PRESERVICE TEACHERS' USE OF EVIDENCE-INFORMED TOOLS AND METHODS FOR THE ASSESSMENT OF THEIR OWN TEACHING PRACTICES

by

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(Under the Direction of Arthur Recesso)

ABSTRACT

This qualitative study examined preservice teachers' use of evidence-informed tools to formatively assess own teaching practices. To examine their enactment of formative assessment, this study focused on their use of the Video Analysis Tool (VAT) and analysis frameworks designed to encourage their use of video evidence. A case study approach was used to organize the participants' data and open coding was used to analyze the participants' analyses in VAT and interviews. Findings indicated that preservice teachers had many misconceptions about formative assessment, which had a significant impact on their ability to assess their teaching. Subsequently, the participants did not possess knowledge of a systematic process for analyzing and assessing specific attributes of their teaching practice. Through their experiences in this study, the participating preservice teachers were able to develop their own processes and strategies for assessing their teaching. The data indicated that the participants were able to develop systematic processes for observing their teaching in VAT. However, VAT and the analysis frameworks did not provide the type of support necessary to help the preservice teachers interpret the video evidence. Subsequently, their assessments, as a whole, lacked depth, which prevented them being able to develop solutions for changing their teaching practices. Yet, the data indicated that

through their experience in this study, they were able to develop knowledge of formative assessment.

INDEX WORDS: Formative assessment, self-assessment, reflection, evidence-informed methods, evidence-informed tools, video annotation

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DEDICATION

This work is dedicated to mom, dad, and sister. They have loved, supported, and provided a lot of encouragement. I love you more than I could ever possibly tell you and greatly appreciate all that you have done.

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CHAPTER 1

INTRODUCTION

Formative assessment, a commonly promoted practice in teacher education, is defined as a process for examining one's own teaching. The use of formative assessment, whether it is continuous or occasional, is intended to inform and improve teachers' understanding while developing their own teaching practice (Yorke, 2003). Advocacy for formative assessment has increased since the inception of the standards-based movement that began in the 1980s with the alarming report, *Nation at Risk* (1983). This ongoing movement has led to several iterations of national, state and even local teaching standards, which assist in setting goals and developing professional growth plans for practicing teachers. Within those teaching standards frameworks, formative assessment is frequently mentioned and promoted as a critical component of teacher professional development (AAAS, 1993; NRC, 1996; NSTA, 2003). However, those standards do not provide clear processes or expectations for conducting formative assessment. Additionally, the need for teachers to better understand their own teaching and further their own growth and development has intensified since the reauthorization of the Elementary and Secondary Education Act in 2001, known as "No Child Left Behind" (NCLB) (US Department of Education, 2001). This policy, which is best known for its accountability measures and focus on student learning, mandated that every public classroom have a highly qualified teacher by 2005 (US DOE, 2001). Furthermore, it required all states to develop and implement a plan for measuring teacher quality based on student achievement. Thus, prospective teachers are expected

to enter K-12 classrooms with the ability to examine their own teaching practices and implement changes as needed.

How Is Formative Assessment Supported in Teacher Education?

Researchers in teacher education have developed and examined several approaches to better support formative assessment (e.g., Artzt ,1999; Bryan, 2003; Griffin, 2003; Grossman, Wilson, & Shulman, 1989; Hoffman & Geller, 1981; Hoover & Carroll, 1987; Rennert-Ariev, 2005; Ross & Bruce, 2007; Schön, 1983; Schön, 1987; Towler & Broadfoot, 1992; Van Riper, 1982; Wilson, 1995). Traditionally, formative assessment is supported through the processes of reflection and/or self-assessment. Both of those approaches have been widely used in education as a means for guiding preservice teachers' looking inward to further develop their understanding of pedagogy and pedagogical content knowledge (Day & Pennington, 1993; Carr & Kemmis, 1983; Schön; 1983; Van Zee & Roberts, 2001). A review of education's definitions and approaches for the development of teacher knowledge through the use of formative assessment reveal common themes of supporting teacher learning (Abell, Cennamo, Anderson, Bryan, Campbell, & Hug, 1996; Abell & Bryan, 1999; Day & Pennington, 1993). Teachers need a systematic means for collecting and examining evidence of their teaching practice that will support the iterative and cyclical nature of knowledge development through formative assessment (Deaton, 2007; Land & Zembal-Saul, 2003).

