stated "many of the students are self starters - but several were not. I should have paired up the students so that they would have had a buddy helper" (Betty, Academic Year VAT Analysis 2, 10/27/05, Clip 6053). This sentiment was repeated in another section of her VAT analysis when she typed "notice that all the kids went to the other tree very quickly - they wanted a change. It would have been better to have broken them into groups and used more trees so that they all

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could get closer" (Betty, Academic Year VAT Analysis 2, 10/27/05, Clip 6056). Her knowledge

of her students and the activities she used with her students prompted her to group and pair

students for future activities. In her response to feedback on this VAT analysis, Betty wrote

> I should pay more attention to the small, classroom management issues. If the small
>
> things are more organized it allows more time for teaching. Since this video was shot I
>
> have put my students into "Betty's Buddies" pairs & sometimes small groups.
>
> I am experimenting with more cooperative learning techniques. Many teachers are
>
> hesitant to have Kindergarteners work cooperatively because many of the students are
>
> still so self-centered at 5 & 6 years old. So far with me it has worked very well. I just
>
> have to remember to take it slow with the young ones (Betty, Academic Year VAT
>
> Analysis 2 after Feedback, 10/27/05, Clip 6056).

After viewing the video, Betty was prompted to make changes about how she would group her

students in future activities and lessons. As stated above in her refined VAT analysis, she started

using student groups and partners since watching the video of her lesson. The use of observatory

evidence, which was video observation of the lesson, influenced a change in her future teaching

practices.

Another teaching issue Betty addressed in her VAT analysis was the importance of being

well prepared and organized. "If you are not prepared, what is that tell the students? That you

don't care about them really, in a way" (Betty, Interview 2, 4/2/06, Line 187-188). In her post

VAT analysis interview, she identified and discussed her need to organize her lesson differently

and work on making information or instructions accessible to all students.

> I know from my first video, I know that I didn't have the paper on the desk on the
>
> clipboards. Just small things like that. I did it the second time and it did seem help

things go smoother. But there are some things that I had wished that I had done. The

planning process was, maybe, to put the kids to more groups or smaller groups and where

they could kind of help each other a little bit more. Of course at that age, everybody is

pretty needy as far as needing help (Betty, Interview 2, 4/2/06, Line 29-33).

One of her clips alluded to her need for better instruction and organization of the lesson. Betty

wrote "I should not have talked about using the different colors to use while a group was out of

the room. I need to wait until they are all in the room to give instructions" (Betty, Academic

Year VAT Analysis 2, 10/27/05, Clip 6050). In another clip, she stated

Time to redirect to begin the bark rubbing. It would have been easier to have the new

papers in a basket on the table and had the students get it themselves after they turned in

their clipboard. They were all eager to do the bark rubbings" (Betty, Academic Year

VAT Analysis 2, 10/27/05, Clip 6055).

Again, she used observatory evidence, in the form of video observations, to support her

explanations about why she needed to work on her lesson instruction and organization.

For this VAT analysis, Betty used both VAT and the reflection framework to analyze her

video. In her development of her second academic year VAT analysis, Betty developed 19 clips

with one to eight lines of text for each clip. The clips in her VAT analysis were used to discuss

her teaching strategies, narrate her lesson, provide reasoning for her teaching strategies, discuss

teaching resources, list concerns with the lesson, and assess her teaching. Her VAT analysis led

to the development of three evidence-based explanations.

Although she used the reflection framework to guide her VAT analysis, she did not to

several of the questions listed on the framework. Specifically, she did not respond to questions

about how the issue she was examining in her VAT analysis influences students learning, how

she felt about her focus, her previous knowledge of the issues, her beliefs about teaching, standards relating to the focus of her reflective writing, and how she could further examine her issue. Feedback that was provided to Betty on this VAT analysis prompted her to discuss these factors and clarify comments made in her initial VAT analysis. In her refined VAT analysis, she incorporated responded to all the feedback questions in which she was provided. She did not create any new clips in response to the feedback questions. Instead, Betty added new text to her preexisting clips within VAT. While responding to the feedback, she developed one additional evidence-based explanation. This explanation was develop in her response to a question which asked her to discuss what she could do to further enhance her lesson and examine the issue of her VAT analysis further.

Case Study Element 4: Third Academic Reflective Writing

Betty's third academic reflective writing discussed an outdoor lesson on camouflage. The explanations she developed for this reflective writin focused on her teaching strategies, her beliefs about teaching, and her students' behavior (see Table 12). Most of her third VAT analysis focused on her teaching strategies. Specifically, Betty identified areas where she could have adjusted her teaching at the end of the camouflage lesson. She typed

> I should have known to have Jacob repeat the directions since he usually does what HE
> wants to do.Being disorganized in the wind did not seem to bother the kids as much as it
> did me. Having one group at a time worked well. I should have modeled in the
> classroom how to circle the worms and write the number. Two of the groups figured out
> what I wanted, but one group did not (Betty, Academic Year VAT Analysis 3, 3/1/06,
> Clip 5876).

This clip illustrated the problems her students had with organizing the data they collected from their activity. Many of the groups did not understand her directions. Betty had to restate her directions multiple times. She stated "How many times did I have to say "circle" the worms and write the number next to it? I definitely should have modelled [sic] this on the white board in the classroom before we came outside" (Betty, Academic Year VAT Analysis 3, 3/1/06, Clip 5871). Even though she originally thought she planned the lesson well, she realized she should have organized her instruction better. Betty also realized that this lesson was not indicative of her normal lessons.

> It contradicted [my beliefs] because I strive to always do my best and have my students complete a lesson with an understanding of the content. I also did not hold to my usual pattern of teaching a complete unit. This camouflage lesson was really not integrated like I usually do. It did have some connection to my Bird Unit for Bird Count, but I should have built more background knowledge prior to the lesson. This is what happens when I just have a "free standing" lesson that is not a part of what we are doing (Betty, Academic Year VAT Analysis 3 after Feedback, 3/1/06, Clip 5871).

Her video observations, which are observatory evidence, and her previous pattern of planning lessons allowed her to identify areas and time in the lesson that could have been improved.

For this VAT analysis, Betty used the reflection framework along with VAT. She created 16 video clips with text. The text she used ranged from one to nine lines. She used her comments in her clips to narrate the lesson, identify issues of practice, discuss a plan for solving issues of practice, identify positive aspects of her lesson, discuss how her normal instruction differs, and answer reflection framework questions. Her third academic year VAT analysis generated six evidence-based explanations.

Like her other academic year VAT analyses, Betty received feedback on this analysis. The feedback was in the form of questions that were intended to have her clarify statements or respond to reflection framework questions that were not addressed in her initial VAT analysis. For this VAT analysis, Betty did not address reflection framework questions that related to her feelings about her focus, how this influences her students' learning, standards that relate to this issue, her beliefs, and how she will further examine this issue. Her feedback prompted her to address these issues. Betty replied to all of her feedback questions by adding to her preexisting clips. She did not create any new clips while revisiting this VAT analysis. However, she did create three additional evidence-based explanations in her VAT analysis. These explanations were developed in her response to feedback questions which asked her to discuss (a) how she felt when her students were not able to follow directions, (b) how that impacted her students' learning, (c) describe how the issue focused on in her reflective writing supported or contracted her teaching philosophy, and (d) discuss a plan of action for further examining her issue.

Interpreting Betty's Explanations

Throughout this study, Betty used a variety of evidence types and foci when developing evidence-based explanations. The evidence she used was categorized as being observatory evidence, experiential evidence, and preparatory evidence (See Table 13). Each of these forms of evidence allowed her to assess her teaching practice. Due to the population of students she worked with in the past and currently works with, Betty often focused on students' understanding, such as directions for an activity or a class discussion. It was important to her to have her students develop an understanding of the language and classroom procedures.

Betty used VAT and the reflection framework to analyze her video. However, she did not always respond to all of the questions listed on the reflection framework. For instance, in her first

academic year VAT analysis, Betty did not respond to questions about standards that relate to this issue and plans for further examining the issue. This trend continued with her other academic year VAT analyses. However, once feedback was given to Betty, she responded to and expanded upon all of the reflection framework questions. By responding to feedback questions, such as discussing how she will further examine the issue discussed in her reflective writing, she was able to develop additional evidence-based explanations in her VAT analyses.

Patricia

In this section, I discuss Patricia's case study elements. During this study, Patricia used various types of evidence to support explanations about her practice. Like the other participants in this study, she used observatory evidence, experiential evidence, and preparatory evidence (see Table 13) to support her explanations. Her categories of evidence were organized into the same types as Brenda's. Her observatory evidence was classified into video observations and classroom observations. Patricia's experiential evidence was broken into two types, previous experiences and knowledge of students. The preparatory evidence she used was also organized into two types, personal planning and external planning. For each case study element, I provide examples of her evidence-based explanations and describe the specific forms of evidence she used to support them.

Case Study Element 1: Summer Reflective Writings

In her summer reflective writings, Patricia developed multiple evidence-based explanations in her VAT analyses and weblog entries. The explanations she created focused on her teaching strategies (Table 14), such as providing clear instructions and making the lesson less teacher directed. One issue that arose during her summer camp VAT analyses was how her instruction differed from the other teachers in her group. In one of her VAT analyses, she typed

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We must have a ballance [sic] between talking too much and not enough. I feel like the students did not know where the lesson was going. I feel they really have no idea of why they are making paper from paper. The idea of reusing our resources was lost.We need to state our purpose before giving instructions to follow (Summer VAT Analysis 2, Clip 737).

It is clear that we were all on different wave lengths. It is very hard for students to follow instructions when each group is hearing different instructions. I am reminded to think about how the kids feel when they think they understood what you ask but when they go to do it they find that they missed the point. I thought I knew where the lesson was going from our planning session but I had interpreted the goal very differently than others (Patricia, Summer VAT Analysis 2, 6/28/05, Clip 738).

For the two clips above, Patricia used video observation to examine her lesson. From her video observations, it was evident that Patricia thought the students in her room did not understand the purpose of the assignment or the assignment instructions. Patricia concluded that she and the other teachers negatively influenced their students' understanding of the activity. This influence was caused by (a) not providing the students with the purpose of the activity prior to beginning the activity and (b) by providing them with different instructions for the same activity. Her video observations supported her explanation about why her students' did not understand the materials.

Patricia's awareness of the negative impact her teaching team's verbal instructions had on their students was repeated in her second weblog entry. She listed "less verbal instuctions [sic] and more opportunity for students to explore" (Patricia, Weblog Entry 2, 6/28/05) as the focus of her reflections. On the weblog, she wrote

Table 13

Patricia's Evidence

Category	Type of Evidence	Description of Evidence	Case Study Element
Observatory	Classroom Observations	Observation in classroom	1, 2, and 4
	Video Observations	Video footage of classroom	1, 2, 3, and 4
Experiential	Previous Experiences	Previous teaching with former students	3
		Previous teaching with current students	3 and 4
		Previous learning experiences	4
	Knowledge of Students	Student demographics and background	2, 3, and 4
		Student testing/assessment	3 and 4
Preparatory	Personal Planning	Teaching strategies	1, 2, 3, and 4
		Organization of units	2
		Activities	2 and 4
		Research articles	4
	External Planning	Class schedule	2
		School schedule	2
		Curriculum	3 and 4
		School Programs	3 and 4

Table 14

Patricia's Evidence-based Explanations Themes

Location of Explanation	Evidence-based Explanation Themes
Case Study Element 1	Teaching strategies
Case Study Element 2	Teaching strategies
	School and class schedule
	Students' behaviors
	Assessing students
	Teaching resources
	Adjusting science curriculum
Case Study Element 3	Science Curriculum
	Teaching strategies
Case Study Element 4	Teaching strategies
	Student understanding
	Assessing students

I am seeing the student's point of view. Too many verbal cues get boring. I tend to talk

too much becauses [sic] I worry about the students getting the information. I need to give

them time to explore and then pull the concepts from them. . .I would talk less in the

beginnig [sic] and try to have students verberlize [sic] their ideas more. . .I feel I lost the

students' attention in the beginning of the lesson. I had to pull them back everytime [sic]

I talked too long (Patricia, Weblog Entry 2, 6/28/05).