Reflection

Dewey (1933) and Schön (1983, 1987) championed reflection as an inward looking process for teachers to systematically examine their teaching, often in collaboration with a mentor, with a critical eye. Hence, the forefathers of reflection and recent primary research espouse a systematic approach to reflection. Furthermore, the teacher education literature has

substantiated reflection as a valuable process for both learning to teach and developing teaching knowledge (Artzt ,1999; Bryan, 2003; Griffin, 2003; Grossman, Wilson, & Shulman, 1989; Van Zee, & Roberts, 2001; Zembal-Saul, Krajcik, & Blumenfeld, 2000). Teaching is a dynamic process that is influenced by many factors, such as teacher beliefs, classroom environment, and teachers' knowledge of teaching and learning (Rosebery & Puttick, 1998). Reflection provides teachers with the opportunity to examine these variables and perturbations in their teaching practice. Through reflection teachers make informed decisions about their teaching practice by following a more systematic approach to examining their practice (Loucks-Horsley et al., 2003).

Self-assessment

Self-assessment, like reflection, is a defined as a process for examining actions or events of teaching with the goal of improvement (Ward & McCotter, 2004). Self-assessment is a common practice used for learning and development in teacher education, as well as other fields such as medicine, social work, and counseling (Arnold, Willoughby, & Calkins, 1985; Barrows & Tamblyn, 1976; Bishop, 1971; Boud, 1995; Stuart, Goldstein, & Snope, 1980; Ward, Gruppen, & Regher, 2002). In education, self-assessment is most often defined as an introspective effort; one that eludes external mandate in favor of techniques valued by the individual (Hoffman & Geller, 1981; Towler & Broadfoot, 1992; Van Riper, 1982). That is, teachers deliver a lesson and spend time examining their teaching in order to identify what did, or did not, work well and make adjustments. Self-assessment, as defined in the literature, differs from reflection in that it uses specific criteria (e.g., teaching standards) to guide the assessment process (Barber 1990; Darling-Hammond & Snyder, 2000). To better support this process, strategic models that involve using set criteria to support self-assessment and the contemplation of classroom events have emerged (Barber, 1990; Darling-Hammond & Snyder, 2000), which

aim to help teachers assess their own practices based on expected outcomes or teaching standards.

Common Tools to Support Formative Assessment

Due to the demand for formative assessment in teacher education, several approaches and tools have been developed and adopted to support teachers' examination of evidence of their teaching practices. Some of those approaches include cases, journaling, and teaching portfolios (Abell, Cennamo, Anderson, Bryan, Campbell, & Hug, 1996; Abell & Bryan, 1999; Beck, Livne, & Bear, 2005; Berrill & Whalen, 2007; Bowers, Kenehan, Sale, & Doerr, 2000; Darling-Hammond & Snyder, 2000). However, while those approaches show potential for supporting professional growth, the standards-based movement may have resulted in either misuse or unintended consequences regarding the way evidence was generated, collected, and evaluated (Delandshere & Arens, 2003).

To develop a sense of how the standards-based movement may have influenced formative assessment, one can look at the pervasive use of portfolios in teacher education. Portfolios are often implemented as a capstone experience of a preparation program where preservice teachers are expected to store sample artifacts demonstrating knowledge and skills valued in teaching and learning. Programmatically, as Delandshere and Arens (2003) found, portfolios are often used to document practices to show that standards are met. For the most part, this practice may benefit program reporting for accreditation more than it does the preservice teacher. Hence, portfolios have become more of a collection of teacher education program course and field experience products than a measure of an individual's learning or effective teaching practice (Delandsher & Arens, 2003). Implementation has primarily been in the form of snapshot and summative. In fact, the process of preservice teachers completing portfolio activities (e.g., archiving artifacts and

completing disjointed activities) without providing detailed and purposeful explanations may curb understanding and knowledge development in the future (Delandsher & Arens, 2003). Clearly, portfolios have the potential to be a powerful tool to demonstrate progress. Unfortunately, implementation in most preservice programs has not always yielded measurable improvement in preservice teacher practices (Delandshere & Arens, 2003).

Limitations of Formative Assessment in Education

As mentioned above, formative assessment is oft mentioned in teacher education. However, it is not clearly defined in the standards that promote it. One of the dilemmas with formative assessment, particularly reflection, is that they have become commonplace and ill-defined (Boud, 2006; LaBoskey, 1993). Subsequently, many educators and teacher educators have misinterpreted, or disregarded, the reflection literature and have "equat[ed] reflection as thinking" (Boud, 2006, p. 192). Additionally, others have developed a misinformed conception that views formative assessment as prescriptive (Boud & Walker, 1998; Floden & Klinzing, 1990). That is, many practitioners and educators have defined reflection as a set of linear steps that do not require the practitioner to consider or examine issues or events carefully (Boud & Walker, 1998; Floden & Klinzing, 1990). Similarly, self-assessment has been met with skepticism. Wilson (1995) and Rennert-Ariev (2005) noted that self-assessment is perceived to contradict reform-based efforts in teaching, because it is often used to analyze teacher-centric practices. Furthermore, while models for self-assessment have been created, little is known about how self-assessment of teaching practices is systematically performed (Darling-Hammond & Snyder, 2000).

How Has Technology Supported Formative Assessment?

A wide variety of powerful technology-based tools have been developed and used to support teacher assessment and development. Video capture and video annotation technologies have been used in teacher education for many years (e.g., Abell, Bryan, & Anderson, 1998; Abell, Cennamo, Anderson, Bryan, Campbell, & Hug, 1996; Bloom, 1969; Ratcliffe et al., 2003; Winn, 1974). Video tools, in general, have enabled supervisors and teachers to deconstruct the complex interweaving of interactions between teacher, instructional materials, and student learning to understand what happened (Pea & Lemke, 2007; Sherrin & van Es, 2002; Rich & Hannafin, 2008a). These tools, such as the Digital Interactive Video Exploration and Reflection (DIVER) project (Pea, Mills, Rosen, Dauber, Effelsberg, & Hoffert, 2004) and the Video Annotation and Summarization Tool (VAST) (Mu & Koohang, 2006), have demonstrated that it is possible to capture teaching and learning with minimal bias and indicate that further refinements may improve the fidelity of systematic self-assessment processes.

As video compression technologies advance, the ability to use video-based tools to analyze teaching increases each year. These technologies, among other advantages, allow users to index and codify digital video through lightweight, web-based interfaces, and metadata tagging using timestamps in the video file. In short, we are now able to remotely capture, code, and report on the events that took place (even as they take place) in a learning environment (Recesso, Hannafin, Wang, Deaton, Shepherd, & Rich, 2009). Furthermore, through those technological advances, observers (e.g., researchers or supervisors) no longer have to be in the classroom and teachers can capture and observe their teaching practices on demand (Recesso et al., 2009). Technology has increased one's capacity to look closely at very complex events such

as teaching, segment a part of that event from all other extraneous events, and make sense of what took place (Bryan & Recesso, 2006). That is, a novice teacher given a valid and reliable instrument can pick out the parts of their teaching practice, the attributes that make it effective, and look closely with a mentor or peer and determine why their teaching practice was or was not successful. When the same process is used by a supervisor, one who rates and assesses preservice teachers' practices, it ensures an increase in rigor (use of valid instruments) and fairness (less recollection and personal interpretation) through the use of direct evidence of teaching and learning events (Recesso et al., 2009).