Patricia expressed how the video has allowed her to view her instruction from a student's point of view. From this viewpoint, she realized that she provided her students in the summer camp with too many verbal clues. Patricia planned on providing them with a lot of information because she was worried about the amount of information that was needed to successfully complete the activity. However, by talking more, she found that she lost her students' attention. Through video evidence, observatory evidence, and preparatory evidence, which was her plan of using certain teaching strategies, Patricia was able to use video evidence of her practice to support her explanation of why her students were having a difficult time with her instruction.

Like Sarah, Brenda, and Betty, Patricia did not use the reflection framework to guide her summer VAT analyses. She was provided with basic access and instruction on VAT. As with the other participants, she had access to four videos of her teaching during the summer camp. As she developed her VAT analyses throughout the week, she chose to make use only three of the four videos. In her first video analysis, Patricia developed four clips in VAT. The size of each clip ranged from one to three lines of text. In her VAT entries, Patricia used the comments in her clips to critique her teaching and narrate the lesson. None of the clips provided an evidence-based explanation. In her second summer VAT analysis, she developed four clips as well. The text in each clip varied between two to eight lines and was used to narrate the lesson, critique her teaching practice, provide reasoning for her teaching strategies, and discuss an issue in her lesson. Her second summer VAT analysis provided one evidence-based explanation. Patricia's third summer VAT analysis was comprised of two clips. Each clip contained three lines of text and was used to develop an evidence-based explanation. Text in both VAT clips was identical and was used to discuss how her teaching strategies differ from the other teacher on her team. In all three of her VAT reflections, Patricia focused on her teaching strategies.

Case Study Element 2: First Academic Year Reflective Writing

In this section, I discussed the first reflection developed by Patricia during the academic school year. The evidence-based explanations developed in this element focused on her teaching strategies, the school and class schedule, students' behaviors, assessing students, her teaching resources, and adjusting the science curriculum. To support these explanations, she used a variety of observatory, experiential, and preparatory evidence. Due to her position as a full-time science specialist in the elementary school, Patricia was constantly ushering students in and out of her classroom. She did not have the freedom to extend her lessons as easily as other teachers due to her full teaching schedule. In her VAT analysis, she wrote

My time limitations are very frustrating. I have to end lessons at a given time. I am

dependent on other teachers to follow up with lessons because students do not see me but

once a week. . .After timing myself teach (opening lesson, independent work time, and

the closing), I spent equal time on the first two and only 3 minutes on the closing due to

running out of time. . . I am very frustrated that I run out of time. I feel I must give the

students the background and vocabulary needed for the lesson because my student

population comes to me without prior knowledge and with limited English. I like how

my students have time to work on their own. I feel good about the amount of time I let

them work in this lesson. Most children stayed directed and busy with their assignment.

I seem to move between the groups well. (I seem to always be moving.) I did not like

the short closing. I feel that the students need time to voice what they learned. Some

days this timing works out well when other days I can teach the exact lesson and run out

of time (Patricia, Academic Year VAT Analysis 1, 10/13/05, Clip 3684).

From this clip, it is evident that her class schedule and her time restrictions impact her instruction on a daily basis. Her video observations allowed her to time sections of her lesson and examine how they correspond with her total class time. This form of observatory evidence, coupled with knowledge of her daily class schedule, provided support for her explanation addressing her inability to effectively close her lessons. Patricia viewed her verbal instructions and discussions as playing a major role in how she manages her time. She wrote "I feel I run out of time because I talk too much. I tend to get caught up in the "teachable moments" and forget that I am on a rigid time table" (Patricia, Academic Year VAT Analysis 1, 10/13/05, Clip 3684). This teaching issue is identical to a one of her summer foci, which was her need to give a lot of verbal instructions.

Another issue surrounding her class schedule is the amount of students she works with on a daily and weekly basis. Because of the large number of students, she feels like she is not able to use written assignments as much as she would like. Patricia stated

> If I take lab time for journaling, I am taking away from the time students get to use the
> equipment. Also, if they write it, I feel like I should read it. I am presently having a very
> hard time grading work for 300 students, 3rd-5th (Patricia, Academic Year VAT Analysis
> 1 after Feedback, 10/13/05, Clip 3684).

Her demanding course load and the large amount of students she teachers influenced how she assessed her students. She used preparatory evidence, which is her knowledge about her school schedule, to plan her assessments.

Patricia used the reflection framework to guide her development of her first academic year VAT analysis. For her analysis, she developed nine clips, which ranged from one to 122 lines of text. She used her clips to narrate the lesson, discuss teaching strategies, describe issues

of her teaching practice, and answer questions from the reflection framework. In her clips, she developed three evidence-based explanations. Although she used the reflection framework to guide her reflection, she needed prompting to expand on her response to how she would be able to further examine the issue or practice identified in her reflective writing. This prompting was presented in the feedback she received on her reflection. Additionally, the feedback also asked her to clarify comments she made during her initial reflective writing. Patricia responded to all of her feedback questions by adding additional text in preexisting clips in VAT. She did not create any new clips. However, she did develop an additional evidence-based explanation. This explanation was developed in her response to two feedback questions which asked her to discuss (a) strategies she could have used to help her manage her class time and give students an opportunity to voice their understanding of the science content and (b) how her students voice their understanding of science content.

Case Study Element 3: Second Academic Year Reflective

In her second academic year reflective writing, Patricia focused on a lesson about the states of matter. Her evidence-based explanation focused on her teaching strategies and the school curriculum. Comments made in her VAT analysis signified that she was pleased with her teaching practice. Patricia stated "I feel this was a strong lesson. My time usage worked out well. One concept was covered well and students had multiple chances to experience the concept. Students also had the opertunity [sic] to review prior ideas and build on them" (Patricia, Academic Year VAT Analysis 2, 2/16/06, Clip 6197). Patricia believed this lesson and her teaching style afforded not only the teaching of science concepts, but also the use science as a vehicle for reviewing and teaching language skills. She typed

I have advocated teaching reading through content sreas [sic] for years. THis clip shows

how you can teach language skills through science. (Patricia, Academic Year VAT

Analysis 2, 2/16/06, Clip 6193)

I use vocabulary like prediction to help students learn the correct term. I also force

students to use the correct words when they talk to me. Second language learners often

misuse basic vocabulary and it is very important to model correct usage. We are not

burning the butter, we are melting it. (Patricia, Academic Year VAT Analysis 2, 2/16/06,

Clip 6194).

Through these clips, Patricia noted how she incorporated and encouraged the use of correct

scientific terminology. It was important for her to model correct use and understanding of basic

vocabulary among students. Her use of observatory evidence supported her explanation on her

modeling and emphasis on scientific terminology.

Patricia also expressed her pleasure with students' success in the Crawford Hill's science

program. She believes her position as the school's science specialist allowed her to have a

"vision of where they are going . . . I have a much broader view of their learning (Patricia,

Interview 2, 4/14/06, Line 47-50). Patricia used her knowledge of the curriculum and students'

understanding to fill in gaps in the curriculum and slowly scaffold students to learn state science

content standards they will address in the future. When talking about her program in her second

academic year VAT analysis, she stated

I think it is priceless. It gives the students opportunities to use the content year after year.

It also allows students to develop deeper understandings. I can clarify

misunderstandings. Also, students have 2nd and 3rd chances to grasp content they

missed due to immaturity, stress. . . . My fifth graders this year who have been with me

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in science since kindergarten score much higher than past groups and than students who

have moved into our school (Patricia, Academic Year VAT Analysis 2 after Feedback,

2/16/06, Clip 6197).

Her understanding of the curriculum allowed her to scaffold students' knowledge about science

content. Patricia believed her understanding of the state curriculum allowed her to better plan her

lessons and units to review prior knowledge and assess students' understanding on a yearly basis.

Patricia continued to use VAT and the reflection framework to analyze video of her

science teaching practice. For her VAT analysis, she created 25 clips with text ranging from one

and 25 lines. In VAT she used her text to narrate the lesson, discuss reasoning for teaching

strategies, describe issues with the schools' science program, and respond to the reflection

framework. She only developed one evidence-based explanation. Patricia failed to address all of

the questions found in the reflection framework. She did not respond to questions related to her

feelings about her focus, her knowledge about her focus, how the focus influenced students'

learning, standards that related to her focus, her beliefs, and how she could further examine the

issue.

Feedback was provided to Patricia after she completed her initial second academic year

VAT analysis. It prompted her to revise her VAT analysis and clarify her focus. Additionally,

she responded to reflection framework questions that were not included in her initial VAT

analysis. Patricia addressed each questions provided in the framework by adding text to her

original clips. She did not develop any new clips in her VAT analysis. However, she did create

one new evidence-based explanation about her teaching practice. This explanation was develop

in response to questions, which asked her to discuss how her scaffolding of science content

impacts her students' learning and how this issue contradicts or supports her beliefs about science teaching and learning.

Case Study Element 4: Third Academic Year Reflective Writing

In her final VAT analysis, Patricia focused on an outdoor science lesson on soil. Her evidence-based explanations focused on teaching strategies, student understanding, and assessing students. One teaching strategy that she focused on during her VAT analysis was providing students with multiple learning opportunities. Within her clips, she discussed how her students were provided with real world examples. Patricia typed

> By pointing out the trash on our own school property, hopefully the studnets [sic] will stop and think about what they are doing to the Earth and to our community. I feel it is important to give the students ownership. We are limited in how we can teach students to have a sense of community. I feel this is one way to develope [sic] this trait.Overall I felt like this lesson was a good review of prior knowlege [sic] and an overall introduction to our soil and plant unit. Allowing students to experience the environment allows me to relate to this experience many times in the lessons which occure [sic] within the classroom. I feel it is very important to spend one entire class introducing this unit. The students get excited about the content and their experience makes it easier to teach the following lessons. THere [sic] is no replacement for hands-on learning. (Patricia, Academic Year VAT Analysis 3, 2/16/06, Clip 6209)

> Another chance to point out decaying matter. In the classroom when I use the term rotten, students do not know what it means. This class will remember the experience if not the term. The next time I use the term , I can say remember when we saw the tree

rotting in the forrest [sic]. They will remember. (Patricia, Academic Year VAT Analysis 3 , 2/16/06 Clip 6220).

The two clips above illustrated how Patricia used her schoolyard to provide students with tangible, concrete examples of science concepts. She used her knowledge of her school surrounds, such as the environmental issues that are observable on the school property, their science curriculum, and student questions to guide her lesson. Her use of preparatory evidence and observatory evidence, classroom observations, supported her explanation of how she used the school yard as a resource and hands-on experience for her students.

Like her other academic year VAT analyses, she used the reflection framework to guide analysis in VAT. For this VAT analysis, Patricia developed 13 clips with one to 10 lines of text in each clip. She used her clips to (a) narrate the lesson, (b) provide reasoning for her teaching strategies, (c) describe her curriculum, (d) state her thoughts about the lesson, (e) describe her classroom management strategies, and (f) answer questions from the reflection framework. From the VAT analysis, she developed two evidence-based explanations. Patricia did not respond to several questions in the reflection framework. Those questions she did not respond to were her feelings about her focus, how the focus influenced her students learning and her teaching, her knowledge of the issue, her beliefs, standards that relate to the issues, and how she could further examine this issue. When feedback was provided to her on this VAT analysis, it took the form of questions that prompted her to clarify the focus of her VAT analysis and respond to the reflection framework questions she failed to address in her initial VAT analysis. Patricia answered the feedback questions by adding text to her initial clips that related to the questions. She did not add any new clips to her VAT analysis. Her response to the feedback did result in her development of two additional evidence-based explanations. These explanations were developed in her response

to questions, which asked her to discuss (a) how providing students with science experiences impacts her students' learning and her teaching, (b) her knowledge of this teaching strategy, (c) discuss any standards that related to the issue she focused on in her reflective writing, (d) discuss how the issue supports or contradicts her beliefs about teaching, and (e) discuss how she could and why she would further examine this issue.