The Video Analysis Tool (VAT: http://vat2.uga.edu) is one tool that allows preservice teachers to capture and examine their own teaching practice (Deaton, Recesso, & Hannafin, 2005; Recesso et al., 2009; Rich & Hannafin, 2008a, 2008b, 2009; Shepherd & Hannafin, 2008). VAT is a web-based tool that allows preservice teachers to store, organize, and assess their own teaching practices. Specifically, the tool enables preservice teachers to upload video of their teaching practice and codify that evidence. VAT also allows preservice teachers to make use of specific lenses, or frameworks, or lenses, to help them assess their teaching practice within the tool. Lenses, which are based on a camera metaphor, allow the preservice teacher to focus on specific attributes or events by suppressing extraneous events (Hill, Hannafin, & Recesso, 2007). Frameworks, for example, can consist of state standards, national standards, specific attributes of practice, or guiding questions and prompts. The frameworks in VAT are designed to prompt preservice teachers to systematically and purposefully assess their own practices. For instance, a preservice teacher can upload a video of his lesson into VAT and then use the tool to identify and analyze specific attributes or issues of his teaching practices, which includes developing written reflections and/or assessments. Furthermore, VAT also promotes the sharing of ideas and

evidence. Through the use of VAT and the collection of preservice teachers' assessments of their own practices, teacher educators are able to examine and try to make sense of the events embodied in the video evidence in ways that inform decisions for preservice teacher growth and development (Bryan & Recesso, 2006).

Context of the Study

The context for this study was a three-month exploratory study in which four preservice secondary science teachers allowed me to capture and store video of their teaching in VAT. After their videos were uploaded, the participants completed three assessments of their own teaching practices using specific analysis frameworks to support the analysis of their own teaching. By allowing the participants to analyze and assess their own teaching, this study examined assessments that were personally relevant to the teachers. Furthermore, studying the preservice teachers' written assessments in VAT allowed the researcher to identify what they assessed in their teaching and the processes they used to complete their assessments. Finally, through the collection of interview data, the researcher was able to understand their conceptions of formative assessment (reflection and self-assessment) and how it was supported in their teacher education program.

Purpose of the Study

The purpose of this study is to a) understand preservice teachers conceptions of formative assessment, b) identify the processes they use to assess their own teaching with the Video Analysis Tool (VAT), c) identify and understand the issues of their teaching practices they identified using VAT and analysis frameworks, and d) identify the constraints and enablers of preservice teacher formative assessment. To support this purpose, this study will examine the following research questions:

- To what extent do evidence-informed methods and tools influence preservice teachers identifying and describing specific attributes of practice?
    - How do preservice teachers assess their own teaching? What do they look at and what processes do they apply?
    - To what extent do preservice teachers rely on intuition or evidence to define a need for change?
    - What situations, tools, or resources enable or constrain evidence-informed approaches to preservice teachers' assessment of fine-grained attributes of practice?

Rationale

Learning to assess one's own teaching practices plays an important role in preservice teachers' growth and development. By examining preservice teachers conceptions of self-assessment and reflection, this study will allow teacher educators to better understand how preservice teachers operationalize and implement assessment of their own teaching. Furthermore, this study examined the issues that preservice teachers encountered as they analyzed their own teaching for the first time. Additionally, this study identified how preservice teachers used evidence of their teaching practices to inform the examination of their own teaching practices. The findings provide insight to teacher educators about how preservice teachers identify issues of practice as they assess their own teaching and the challenges they faced in trying to make sense of and understand the available evidence.

This study is unique because of its use of an innovative technology (VAT) for supporting preservice teacher self-assessment. Specifically, this study explored how preservice teachers identified issues of practice and the processes they used to assess their own teaching with VAT.