Interpreting Patricia's Explanations

Patricia used a variety of evidence types and foci for her evidence-based explanations. In her reflective writings, she used three types of evidence to support her explanations. She used observatory evidence, which was in the form of video observations and classroom observations. She also made use of experiential evidence, through her knowledge of her own students' demographics and backgrounds. And, finally, she made use of preparatory evidence, which was her use of specific teaching strategies. Through the use of these forms of evidence, Patricia was able to not only focus her reflective writings on the examination of the teaching strategies she employed, but also on how those strategies impacted her students' understanding and her school science curriculum.

Although she used VAT to analyze her video, she did not create an evidence-based explanation in all the clips she created. Instead, Patricia used VAT for many different purposes in the development of her reflections. In some of the clip comments, she narrated her lessons, provided reasoning for her teaching strategies, and critiqued her teaching. Patricia used the reflection framework to guide and scaffold her VAT analyses. However, Patricia did not respond to all of the reflection framework questions. For instance, in each case study element, she failed to discuss how she would further examine her issue of practice. The feedback I provided on her

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VAT analyses guided her to revisit each of the questions not addressed in her initial VAT

analyses and clarify and expand on other elements of her initial VAT analyses.

CHAPTER FIVE

CROSS-CASE ANALYSIS

This chapter compares the cases of Sarah, Brenda, Betty, and Patricia. It is formated into

sections based on the research questions.   The research questions addressed are:

- How do elementary science teachers develop explanations of practice using Video Analysis

  Tool?

- How do elementary science teachers develop explanations of practice using the reflection

  framework?

- What is the nature of the evidence that elementary science teachers use to develop

  explanations of their science teaching practice?

For each research question, I will discuss themes and immersing situations that emerged from the

data analysis and cross-case analysis.

How Did They Develop Explanations Using VAT?

While reflecting on their science teaching practice, the participants used VAT to collect

evidence of and examine their science teaching practice. One theme about their use of VAT

surfaced from the development of the participants' individual cases. The participants' use of

VAT to reflect on their science teaching practice focused on examining teaching from another

perspective. While using VAT to observe their science teaching practice, two participants, used

VAT in unexpected ways: to support students to assess and monitor their own behavior and to

collect video evidence of others' teaching practices to support their explanations of their own science teaching.

Sarah, Brenda, Betty and Patricia used VAT to examine various aspects of their science teaching practice. They specifically appreciated VAT affording them the opportunity to observe their teaching practice from a different perspective. "This tool is great for being able to watch teaching styles, classroom management, organization, etc." (Brenda, Weblog Entry 4, 6/30/05). In one of her weblog entries, Betty wrote, "the ability to see myself on video and then take parts [and] pieces and evaluate them is also great" (Betty, Weblog Entry 4, 6/30/05). Sarah reiterated this fondness of VAT when she stated

I absolutely loved being able to watch the whole class from the back of the room! There is so much that you can see that is going on while you are working on something with a single student! I really pride myself in monitoring my class.

I think it is so beneficial to see yourself teach a lesson especially over time. It was nice to see the good things that I do and hear how comfortable I sound in talking with the kids. I really do enjoy teaching and I am glad that it shows in how I interact with the class.

It is very useful in making sure you employ different teaching techniques and helps you monitor your questioning strategies. You can realize that you are calling on the same kid all of the time or that someone is dominating the discussion (Sarah, Weblog Entry 4, 6/30/05).

The previous quotes illustrate the participants' interest in VAT and abilities to use video observations to study their science teaching practice. The participants identified video evidence of their teaching practice to support the focus of their VAT analyses. This type of observatory

evidence supported many of the evidence-based explanations developed while the participants' reflected on their science lessons.

The participants used VAT as a tool for collecting and analyzing videos of their science lessons. In the process of analyzing their teaching videos, the participants created multiple clips. All of the participants used some of their clips to narrate events in the video, provide reasoning for using certain teaching strategies, describe science activities, list positive and negative aspects of their teaching practice, and answer reflection framework questions once it was introduced. However, the depth and application of the comments developed in the participant's clips varied from VAT analysis to VAT analysis and among participants. At times, participants focused on technical issues of practice, such as time management and the use of science resources. However, during other reflective writings, participants chose to focus on a deeper teaching issue, how students learn.

Monitoring Students

During the academic year, Sarah used VAT as a tool to observe her class from another perspective. She decided to employ this aspect of VAT in an unexpected way, Sarah used VAT with her students to help them monitor their behavior. As stated in one of Sarah's summer journal entries,

> I would also use this as a tool in my classroom with my children. They would love to see themselves and we could not only enjoy it but I could use it to help them with monitoring work habits, use of time, etc. (Sarah, Weblog Entry 4, 6/30/05).

In the summer, she realized the potential of using VAT with her students. During the academic year, she introduced her entire class to VAT. She allowed her students to watch the video footage of their science lesson and comment on it. Sarah helped the students develop clips by stopping

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the video for them as different segments and typing the students' comments made while watching the video. In one clip, the students' stated "We went over the kwl[sic] chart to remind us about our thinking yesterday. [The teacher] wants us to think out loud to help us think better" (Sarah, Academic Year VAT Analysis 2, Clip 5161, 2/16/06). Then, the students went on to further describe the review activity they participated in and why the teacher used that activity. In another clip, the students stated, "[The teacher] writes down the list of colors for our note taking. This helps us spell the colors quickly and correctly. She moves around the room to answer questions and help people with their thinking" (Sarah, Academic Year VAT Analysis 2, Clip 5162, 2/16/06). Here, the students discussed the reasoning for their Sarah's actions. Sarah used the video as a springboard for discussing the lesson, her teaching, and the students' behaviors. She wanted her students to realize why she moved around the room and used certain activities in class. She believed their understanding of this may help them monitor their behavior in the classroom. She saw VAT as a tool that both she and her students could use to assess the lesson and their actions.

Evidence From Other Teachers

Betty also used VAT in a unique manner. She collected video evidence from another participant. While using VAT to analyze her teaching during the camp portion of the summer workshop, Betty asked another participant for permission to view her teaching video. Betty observed one of the other workshop participant's science lessons and liked the approach that she used with a certain camp student, Kayla. Throughout the camp, Betty was interested in engaging Kayla, whom she also taught during the camp, in the lesson. So, Betty wanted to use a clip from the other participant's video to support the focus of her own VAT analyses. After obtaining access to the video in VAT, Betty created a video segment to share during her summer

presentation. When presenting her VAT analyses, Betty pointed out the video segment to the other participants. Betty stated

> I want to improve my skills of bringing out students that are quiet and not eager to engage. I pulled a clip, this one right here of the teachers and what they were doing to pull students out. This was really a group effort the whole entire week to pull her out. Day two, this is the same day that she started to talk to us. The first activity and this was before we had our little break and we rearranged the seating afterwards on the floor. This was much more casual. That helped further bring her out (Betty, Summer Workshop Presentation, 7/1/05).

This excerpt from the presentation illustrated how Betty used another teacher's video in VAT to support her examination of the teaching strategies used to engage shy students. She saw how the other teacher's interactions with Kayla impacted Kayla's participation in Betty's class later on. Since Betty was focused on engaging Kayla and students like Kayla, she wanted to build her repertoire of strategies that were effective with these students. Betty used VAT to record the teaching strategies she viewed as being effective for engaging and motivating shy, withdrawn students.

Participants used VAT to examine their classrooms from different viewpoints. They were able to see their teaching from another perspective. Knowing how it influenced her actions in the classroom, one teacher, Sarah, decided to use VAT to help students monitor their own behaviors. VAT also provided teachers, to give others access to their video. Betty used this feature to build a library of effective teaching strategies. She collected video evidence of effective strategies that another used during her science lesson.

How Did They Develop Explanations Using the Reflection Framework?

Participants used the reflection framework to guide their development of each academic year VAT analysis. However, they did not always use the entire reflection framework when creating their VAT analyses. The format of the reflection framework, which was not embedded within the Video Analysis Tool, may have influenced participants' use of the framework. Unless the participants had a copy of the framework with them as they analyzed their teaching videos, the reflection framework was available to them while using VAT. When using the reflection framework, there were two questions the participants often left incomplete or unaddressed. Those questions related to (a) the teaching or curriculum standards that pertinent to the focus of their VAT analysis and (b) contradictions between their teaching practice and teaching philosophy. While there were other questions that were often not addressed in the VAT analyses, participants' attempts to address the above questions resulted in some interesting findings. Being practicing elementary teachers, I assumed the participants were familiar with all of the state elementary science standards. The participants were also provided with copies of national and state science standards during the professional development experience. However, they did not choose to use specific science content or science teaching standards when addressing these standards. Even with feedback prompting them to respond to these questions, the participants still did not answer the questions clearly. Additionally, it was assumed the previous teaching experiences of each participant would make it easy for them to identify contradictions between their teaching practice and teaching philosophy. However, the participants were not always able to identify contradictions. The following section discusses two questions the participants' had trouble addressing.

Addressing Teaching and Curriculum Standards

When addressing the question related to content or teaching standards, the participants often (a) mentioned a broad science concept or teaching strategy related to the focus of their VAT analysis, (b) listed standards that did not relate to the focus of their VAT analysis, (c) claimed there were not any relevant standards, (d) did not answer the question, or (e) listed science curriculum standards. Only Patricia and Brenda identified specific curriculum standards that related to their teaching. With the exception of a few instances, the participants did not address the specific science curriculum standards or science teaching standards that related to the focus of their VAT analysis. The following paragraphs describe how the participants identified standards relating to their science teaching or science curriculum.

When Sarah was asked to discuss any standards that related to her VAT analyses, she usually discussed a broad concept related to science teaching. For her first academic year VAT analysis, Sarah identified all standards as relating to her focus. She stated "all the standards speak to demonstrating an understanding of a topic and that can be measured by doing an activity correctly" (Sarah, Academic Year VAT Analysis after Feedback, Clip 3671, 10/25/05). IShe interpreted all standards as relating to ways of demonstrating understanding and identified the concept of "demonstrating an understanding of a topic" as a standard relating to the focus of her VAT analysis. She did not examine how the National Science Education Standards (NSES) (NRC, 1996) or any other standards related to the idea of demonstrating understanding. She used her interpretation of the purpose of standards to support the focus of her VAT analysis. This may have resulted from her lack of knowledge about the state and national standards. She did not receive training on the NSES Science Content or Science Teaching Standards(NRC, 1996)

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during the professional development course and she may not have had previous training on identifying or implementing the current state standards.

In her second academic year VAT analysis that focused on her ability to monitor her students during a geology lesson, Sarah identified the concept of hands-on activities as being a standard that related to her focus. In her refined second academic year VAT analysis, Sarah typed "we are expected to use the hands on[sic] approach to learning. After all this is third grade and it would not really become real to them if we just talked about the rocks and looked at pictures of them" (Sarah, Academic Year VAT Analysis 2 after Feedback, Clip 5341, 2/16/06). While she realized that her lesson incorporated hands-on activities, she did not identify a specific teaching standard related to the focus of her reflective writing. The concept she discussed, which was hands-on activities, differed from the focus of her reflective writing, which was monitoring student understanding. It was obvious from Sarah's discussion of hands-on activities that she believed they resulted in student engagement. Due to this, Sarah identified this concept as relating to her focus of monitoring student behavior. This could have been the result of Sarah seeing a connection between monitoring student behaviors with factors associated with using hands-on activities. It could also have been due to a quick or minimal attempt to complete the reflective writing or lack of knowledge about the national and state science standards.

Like Sarah, Betty did not list any specific science curriculum or teaching standards in her VAT analyses. Often, she did not see a connection between the issue she focused on and any teaching or content standard. As with the Sarah and the other participants, Betty did not received any training on the NSES Science Content or Science Teaching Standards (NRC, 1996). Like Sarah, she also may have lacked training in identifying or implementing state science standards. In her third VAT analysis, Betty examined the teaching strategies, such as lack of modeling and

providing clear instructions, she used during a science lesson on camouflage. However, when asked during feedback to discuss any relevant teaching or curriculum standards that related to her issue, Betty stated

> I believe that all of the standards present opportunities to model. I don't think any specifically mention modeling since it is an instructional strategy.
>
> I think the Process Skills standards are the most wide open to allow of all types of modeling as well as other hands-on instructional strategies (Betty, Academic Year VAT Analysis 3 after Feedback, Clip 5871, 3/1/06).

She did not list any teaching standards that related to the focus of her reflective writing. Betty interpreted all standards as affording teachers the opportunity to model strategies and activities to students. She believed that teachers should take the liberty to use modeling as a strategy while teaching concepts associated with each standards.

Brenda used the reflection framework question to identify standards other than those that are related to science curriculum or science teaching. In her first academic year VAT analysis, Brenda discussed how Language Arts standards related to her focus. She typed,

> Many of the Georgia Performance Language Arts Standards apply to this situation: ELA4R1 The student demonstrates comprehension and shows evidence of a warranted and responsible explanation of a variety of literary and informational texts.ELA4R3 The student understands and acquires new vocabulary and uses it correctly in reading and writing.ELA4LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.ELA4LSV2 (Brenda, Academic Year VAT Analysis 1, Clip 3301, 10/13/06).

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Even though her first VAT analysis focused on her ability to monitor student understanding of science content, the standards she used were language arts standards. She concentrated on how her lesson integrated certain language arts standards. Brenda did not always seem comfortable discussing science content or science standards. Her comfort level may have been due to her lack of training and knowledge of national and state science standards. She did not receive training on any of the state or national standards during the professional development course. Due to her comfort level with the science standards, she sometime referred back to content and activities she was more comfortable discussing. This was evident in the VAT analysis discussed above. Brenda has a deep understanding of the Language Arts standards and discussed them rather than identifying science curriculum or science teaching standards that related to her focus.

Addressing Contradictions Between Teaching Practice and Philosophy

The video in VAT allowed teachers to observe their classroom from a different perspective. This perspective often illustrated inconsistencies as well as consistencies between their teaching and their teaching philosophy. The reflection framework explicitly asked them to identify if the focus of their VAT analysis supported or contradicted their teaching philosophy. If they did not address the question at all or entirely during their initial analysis, they were given feedback that prompted them to respond. The participants often viewed their teaching practice as mirroring their teaching philosophy. Some stated this view even though the teaching strategies they discussed in their VAT reflection were not always consistent with their teaching philosophy. Not recognizing inconsistencies may have been a result of participants' not revisiting the philosophy of teaching they developed at the beginning of the professional development experience. It may also have been the result of their unwillingness to confront those inconsistencies while creating their reflective writings. Two participants, Brenda and Betty, were

able to identify instances where their teaching practice and philosophy of teaching did not match up. I believe the participants struggled with the idea of their practice not being consistent with their teaching philosophy. While some may have noticed contradictions, those participants may not have been in a frame of mind to confront contradictions between their teaching practice and the philosophy of teaching.

Here, I will discuss how Brenda's response to reflection framework questions illustrated her struggle with her teaching practice contradicting her teaching philosophy. Brenda's third academic year VAT analysis focused on a lesson about speed. While watching video of the lesson, Brenda was shocked at how her practice contradicted her teaching philosophy. She was especially surprised at her use of a teacher-centered lesson. In her Academic Year VAT Analysis 3, she stated "I contradicted my belief of allowing students to learn themselves while I act as a guide, coach and facilitator. By leading them directly step-by-step through the experiment, I was not acting as a coach and guide" (Brenda, Academic Year VAT Analysis 3, Clip 5854, 2/23/06). Brenda realized her practice was inconsistent with her beliefs. However, she tried to justify why she contracted her teaching practice. She used two reasons, which were "being videotaped" and "previous experiences with these students", to justify why she contradicted her teaching beliefs. Brenda was adamant about how planning to videotape her lesson influenced her instruction. She typed,

> I really wish I had not led the students directly through all aspects of the experiment. Again, I feel the majority of the reason behind this is due to the videotaping and trying to make sure there was a lesson to evaluate and comment on. I need to remember that even when coaching, guiding and facilitating students, the groundwork has already been laid. The best way lesson or testimony to teaching is that the students are able to continue the

lesson without you. In that sense, I robbed myself and the students of that experience

during this lesson (Brenda, Academic Year VAT Analysis 3, Clip 5854, 2/23/06).

Although she realized the contradiction, she still felt the need to justify her lesson planning. She

believed the videotaping of her science lesson influenced the instruction she provided for her

students. Brenda stated that the "lesson definitely was intended to be student centered" (Brenda,

Academic Year VAT Analysis 3 after Feedback, Clip 5854, 2/23/06). When asked to elaborate

on activities and lessons she thought should be student centered, Brenda discussed an activity her

students recently completed on Area. Some of her students had problems successfully

completing an activity associated with her lesson. Brenda believed her observations of her

students completing the area activity influenced how she instructed the lesson on speed. Brenda

stated

> In my defense, maybe that was why subconsciously I led the science lesson more
>
> directly. Students do need student centered activities, but sometimes they need more
>
> direction and assistance along the way.   This could also be because they have little
>
> confidence, due to the fact that most activities and lessons are kept teacher centered . . . .
>
> I believe most of math and science should be done as student centered activities where
>
> students are discovering the answers and relationships among the various components of
>
> the lesson" (Brenda, Academic Year VAT Analysis 3 after Feedback, Clip 5854,
>
> 2/23/06).

In this excerpt, she noted that she believed students need student-centered activities and science

should be taught using student-centered activities. However, she believed the contradiction

between her teaching philosophy and her teaching practice was justified. By discussing how the

act of being videotaping and her observation of a previous science lesson influenced her

instruction, Brenda illustrated the internal struggle she had with her teaching practice contradicting her teaching philosophy.

The participants often had issues addressing all components on the reflection framework. They specifically had problems discussing standards that related to the focus of their VAT analyses or contradiction in their practice. They were not always able to list standards that related to the focus of their reflective writings or see inconsistencies in their practice. As previously discussed, these issues may have been a result of many influences. Participants were not able to only focus on the issue they were examining. They may have made a minimal or quick attempt to complete their reflective writings. Their lack of knowledge about national and state science standards may have influenced whether they used standards from other subject areas or identified standards that related to their beliefs about their lesson components. Participants that were not able to identify inconsistencies between their teaching practice and philosophy of teaching may have been unwilling to revisit the philosophy of teaching the developed at the beginning of the professional development experience. They may have only wanted to recognize aspects of their teaching practice that was consistent with their teaching philosophy. Those participants, as well as ones who were willing to note inconsistencies, may have been uncomfortable confronting those inconsistencies.

<center>What Is The Nature of the Evidence?</center>

When developing their summer and academic year VAT analyses, Sarah, Brenda, Betty, and Patricia used evidence that was categorized as being observatory, experiential, and preparatory. However, the participants' use of those categories of evidence varied as they employed VAT and the reflection framework to analyze their practice. Basically, the participants used evidence to develop explanations about three pedagogical themes. The three

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pedagogical themes they focused on were nurturing students' emotional needs, how students

learn, and technical aspects of teaching. The following section details how the participants

addressed those themes through the use of evidence to support their views of teaching and

learning.

Nurturing Students' Emotional Needs

The emotional needs of students was observed in Sarah's and Betty's cases. Both Sarah

and Betty identified moments where students' emotional needs were critical factors in motivating

them to learn or participate in school. They believed that meeting these needs impacted their

students' success in their classroom.

In her third academic year reflective writing, Sarah discussed how her video highlighted

the result of community issues affecting her students' behavior in the classroom. She realized

that her students were more talkative than they normally were during their science lessons. She

attributed this abnormal behavior to recent out-of-school events. Sarah noted

> I was not surprised by their talkativeness because we had just had a discussion before [the
>
> person videotaping my lesson] came in about the flyers that had been circulating in the
>
> Hispanic community about immigration arresting their parents and sending them all back
>
> to Mexico. They were very upset about that! (Sarah, Academic Year VAT Analysis 3
>
> after Feedback, Clip 5777, 3/22/06)

Sarah took time out of her lesson to discuss her students' concerns about this situation. She

realized they needed to voice their concerns and she needed to develop an understanding of why

their behavior was out of the ordinary. In her third interview, Sarah stated

> I had told you that my kids were upset . . . The boycott that was suppose to happen on
>
> Friday. They were just worried and we talked about it Wednesday morning, Wednesday

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afternoon before they went home. We talked about it Thursday again and I talked

Thursday right before they went home. They really thought that the police were coming

to school. The police were going to put their parents in jail. . . And they were really

nervous about it. I had only ten kids there on Friday. . . . I have 17 kids in my class and 7

were absent because of the boycott. It was even fewer in some of the other classes. . . .

[The school] had 208 children absent on Friday because of the boycott. I even asked one

of the girls that was saying they are passing out papers. I said if you don't mind bring me

one of those papers. She did the next day and it said not to go to work, not go shopping

and not to go to school. The immigration officials were going to be checking driver

licenses. . . .So, my kids were nervous. . . They were really, so thinking about all that

running around in their heads, they were angels for the day (Sarah, Interview 3, 3/31/06).

This interview excerpt illustrates how Sarah takes an active interest in issues, which were outside

of the classroom and school, impacting her students. She focused on providing students with

emotional support because she believed it was important to English as Second Language

learners. By helping students work through their concerns and feelings about an issue, Sarah was

able to calm their fears, help them understand the situation, and show her concern for them.

Providing her students with a loving and caring environment is important for Sarah. She believed

her students will not function well in an environment that does not illustrate those factors.

Because of this belief, Sarah wanted to find evidence of emotionally supporting students in her

teaching practice.

Like Sarah, Betty also realized how students' emotional needs affect their participation in

school. She understood the influence she has as a kindergarten teacher. In her refined second

academic year reflective writing, Betty wrote

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One of the main issues in planning for teaching a concept to Kindergarteners is their lack of prior knowledge about most topics. For many I am their first teacher and their first introduction to learning. Many of my students have not been to Pre-K and their parents have not worked with them at home. Their lack of previous experience makes my planning very critical. They are blank slates and I want to positively influence what they learn (Betty, Academic Year VAT Analysis 2 after Feedback, Clip 6056, 10/27/05).

Betty believed that her role as a kindergarten teacher, the first teacher for many students, emphasized the need to think critically about her teaching and planning. For some students, she was the first contact they had with public school teacher and adult other than their parents. She took her role, as an influence in students' first impression of school, very seriously.

When discussing Maria, a shy, quiet student, Betty stated, "I really need to just make an effort and acknowledge her" (Betty, Interview 1, 1/26/06, Line 233). Betty believed that acknowledging students' ideas is critical to their participation in the classroom. This belief prompted Betty to make a point of acknowledging her students. Through classroom observations, she realized that her intervention of valuing all students' opinions, especially quiet students like Maria, has positively impacted the participation in the classroom. During her first interview, Betty stated

I think in classrooms where you don't have pretty good order you end up with the strongest, loudest kids doing all the talking and all the feedback. Then, the little [quiet] and shy ones just give up. They cannot compete. So they just sit back and are not heard. I really try to foster getting everybody's opinion or I make sure everybody is listening to everybody else. I see my shy ones really to begin to come out. I know in a couple of my writings I was really worried about Maria, a little girl in that class that was real shy. I

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mean now, when anybody even my parapro[sic] or my intern or myself ask a question her

hand is up (Betty, Interview 1, 1/26/06, Line 109-116).

In her second interview, Betty reiterated how her attempts to value and acknowledge students'

ideas and experiences have positively enhanced participation in her classroom. Betty focused on

this issue of her teaching because she believed it is important when teaching students that are

English as second language learners. She wanted to provide evidence that she supported her

students emotional. Betty discussed how Maria has increased her level of participation even

though she still has problems with the English language. Betty stated

> We were talking about wells one day and I was talking about well water. We were
>
> talking about where the water went down the sink and . . . this is not what we planned for
>
> the day. But one of the kids were washing hands and stuff was going down the sink and
>
> they were like where does this water go. So, I kind of went into a thing where the water
>
> goes and where did it come from. We started to talk about Lake Luke. Where the water
>
> comes from and how it is pumped out of the lake and it is cleaned up so that we can drink
>
> it. But then several kids [have well water]. Then I asked if anybody has a well. If you
>
> have a well then your water is not coming out of Lake Luke. A lot of hands went up and
>
> then little Maria who I have been worried about all year, stuck her hand up and said I saw
>
> a well in Mexico. And then I asked what it looked like and she did the hand pump thing.
>
> She couldn't tell me pump but she was doing her hand up and down telling me she had to
>
> pump water out of the ground. . . .So she recalled that. And I asked when did she see that
>
> and she said when I was little at my grandmother's (Betty, Interview 2, 4/2/06, Line 111-
>
> 127).

Through these two excerpts, Betty identified how Maria's participation has increased throughout the year. She believed her acknowledgement of Maria's participation and effort in class influenced her participation. Even though there are still language barriers, Betty created a classroom environment in which Maria felt comfortable enough to participate in class discussions and share her personal experiences with the class.

Both Sarah and Betty identified instances where they provided emotional support to their students and developed a nurturing learning environment. Both participants believed that providing students with emotional support helped create a caring environment for students to be successful in school. They believed emotional support and a nurturing environment influenced students' success and participation in school. Nurturing the emotional needs of students was a prominent factor in Sarah and Betty's reflective writings. It was evidence from their reflective writings that Sarah and Betty made a conscious effort to show their students how much they care about them. Unlike other participants, Sarah and Betty did not always reflect on perturbations of their science teaching practice. They use their reflective writings to support their beliefs about effective teaching strategies for their students. Through their reflective writings, Sarah and Betty focused on examining why they believed their lessons were successful. While they were not focusing on problems of practice, they were still participating in the reflective process. They were collecting evidence of their practice using their previous knowledge of their teaching.

How Students' Learn

Another theme that emerged from the participants' use of evidence was examining how students learn. This epistemological theme focused on how learning is achieved by students and identified by teachers. In this section, I will discuss how Sarah and Patricia attended to issues addressing this theme.

In her first interview, Sarah discussed her students' problems with understanding a lesson on language arts concepts. Through her classroom observations and a peer's observation of a language arts lesson, she realized her teaching approach did not result in students understanding plural and possessive words. Sarah was surprised by their lack of understanding. She stated " I did the most beautiful job in the world explaining plural and possessive . . . When I told them to do the lesson right off the page, they missed every single one" (Sarah, Interview 1, 3/28/06). Even though she executed what she considered to be a great lesson, the students did not understand the concept. Her teaching strategies were not effective and did not support students' understanding of the language arts concepts. Sarah was faced with an inconsistency between what she identified as good teaching and what she believed resulted in student learning. She realized that she should have approached the lesson in a different manner. Specifically, Sarah described a method, which she termed simplifying or chunking, she used when teaching lessons in other subject areas. In her interview, Sarah described the method as

> they would do the first three and we would check. It is so much better to miss three than ten. . . And then I would say do the next three and walk around the room and see if they got it or not. That way instead of them having to do ten things and have to do all ten wrong. The success rate is a little higher when you do it that way. I do that in Math a lot. . . . I will do well I will explain and explain. Do it on the board and have them take notes and so some sample problems on the top of their page. Then I will say do number 10, 11 and 12. And I will not let them go any further unless we have checked it together and talked about it. And that usually ensures a much higher success rate then saying ok go ahead and do these ten problems and let me see it when you are finished. . . .That just

keeps me from having to back and track and re-explain everything again (Sarah,

Interview 1, 3/28/06).

Here, Sarah described how the alternative strategy of chunking could have better supported her students' learning. By breaking down the activity into smaller sections, she would be able to identify areas where her students were having problems with the lesson and be able to make adjustments accordingly. Sarah realized that although she believed her original strategy should have been successful, students were not able to understand the material. Through this realization, she began to examine how another strategy may have fostered student learning.

Another participant, Patricia, was also concerned with how her students' learn. She used her personal learning experience, her knowledge of others' teaching science, and her knowledge of Crawford Hill's state assessment scores to support her science teaching. Patricia used a teaching approach, which provided students with hands-on activities, multiple chances to experience science concepts and materials, and integrated other subject areas into her science lessons. In her third VAT analysis, she discussed why she used this teaching style in her science classroom, specifically during an outdoor activity on environmental education. While responding to feedback questions, Patricia typed

I love taking students outside to experience their world. . . . I also [feel] sad because I

know next year when Crawford Hill no longer has a science lab; most of our students will

not get a hands on [sic] experience like this. . . . [I used this teaching approach in science]

because for years I watched our students struggle to read stories with which they could

not relate to the simplest of concepts due to their limited backgrounds. I saw most

classroom teachers only teaching science out of a textbook if at all. Science is a naturally

high interest area for students. It is an easy way to motivate while teaching. . . . IN[sic]

almost every science standard listed under the heading of habits of the mind, the students are required to use tools and ideas. [One standard] states that students will be aware of the importance of curiosity. I think these scream for hands on experiences that can only build background knowledge. . . . [The teaching approach I used] supports my beliefs 110%. We all learn when we do. When we experience life, we relate better to abstract concepts because we have something to pull from. When we have to solve problems, we rely on our bank of experiences. I see my job as helping students add to that bank and insure that the interpretation of that information is correct. . . . I would love to study Crawford Hill's test data to determine the amount of growth in other areas like reading and math with the science lab and without the lab. I know prior to the lab, our students' reading and math scores were very low. Last year (5th graders have received lab every year of school) our [national standardized test] score rose in reading and math. Science scores were the highest scores in the school. What I found interesting was that even though they had to read the science portion of the test, they scores[sic] over 20 points higher than reading. I feel this is due to the background knowledge they could pull from and relate to while reading the passages. The reading passages were over topics the students had little experiences. I know there are too many variables to state that the experiences gained from the lab correlated with the test data. However, I feel in my heart that it could have only helped the students (Patricia, Academic Year VAT Analysis 3 after Feedback, Clip 6208, 2/16/06).

Patricia's experience using this style of teaching and knowledge of Crawford Hill's assessment scores since the induction of their science program supported her use of this style. She saw the rise in test scores as a possible result of her science teaching style. Patricia's beliefs about the

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effectiveness of their science program, due to the curriculum and her instruction influenced her use of certain strategies. Her beliefs about hands-on learning and her students' background impacted how she designed her lessons. She was adamant about providing her students, whom most she believes have limited science experiences, with opportunities to experience science. Patricia believed that she needed to provide students with science experiences so that they could develop an understanding of science concepts.

Technical Aspects of Teaching

The third pedagogical theme that emerged from participants' use of evidence was examining technical issues of teaching. This theme was an obvious component of Betty's VAT analysis on her tree lesson. While analyzing this lesson, Betty recognized that her lesson did not flow was well as she intended. Instead of observing trees as they were instructed to do outside, some of her students were playing with rocks found in the schoolyard. Betty realized that she needed to adjust her lesson so that all of her students were actively engaged. Betty also noticed other factors, the context of her lesson and the instructions for her lesson, which influenced student engagement. She chose a certain area of the schoolyard for her activity. The amount of trees in that area versus the amount of students in her classroom resulted in some students not being able to closely observe each tree. During her tree observation activity, the students were so crowded that all of the students were not able touch and examine each tree closely. She realized that she did not direct students in a manner that would allow each student an opportunity to observe each tree. As Betty noted in her VAT analysis, "It would have been better to have broken them into groups and used more trees so that they all could get closer" (Betty, Academic Year VAT Analysis 2 after Feedback, Clip 6056, 10/27/05).

After observing her lesson in VAT, Betty decided to implement an approach that used more cooperative learning in her classroom. She believed this approach would help keep students engaged in the lessons and help her lessons run smoother. Thus, she started to group her students for certain activities. In her second interview, Betty stated "I have some small groups that support each other. I actually have them in a little "Betty's Buddy Groups" now. The two kids seem to help each other with lots of little things, just to think through more. (Betty, Interview 2, 4/2/06, Line 35 - 37). Not only did Betty examine her planning and execution of her lesson plan, she also evaluated the plan and developed interventions for similar activities. In subsequent activities, she implemented her plan of using a cooperative learning strategy, pairing students together. Betty believed this strategy influenced students thinking during these activities.

Sarah, Brenda, and Patricia's use of evidence also related to the domain of teaching. In one VAT analysis, Sarah discussed how preparing for her lessons, which included getting videotape permission slips from the students, affected how she placed students in the classroom and how the students behaved during the lesson. In multiple reflective writings, Brenda discussed how her lesson planning contributed to the success of her science lessons. Specifically, she discussed how her use of resources influenced the success of her science lessons. In her summer reflective writing about a lesson on tree products, Brenda realized that her use of certain pictures negatively influenced the success of her lesson. She assumed her students were familiar with products she was familiar with. However, her students did not understand pictures of a baseball bat and a fig. She recognized the importance of understanding her students experiences and background knowledge when selecting materials for her lessons. This was specifically important for her classroom since she worked with students from other cultures and backgrounds.

During an academic year VAT analysis, Brenda was also concerned with the resources she used for her science activity. She specifically focused on the type and amount of science articles her students had to read in order to complete an activity on tree products. She realized her use of these article impacted the amount of time it took her students to complete the activity and what they were able to understand from the articles. Although her students were classified as gifted students, they were still English as Second Language learners and had some difficulty with the articles. In another academic year VAT analysis, Brenda discussed how she carefully planned for her lesson on tree identification. Brenda cautiously considered the outdoor area she would use, researched the types of trees in that area, and revised her activity to fit her schoolyard and students' abilities.

Patricia also focused on a technical issue of teaching. Due to her role as the science specialist and her daily teaching load, Patricia was very concerned with time management. She realized that she did not always set aside an appropriate amount of time for closing her lesson at the end of class. Technical issues, such as time management and lesson planning, were often discussed by the participants' use of evidence. She realized that by considering all aspects of this lesson before implementing it, she was able to make adjustments so that the activity was appropriate for her students. She believed this extra planning contributed to students successfully completing this lesson.

The participants in this study used evidence, some of which was generated using VAT and the reflective framework, to examine three aspects of teaching, nurturing students' emotional needs, how students learn, and technical aspects of teaching. These three pedagogical themes are reminiscent of three pedagogical domains discussed by Alexander (2004). Alexander (2004) described pedagogy as being concerned with multiple domains: children, teaching, learning,

curriculum, school, policy, culture, self, and history. The domains of children, teaching, and learning (Alexander, 2004) are three domains that corresponded with the participants' use of evidence. Alexander (2004) describes the domain of children as being "their characteristics, development, and upbringing" (p. 11). This domain corresponds to the participants' use of evidence to support their beliefs about nurturing students emotional needs. Alexander (2004) identified the domain of learning as how learning is "motivated, achieved, identified, assessed, and built upon" (p. 11). This connects with the participants' use of evidence to examine if and how their students learned science concepts. The domain of teaching domain, which is described as "the planning, execution, and evaluation" of teaching (Alexander, 2004, p. 11) is also seen in the participants use of evidence. Through evidence, the participants were able to identify instances where technical aspects of their teaching practice, such as using certain science activities and resources and school locations, influenced the success of their lesson.

<center>Summary of Cross-Case Analysis</center>

In this study, the participants use of VAT, the reflection framework, and evidence varied from reflective writing to reflective writing. Furthermore, the length and focus of their VAT analyses varied from reflective writing to reflective writing. VAT provided the participants with opportunities to step outside their current viewpoint and observe their class from another perspective, help students monitor their behavior and their teacher's actions, and collect video evidence of other teachers' science teaching practices. Through these opportunities, VAT enhanced the ability of the participants to reflect on their practice. It enabled them to select and discuss specific events of their science teaching videos. This allowed them to use video evidence to support the focus of their reflective writings. Specifically, the video evidence allowed them to identify issues of practice that may not have been as obvious from their observations while

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teaching. For issues that were noticed while they were in the classroom, the video evidence was used to support their personal observations. VAT also provided them with a forum for matching their discussions of classroom events to corresponding video clips. This would not have been as easy using separate video and word processing programs.

The reflection framework provided the participants with prompts to guide their thinking during the reflection process. While developing their VAT analyses, the participants were expected to use the framework to examine one issue of their science teaching practice. The reflection framework asked them to review their understanding of their issue as it pertained to their science teaching practice, their students' learning, and science teaching and content standards. Additionally, the framework encouraged them to develop a plan of action for further examining their science teaching issue. Unfortunately, the reflection framework alone did not provide the type of guidance needed for the participants to address each question on the framework. Often, participants did not address all of the questions on the reflection framework. There were many reflection framework questions that were not addressed until the participants were provided with feedback on their VAT analysis. Some participants' answers to the framework questions were influenced by their lack of understanding or comfort with science standards. With the addition of feedback, the participants addressed all areas of the reflection framework. However, they still may not have addressed the areas thoroughly. Without feedback, some of the participants would have not discussed standards that related to their teaching issue or identified areas where their science teaching practice contradicted their philosophy of teaching. Feedback was used to further help participants critically examine one issue of practice. The participants often had problems focusing only on one issue of practice while developing their VAT analysis using the reflection framework. They would often switch between issues while

addressing questions from the reflection framework. The feedback helped them redirect their thinking and clarify their focus of their reflection. These prompts helped the participants stay more focused on one issue of practice.

With all of their VAT analyses, the participants' reflective writings on their science teaching practice varied in length and depth. The complexity of the reflective writings was evident in the evidence used, explanations developed, and focus of the VAT analyses. Each participants VAT analysis was different based on the use of the reflection framework, the focus of their VAT analysis, and their use of evidence. As previously discussed, the focus of the VAT analyses ranged from technical issues of teaching to issues of how students learn. When used as intended, the reflection framework supported more in-depth examinations of the participants' science teaching practice. During their summer reflective writings, the participants did not voluntarily address areas that were discussed on the reflection framework. While they may not have addressed or thoroughly discussed each question on the reflection framework without feedback, the participants' use of the reflection framework resulted in a more in-depth discussion of an issue of their science teaching.

CHAPTER SIX

CONCLUSION AND IMPLICATIONS

"Teacher learning is analogous to students learning: Learning to teach science requires that the

teacher articulate questions, pursue answers to those questions, interpret information gathered,

propose applications and fit the new learning into the larger picture of science teaching"

(NRC, 1996, p. 68)

Conclusions

The purpose of this study was to examine how elementary teachers use the Video

Analysis Tool (VAT), a reflection framework, and evidence from their teaching practice to

develop evidence-based explanations of their science teaching practice. This study focused on

using VAT because it provided participants with a tool for examining video recordings of their

practice and linking evidence and teaching standards to their teaching practice. Thus, the

research questions guiding this study were:

- o How do elementary science teachers develop explanations of practice using Video

  Analysis Tool?

- o How do elementary science teachers develop explanations of practice using the

  reflection framework?

- o What is the nature of the evidence that elementary science teachers use to develop

  their explanations?

For this study, I used VAT reflective writings, journal entries, and interviews with participants engaged in a yearlong professional development experience. Through open coding, themes emerged from the data. Research questions that guided the development of the themes in this study, also guided the design of a multiple-layered case for each participant (Yin, 2003).

The examination of Sarah, Brenda, Betty, and Patricia's explanations of practice provided insight into teachers' use of evidence to support explanations of their practice. Their introduction to VAT afforded them the opportunity to view and critically examine video recordings of their teaching practice. Through their development of their VAT analyses, the participants were able to identify issues in their teaching practice. Some of the participants were able to develop plans for further examining those issues of practice. The use of VAT and the reflection framework presented participants with the opportunity to examine or revisit issues of practice they had in the past. They used their previous knowledge of students and their teaching practice to guide the focus of their reflective writings and support explanations of their teaching practice. Through their development of reflective writings, participants began to participate in the reflective process. Some teachers were able to were able to frame and reframe issues of practice. In Zeichner and Liston's (1996) discussion of Schön's notion of reflection, they identified how teachers can frame and reframed issues of practice in light of new evidence. VAT supported teachers' collection and identification of new evidence of their teaching practice. This process allowed them to frame and reframe issues of their science teaching practice they wanted to examine. It also allowed participants to examine other areas of their teaching experiences.

Summary

This study provided insights on how teachers, who work with a large majority of English as second language learners, reflect on their science teaching practice. Many teachers never

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encounter the students and situations that Sarah, Brenda, Betty, and Patricia deal with on a daily basis. It is obvious from Sarah, Brenda, Betty, and Patricia's cases that they are evaluating the effectiveness of their science teaching to meet the needs of those students. Through VAT analyses, journal entries, and interviews, the participants were able to discuss how they reflected on their science teaching practice. The context for their reflective writings about science teaching was a professional development experience that emphasized the environment, multicultural education, and teacher's reflective practice.

To develop evidence-based explanations of practice, Sarah, Brenda, Betty, and Patricia used different kinds of evidence. Researchers show that many teachers use their learning experiences as a model for their teaching practice (Artzt, 1999; Bryan & Abell, 1999; Goodlad, 1984; Kubota, 1997; Loucks-Horsley et al., 1990; Loucks-Horsley et al., 2003; Luft, 2001; Osborne, 1998). In the case of Brenda and Patricia, they used their previous teaching and learning experiences as evidence to support explanations about their teaching practice. The participants also used their lesson planning as evidence to support their explanation development. They used these forms of evidence to guide their classroom instruction and the analysis of their teaching practice. Due to the nature of VAT and the context of the professional development experience, the participants were able to access and use video evidence of their teaching. This evidence was the basis for many of their explanations on their practice. Hence, this form of evidence was always accessible and the option of having their lessons taped was always available to participants. Additionally, participants' observation of their classroom during the lessons also supported many of their explanations about events and issues in their teaching.

While analyzing video of their science teaching practice in VAT, the participants used their VAT clips for many purposes. Most of the clips developed in VAT were used to narrate

events in the lesson or describe their teaching strategies. After the introduction of the reflection framework, most of the participants created one clip to solely answer questions presented in the framework. Although these uses of each clip may have eventually led to the development of an evidence-based explanation, it was not always the result. Like their use of VAT, participants used their evidence for multiple purposes. For instance, participants discussed how they tried to meet the emotional needs of their students, examined the positive and negative aspects of their lesson planning, and discussed instances where their science teaching did not result in students learning. Basically, the participants used evidence to address pedagogical domains, such as children, teaching, and learning (Alexander, 2004).

Through VAT, the participants were able to analyze their teaching practice outside of classroom distractions. This form of reflection-on-action (Schön, 1987) allowed participants to pose and respond to questions they have about their current or previous teaching experiences. Some of the participants were able to identify instances where they successfully reflected on and solved issues of teaching. In this case, their reflection-on-action allowed them to identify and discuss an instance where they engaged in reflection-in-action (Schön, 1987). Once introduced to the reflection framework, some of the participants identified situations where their teaching philosophy was supported or contradicted by their science teaching practice. The participants often struggled to reconcile their philosophy and practice when identifying instances in video clips where their science teaching practice contradicted their teaching philosophy. Participants, who recognized the inconsistencies between their beliefs and science teaching practice, began to develop an understanding of how their beliefs influence their teaching practice.

After the reflective framework was introduced in the fall semester, the participants used it in different and unexpected ways. Each of the participants developed their reflective writings

within the clips they created in VAT. Of the four participants, Brenda was the only participant who consistently used the framework as a specific guide to develop her reflective writings. She addressed each question in the reflection framework as she analyzed her video in VAT. While the other participants may have used the framework as a guide, they did not completely address each of the framework's questions in their VAT analyses. The most common framework questions the participants did not address were: making a connection between the teaching event and a teaching or content standard and how they could further examine the focus identified in their reflective writing. There are many reasons why the teachers may have not addressed those questions. In the case of reflection framework questions about standards, only one of the participants was extremely familiar with state and national standards on science teaching and science curriculum. Even though they were provided with resources, such as the National Science Education Standards (NRC, 1996) and copies of the state standards, they did not always refer to or list any standards for that framework question. Although participants were provided with resources about frameworks, the frameworks were not thoroughly addressed during the professional development experience. By not providing participants with the opportunity to become familiar with all of the National Science Education Standards (NRC, 1996), the professional development facilitators may have actually influenced whether or not those standards were used in the participants' VAT analyses. Another question often not addressed related to discussing how they could further examine the focus of their VAT analyses. Since some of the participants did not see inconsistencies between their science teaching practice and philosophy of teaching, they did not see a need for continuing to examine the issue. I believe the teachers could not identify how they could further examine their issues without the assistance of the professional development facilitators and reflection tools. They did not view VAT and the

use of video as a readily available to them once the professional development experience ended. I believe they could not see how to continue this type of reflective writing on their science teaching practice without assistance.

Feedback was provided to the participants to help them address all of the reflection framework questions. After providing feedback to each participant, the participants would return to VAT to refine their VAT analyses. Interestingly, none of the participants created new clips in VAT, but, instead, refined clips they had created during their initial VAT analysis. The process of refining their VAT analyses required a significant amount of coaching and support from the researcher. As Schön (1987) noted, "The student cannot be *taught* what he needs to know, but he can be *coached*" (p. 17, italics in original). The participants needed more than direct instruction on the process of reflection. They needed coaching or individual support from the researcher to narrow the focus of their reflection and participate in the reflective process. Although the professional development experience provided an introduction to reflection, instruction on how to analyze video in VAT, and a discussion about the reflection framework, the participants were not always able to thoroughly analyze their teaching practice on their own. Through individual coaching, the participants were better able to address all of the questions in the reflection framework and elaborate on or clarify statements they made in their initial VAT analyses.

There were limitations with the participants' use of VAT to develop written analyses of their science teaching videos. One limitation was the inability to develop a VAT analysis with multiple videos. The structure of the system did not allow a teacher to create a VAT analysis with multiple videos. Unfortunately, the participants were not able to link clips from multiple VAT analyses together to create one written VAT analysis. This would have been a wonderful feature for Betty as she used another teacher's video to support her VAT analysis. She could

have linked that video to her VAT analysis. Another limitation associated with the participants'

use of VAT was their inability to collect evidence other than video. Video observations in VAT

were an important form of evidence teachers used to develop explanations of their teaching

practice. However, unless teachers cut and pasted their digital copies of lesson plans, activity

worksheets, or other teaching artifacts directly into the VAT comment box, they were not able to

collect any other forms of evidence. Nonetheless, many teachers briefly described their lesson

plans and other teaching artifacts while typing in VAT. Overall, the participants were able to

successfully use VAT to analyze their practice even though they may have benefited from the

addition of the features described above.

Like using VAT, there were some limitations to the participants' use of the reflection

framework. One limitation of the reflection framework was its location. Although the framework

was provided to the participants in both paper and digital form, it was not uploaded into VAT.

Having the format uploaded into VAT would have made it readily accessible to the participants

while they were developing their VAT analyses. The second limitation of the reflection

framework focused on its format. The framework was not developed in a form that was easily

embedded into the VAT system. The reflection framework was based on a set of questions which

asked participants to examine an issue of their teaching practice. By refining the format of the

reflection framework into a rubric, the framework would have been easily embedded into the

system. Often, the participants did not address all of the questions. This could have been a result

of the two limitations listed above or another limitation, specifically the questions used on the

framework. The questions on the framework were developed for the participants to use for their

academic year VAT analyses. This was their initial use of the reflection framework. Another

limitation of the framework was the need for coaching, in the form of feedback on their VAT

analyses. In order to prompt participants to thoroughly answer all of the reflection framework questions, they had to be provided with feedback. They may not be able to find a colleague willing to provide them with feedback on their VAT analyses or any reflective writings outside of the context of this study. Participants may have responded differently to the reflective framework questions if they had been introduced to the framework during the summer workshop. They were only provided with the framework during the academic year. While they had more practice with VAT due to its introduction in the summer, the participants were not as familiar with using the reflection framework. Having additional time with the framework may have provided the participants with a deeper understanding the framework questions. This may in turn have encouraged them to thoroughly address each component of the reflection framewok.

What Does This Study Say?

The National Research Council (1996) encourages professional development experiences that support teachers' development of knowledge about science content and pedagogy. They state, "Professional development for teachers of science requires integrating knowledge of science, learning, pedagogy, and students; it also requires applying that knowledge to science teaching" (NRC, 1996, p. 62). The professional development experience serving as the context for this study afforded the participants an opportunity to develop a deeper understanding of their students and their science teaching practice. The tools used for the professional development experience, which are VAT and the reflection framework, allowed the participants to use their previous knowledge of teaching and learning to examine their teaching practice. Their application of this knowledge was evident in their reflective explanations and descriptions. Professional development experiences, such as analyzing their practice using VAT and coaching from the professional development facilitators, supported participants in developing connections

between their teaching philosophy and their science teaching practice. "Some of the most powerful connections between science teaching and learning are made through thoughtful practice in field experiences, team teaching, collaborative research, or peer coaching" (NRC, p. 67).

The participants' in this study participated in the essential elements of reflection, which are self-awareness, perturbation, examining one's practice, and knowledge construction (Dewey, 1910; Schön, 1987). Their reflective practice allowed them to examine links between their science teaching and their students' learning. By evaluating evidence of their teaching practice and developing evidence-based explanations about their science teaching practice, the participants engaged in a reflective conversation (Schön, 1987) with their teaching. They were open to the notion of identify anomalies in their science teaching practice. Specifically, they examined and answered questions about their teaching practice (Gilbert, 1999). By using evidence-based explanations to answer questions about their teaching practice, they had to develop an understanding of the nature and knowledge behind their practice (Sandoval & Reiser, 1997). Reflection allowed teachers to extend their normal use of evidence to influence their teaching (Elliot, 2004). The development of evidence-based explanations in participants' VAT analyses of their science teaching allowed the participants to analyze and interpret evidence of their teaching practice, which encouraged them to further reflect on their science teaching.

The practice of teaching and learning to teach is grounded in the context of the teaching environment (Guskey, 1995). Science teachers should be afforded the opportunity to learn about teaching by reflecting on actual classroom practice (Artzt, 1999; Bryan, 2003; Bryan & Abell, 1999; Grossman, Wilson, & Shulman, Loucks-Horsley et al., 2003; Shulman, 1986; Shulman, 1987). This study allowed teachers to develop an understanding of their teaching by accessing

their normal teaching environment. During the academic year, they were developing reflective writings about their own science teaching experience within their own classroom environments. Therefore, they were studying their own teaching practice and classroom to develop a deeper understanding of teaching and learning. Participants were making sense of their daily activities and their teaching practice (Grimmett & Mackinnon, 1992). In the following section, how this study contributes to the literature in science teacher education is discussed.

<p style="text-align:center">Contributions to the Literature</p>

This study contributes to the science teacher education body of literature in several ways. In this section, I will briefly outline and describe those contributions. This study is unique to science teacher education literature in that it explores areas of teacher practice that have not been researched extensively. To date, there have been several studies that have identified the effectiveness of using evidence of practice to promote teachers' professional growth (Zeichner & Liston, 1996; Desforges, 2003). There have also been several studies conducted that discuss the role of explanations in the science classroom (Sandoval, 2001; Sandoval & Reiser, 1997; Sandoval & Reiser, 2004). Additionally, there have been multiple studies related to explanations through the lens of developing scientific explanations of science content (Chi, 1996; Coleman, 1998; Sandoval & Reiser, 1996; Wong, 1996; Zuzovsky & Tamir, 1999). However, this study examined the role of evidence and explanations as it pertains to science teaching practices. It is grounded in the belief that if science teachers are expected to be able to explain scientific concepts using evidence, they should also be able to use evidence-based explanations to better understand their own teaching practices.

The tenets of reflection advocate the use of evidence for professional growth (Dewey, 1991; Schon, 1987). This study was grounded on that premise and examined the use of evidence-

<p style="text-align:center">203</p>

based explanations to support reflective practice. Reflection is the process of analyzing and finding solutions for problems of teaching practice (Calderhead, 1989; Dewey, 1910; Schön, 1987). It is during analysis and the development of solutions that teachers gather evidence from their teaching practice. Teachers use evidence of their teaching practice to inform them of anomalies that exist in their teaching practice. Evidence gathered may support or contradict their philosophy about teaching and learning. Additionally, teachers can use evidence to help them frame the issue of their teaching practice. Through framing their issue of practice and developing solutions for their teaching problem, the teacher will use evidence to develop explanations.

This study also contributes to the science education literature in its use of new technologies for supporting reflection. This research employed the use of two innovative technologies, weblogs and VAT. The weblogs, which were only employed during the summer workshop, were used as an electronic tool to support reflective journaling within the professional development experience. Since they are web based, weblogs provide teachers with an internet accessible, journaling tool. VAT allowed teachers to upload, interact with, and analyze evidence of their own teaching practices (i.e. digital video). Using VAT was innovative because it involves a new technology that allowed teachers to collect and store evidence as well as analyze the evidence and their science teaching practice. Teachers were able to choose video segments in VAT and document other forms of evidence. VAT also afforded the researcher and professional developer with new ways to coach and support reflective practice through the reflective framework. While this framework was not embedded into the VAT system, it has the possibility of being uploading in to the system.

Implications for Future Research

There have been a number of studies that examined students' abilities to evaluate and apply evidence in science. Sandoval (2001) stated

A central goal of scientific explanation is to account for patterns of data. An important way to assess students' abilities to construct scientific explanations is to examine how they use data as evidence. A good deal of cognitive research has explored how students respond to specific pieces of data and evaluate them in terms of a current theory or belief (Chinn& Brewer, 1998; Klahr, Dubar, & Fay, 1990; Koslowski, 1996; Kuhn, Amsel, & O'Loughlin, 1998) (p.1).

Since there are many parallels between learning science and learning to teach science (Bryan & Abell, 1999; NRC, 1996), it seems evident that research should be done on teachers' interactions with and evaluation of evidence. This would allow educators to develop a better understanding of how teachers develop explanations about their teaching practice.

The findings in this study highlight the need to further examine and refine the reflective framework provided to the teachers, as well as the role of coaching to support teachers' use of VAT and the reflective framework. The teachers participating in this study did not use the framework completely and required continuous coaching to address many of the prompts. While that is expected with practitioners new to reflective practice, further training on the framework also needs to be considered. The questions, prompts, and formatting of the reflection framework should be studied further. Due to its relationship with VAT in this study, research examining the reflection framework would also inform studies about teachers' use of VAT.

The participants appreciated the opportunity to examine their classroom practice from another viewpoint. They mentioned how the chance to watch their classroom from the back of

the room using VAT provided new insights into their teaching. A few of the participants were forthcoming about the amount of time it took to reflect on their video in VAT. Watching, clipping, and commenting on sections of video can be an extremely time consuming process. At this stage in the study, the nature of the tool was not as intuitive as it could have been. The participants had to receive a certain amount of technical help throughout the study. Research on in-service teachers continued use of VAT would provide insight into how practicing teachers could integrate VAT into their teaching practice on a more constant basis. With the many demands placed on teachers on a daily basis, it would be interesting to see how VAT can be integrated into a school or schools system on a regular basis.

Although VAT provided participants with an innovative tool to collect and examine video evidence on their teaching practice, the participants also used classroom observations and their previous knowledge about their teaching to support their explanations. Even though participants were able to comment on other forms of evidence, they were not able to collect it using VAT. Through further development, VAT has potential to incorporate the collection and analysis of additional forms of evidence. The use of a VAT-like tool, with the additional ability to upload other forms of data, would be beneficial to in-service, as well as preservice, teachers. Through this type of tool, teachers could actually collect multiple forms of evidence, such as lesson plans, student work, school schedules, to inform their teaching practice and explanations. This would allow teachers to develop a better understanding of teaching and learning. Additionally, this would allow educators and professional development facilitators with access to the VAT-like tool, to understand the many variables which impact teachers' practices and reflections. This tool would make explicit what participants were using as evidence and better

allows the practitioner and teacher educator to make connections between planning, evaluation materials, and teaching practice.

Due to the complex nature of reflection, it would be informative to examine how elementary science teachers, as well as science teachers in general, utilize and interpret evidence. Additionally, it would be beneficial to examine teachers' understandings of the relationship between data and evidence. How do teacher identify evidence and why do they identify certain types of data as evidence? Sarah, Brenda, Betty, and Patricia all made a contentious effort to examine their practice and improve the teaching and learning in their classroom. The background of their students and their irregular use of VAT along with the reflection framework influence how, what, and why they developed certain evidence-based explanations about their science teaching. Based upon the findings of this study, the avenues of research noted above are warranted.

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APPENDIX A

PROFESSIONAL DEVELOPMENT SCHEDULES

Summer Workshop Schedule

Week 1: Summer Workshop Course

Summer Workshop Week 1				
Monday	Tuesday	Wednesday	Thursday	Friday
1. Introduction to Professional Development 2. Discuss Multicultural Approaches 3. Project Learning Tree Activity 4. Short Tree Physiology and Dendrology Lesson (by State Forester) 5. Project Learning Tree & *Science Is . . .* Activity (Tree ID) 6. Leaf Press Activity 7. Give out Multicultural and Reflection Articles 8. Close lesson	1. Review Monday 2. Project Learning Tree Activity 3. Short Forest Ecology/Environmental Science Lesson (by Science Forester) 4. Discuss Multicultural and Reflection Articles 5. Guest Speaker presentation on making environmental science relevant 6. Close lesson	1. Review Tuesday 2. Project Learning Tree Activities 3. Discussion on Multicultural Approaches 4. Participants will design a lesson using resources and incorporating their students culture and "backyard" 5. Present lesson 6. Close lesson	1. Review Wednesday 2. Field Trip to local field station 3. Review Multicultural Approaches and Reflection 4. Close lesson	1. Discuss Field Trip 2. *Science Is . . .* activity 3. Project Learning Tree Activity 4. Discuss next week (working with students, signing up for lessons, reflection) 5. Introduction to Reflection 6. Introduction to Video Analysis Tool 7. Close lesson

Week 2: Summer Workshop Camp

Summer Workshop Week 2: Camp				
Monday	Tuesday	Wednesday	Thursday	Friday
Morning Session 1. Meet and Greet Boys & Girls Club students 2. Teacher groups teach one lesson each 3. Snacks for students 4. Students leave	Morning Session 1. Teacher groups teach one lesson each 2. Snacks for students 3. Students Leave	Morning Session 1. Each teacher group teachers one lesson 2. Snacks for students 3. Students leave	Morning Session 1. Outside groups activity with students (leaf press) 2. Forester talks about environmental science 3. Begin working on Posters (students products) 4. Snacks for students 5. Students leave	Morning Session 1. Students work on posters 2. Poster session (invite parents, scientists, etc.) 3. Snacks for students and guests 4. Students leave
Afternoon Session 5. Lunch 6. Teachers learn how to use VAT 7. Give Reflection reading 8. Plan for tomorrow 9. Close session	Afternoon Session 4. Lunch 5. Discuss reflection reading 5. Teachers use VAT to reflect on their lessons 6. Plan for tomorrow 7. Close session	Afternoon Session 4. Lunch 5. Teachers use VAT to reflect on their lessons 6. Review Reflections 7. Plan for tomorrow 8. Close session	Afternoon Session 6. Lunch 7. Teachers use VAT to reflect on their lessons 8. Plan for tomorrow 9. Close session	Afternoon Session 5. Lunch (provided by professional development) 6. Teachers finish their VAT analyses 7.Teachers present VAT analyses & discuss their experience 8. Discuss academic year and close workshop

Academic Year Schedule

Fall Meeting	Spring Meeting
1.Discuss questions and concerns about Science activities and Project Learning Tree 2.Discuss questions and concerns with VAT 3.Schedule videotaping 4.Review using VAT 5.Introduce Reflection Framework 6.Teachers use VAT to reflect on their lessons 7.Close Fall Meeting	1.Discuss questions and concerns about science activities and project learning tree 2.Discuss questions and concerns with VAT 3.Present VAT analyses to peers 4.Discuss questions and concerns with professional development course 5.Close Spring Meeting

APPENDIX B

REFLECTION FRAMEWORK

Reflecting on Your Lesson

1. Watch your video. Identify events or issues that attract your attention.
   a. Clip those events or issues in VAT
   b. Describe the events/issues that you see. (What was interesting? surprising? frustrating? etc.)

2. Pick one of the events/issues you would like to examine more closely.
   a. After your description of the event/issue (see 1a), discuss any emotions that were evoked when you saw that event/issue. (How do you feel about that event/issue?)

3. Develop an explanation of the event/issue.
   a. Why do you think this event/issue happened?
   b. What does this mean to your teaching or your students' learning?

4. Develop your understanding of this issue.
   a. What do you know about your event or issue?
   b. What do you know about that particular topic?

5. How does this issue relate to your teaching as a whole? (Is it an issue of teaching? science content? the elementary curriculum? etc.)
   a. What specific standards relate to this event or issue? (Does this event/issue relate to a teaching standard? state content standard? etc.)

6. Revisit your beliefs statement in the Blog.
   a. What beliefs do you have about this event/issue?
   b. Do any of your beliefs, which were stated in your Blog, relate to this event/issue? If so, which ones?
   c. Does this event/issue contradict or support any of your beliefs about teaching and learning? If so, which ones?

7. What actions can you take to further examine this event/issue?
   a. For example:
      i. What can you do to find out why a successful strategy worked?
      ii. What can you do to find out why a strategy didn't work?
      iii. What steps can you take to solve this issue?

APPENDIX C

SAMPLE VIDEO ANALYSIS TOOL REFLECTION

Sample VAT Reflection

Teacher's Name . . . . . Brenda

File Name   . . . . . Brenda_1

Class Name   . . . . . Science

Date of Event   . . . . . OCTOBER 13 - 2005

Place of Event   . . . . . Tivoli Elementary School

Clip Id	Start	End	Comments
3292	01:16	02:02	Luis seems to guide the activity instead of letting Javier agreeing.
3293	02:05	02:33	have actual items or make sure students know what the items are if using pictures
3294	02:56	03:32	Luis still seems to be doing most of the talking and deciding for the pair.
3295	03:35	03:57	Luis again telling Javier what to write
3296	03:59	04:25	Again Luis making the decision first
3297	04:28	05:17	Again, Luis has made the decision
3298	05:19	05:47	Javier has made the decision first
3299	05:49	06:09	Luis first twice
3300	06:11	06:37	Javier making a decision
3301	09:47	10:44	Javier mentions information gleemed from the article. I am glad that he is using the information from the article to re-examine the products to determine if they should be on the list of wood products. This happened because this was the next step in the lesson, to read the articles about wood products and share the information, using the information in looking back over the list of wood products and updating the list. This way the students become familiar with the wide diversity of wood products. This means the students were able to use the information from the article to complete the task. This increased their learning, as they now know many different type of wood products. By reading the articles myself, I learned (or reacquainted myself) with the many diverse wood products. Being familiar and knowledgeable concerning wood products helps us become better consumers and increases awareness of the value of forests. It is critical for students to be able to read informational texts and articles and apply that knowledge to their lives and the world in which they live. This is primarily an issue of teaching with the content in the science field. Many of the Georgia Performance Language Arts Standards apply to this situation: ELA4R1 The student demonstrates comprehension and shows evidence of a warranted and responsible explantion of a variety of literary and informational texts.ELA4R3 The student understands and acquires new vocabulary and uses it correctly in reading and writing.ELA4LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.ELA4LSV2 The student listens to and views various forms of text and media in order to gather and share information, persuade others, and express and understand ideas. My beliefs about this event/issue are that students are able to take charge of their learning environment and discover information relative to the world around them. Several beliefs stated in the blog relate to this event/issue: all students can learn, at different rates and different styles; connect learning to real-life;question things;stuents solving problems in a warm, caring environment. This event supports many of my beliefs about teaching and learning. Students need real-life experiences and the opportunity to question things and learn in an inquiry-based atmosphere. The boys used the information from the articles to determine which products were dervied from wood. They were able to re-examine their first list and make corrections to their list then, based on this information. This was successful because the students were able to read and use the information from the article. More practice in

			reading informational texts and making connections is needed to continue to increase their reading skills. A related issue to this event is Luis's continued drive to always be first and not allow Javier an equal chance of contributing or answering questions.
3302	10:46	11:49	Javier discussing additional information about tree usage. I am pleased that Javier is able to read and gather information from the article. This was the next step of the lesson and happened as it should have in the sequence of the lesson. This means that the students clearly understood the directions for the activity, where able to follow the directions, were able to read and understand the article and then assimilate the information and determine which items should have been originally included on their list of wood product items. They have learned the wide range of products derived from trees.
3303	11:51	12:56	Luis summarizing information from his article; they both seemed to have some trouble discussing the information. They easily found the information, but had trouble trying to share.
3304	13:13	14:06	Looking again based on information from articles, using reference to article
3305	14:08	14:38	using info from article
3306	15:01	15:19	using info
3307	16:11	16:32	Luis again taking the lead and doing all of the talking.
3308	16:34	17:24	Javier talking, after asking Luis to give him some time.Groaned about sponge
3309	17:26	17:36	missed something in article
3310	17:59	18:19	Luis taking lead again several times
3311	18:46	19:07	Luis again doing all the talking and yet again
3312	19:10	19:20	Luis again and again
3313	19:24	19:40	Javier answering first!
3314	19:51	20:11	made the connection that all the products came from trees
3315	20:36	21:47	I wonder if I was taped on a subject that I felt comfortable about if I would not be as nervous!!!!
3316	21:59	22:36	summary of object of lesson

APPENDIX D

WEBLOG JOURNAL ENTRY PROMPTS

WEBLOG QUESTIONS

Reflection - Monday, June 27

Reflection on your own teaching

- What did you like about your lesson? Why?

- What would you change about your lesson? Why?

- How could you change/improve the lesson?

- What will you focus on for your first use of EBI? Why?

Reflection from your observation

- What did you like about their teaching? Why?

- How could you use this in your own teaching? Why?

- What suggestions would you give them to help their lesson?

Reflection - June 28

Today's goal was to identify an initial focus for the inquiry you are conducting on your own teaching practices.

Please respond to each statement in 3-5 sentences.

- Explain what are you learning about your own teaching from the video.

- After watching the video of your teaching, explain what would you change about the lesson.

- Describe initial inquiry focus.

- Explain what led you to choose that as your focus.

- After watching the video, explain how it and other evidence represent your inquiry's focus.

- Explain what other types of evidence might help you make more sense of the inquiry.

- Explain how you will analyze your teaching

Beliefs Statement

Develop a Personal Science Teaching Philosophy

To write your philosophy, examine your beliefs about teaching and the teaching profession. Do not limit your response to the following four questions, but include them within your teaching philosophy statement.

- On average how much time do you spend on science each day in your classroom?

- * What does it mean to be a science teacher?

- * What is the role of the science teacher?

- * What is the role of the science student?

* These questions are based on Bryan, L. (Fall, 2004). Beliefs statement questions. Questions used in Dr. Lynn Bryan's ESCI 5400/7400: Reflection in Science Teaching at the University of Georgia.

Reflection - June 30, 2005

Review the Teaching Philosophy statement you generated yesterday. Each day during this professional development experience, you have been thinking about your teaching and examining video (direct evidence) of your teaching practices.

1. Identify and explain an instance where you contradicted your beliefs about the teaching of science.

2. Identify and explain an instance where your teaching supported/confirmed your beliefs about the teaching of science.

Revisit the focus of your inquiry.

3. In one or two sentences, state the focus of your inquiry.

4. Identify and explain why you chose to focus on/examine that part of your teaching practice. Be as detailed as possible.

Think about the EBI Tool

5. List and describe three of your favorite features about the EBI tool.

6. List and describe three things you would like to see changed with the EBI tool.

7. Describe ways in which you might use this tool in the future.

APPENDIX E

INTERVIEW PROTOCOLS

Initial Interview Questions for Teachers

1. Please summarize and describe your teaching experiences thus far.

2. Describe your classroom environment.

3. How would describe your teaching style?

4. What type of relationship do you have with your students?

5. How do you support your students learning and academic success?

6. Please describe the teaching strategies and methods you use to teach science to your students.

7. How do you know when you met your personal teaching goals? How do you know when you have met the county/state's standards for teaching science?

8. Describe how you assess your own teaching practices.

9. Describe the areas of your teaching practice you would like to examine more closely.

10. Why do you want to examine those areas more closely?

11. Describe issues or event you would like to focus on during your reflections.

12. Why do you want to focus on those areas?

13. What do those issues mean to your students' learning?

14. How do you know those issues affect your students' learning?

15. How do those issues support or contradict your philosophy about teaching and learning?

16. How will you try to fix or further examine those issues?

17. Is there anything I should know that I have not asked you? Is there anything you would like to elaborate on further?

Follow-up Questions for Teachers

1. Describe an issue or event you focused on during your reflection.

2. Why did you focus on that area?

3. What does that issue mean to your students' learning?

4. How did that issue affect your students' learning?

5. How does that issue support or contradict your philosophy about teaching and learning?

6. How will you try to fix or further examine that issue?

7. Is there anything I should know that I have not asked you? Is there anything you would like to elaborate on further?