Through the examination of their assessments, teacher educators can better understand a) how preservice teachers use video evidence to examine and analyze their own teaching b) and the issues they faced as they assessed their own practices. This study also introduced resources to help scaffold and guide the preservice teachers' assessments in VAT. The findings from this study present how those resources assisted preservice teacher self-assessment and provide recommendations for addressing their deficiencies as well. Finally, the preservice teachers use of VAT and the resources will allow educational researchers to better understand how and if VAT promotes an evidence-informed approach to assessment. Due to the fact that recent advances in video capture and annotation technology has demonstrated utility in teachers developing knowledge of teaching (Bryan & Recesso, 2006; Pea & Lemke, 2007; Sherrin & van Es, 2002), the intent of this study is to further our understanding of these tools and determine to what extent VAT supports the systematic assessment of their own teaching.

CHAPTER 2

CONCEPTUAL FRAMEWORK

This conceptual framework of this study is comprised from several bodies of literature, which include (a) the types of teaching knowledge, (b) formative assessment of teaching, (c) tools that support formative assessment. This chapter also presents a specific tool and methodology that supports evidential-reasoning. This literature is important in understanding how preservice science teachers examine their own teaching practices for professional growth and development. Research has shown that preservice teachers do not enter preparation programs as blank slates (Bryan & Abell, 1999; Grossman, Wilson, & Shulman, 1989; Mellado, 1998; Mellado, Blanco, & Ruiz, 1998). Instead, preservice teachers have been participants of classroom teaching for roughly fifteen years, which leads to deeply entrenched mental models of teaching and how people learn (Mellado, Blanco, & Ruiz, 1998). Furthermore, their previous experiences may encourage preservice science teachers to make use of certain models, such as teacher-centered instruction and traditional assessment, in their science teaching practices (Artzt, 1999; Bryan & Abell, 1999; Goodlad, 1984; Kubota, 1997; Loucks-Horsley, Love, Stiles, Mundry, & Hewson 2003; Luft, 2001; Osborne, 1998). However, those experiences do not consistently model reform-based teaching practices emphasized by state and national standards. At the core of every teacher education program is the challenge to ensure that what preservice teachers understand about teaching and learning is aligned with the values and expectations of their domain (AAAS, 1993; NRC, 1996; NSTA, 2003).

Teacher educators utilize multiple strategies intended to facilitate preservice teachers' understanding about their own teaching. Assessment of teacher practices can be both summative and formative and take place along the continuum of preparation. Summative assessments are widely used in education and are often realized through products or tests such as capstone portfolios and teacher tests (Delandshere & Arens, 2003; Smith & Tillema, 2001; Wilhelm, Puckett, Beisser, Wishart, Meideth, & Sivakumaran, 2006). In contrast, formative assessment strategies are embedded in courses and therefore subject to interpretation (or even lack of use) by teacher educators. This literature review examines reflection and self-assessment as strategies used by teacher educators. Specifically, this literature review is focused on identifying how formative assessments are currently implemented in teacher education programs and discussing technology-based support-mechanisms that aid formative assessment. Finally, this review introduces a complimentary, evidence-informed method and tool designed to support systematic and purposeful teacher self-assessment.

Preservice Teachers' Development of Knowledge

To understand the complexity of teachers' knowledge is to understand the complex nature of teaching and learning. As stated by Russell, Munby, Spafford, and Johnston (1988): "professional knowledge consists of more than that which can be told or written on paper and professional learning is something more than a process of using 'rules' to make decisions about how to behave in a classroom situation" (p. 67), which implies that multiple experiences and forms of knowledge intersect to create teacher's knowledge. Prior learning and teaching experiences, multiple teaching and learning experiences within teacher education programs, and knowledge developed during the teacher education program impact preservice teachers' knowledge of teaching.

Prior Experiences

Prior experiences are those that take place at the pre-university and undergraduate level outside of teacher preparation programs. The development of knowledge about teaching is constructed by preservice teachers well before they begin their in teacher education programs (Bryan & Abell, 1999; Grossman, Wilson, & Shulman, 1989; Mellado, 1998; Mellado, Blanco, & Ruiz, 1998). As students in K-12 or college classrooms, tomorrow's teachers first develop knowledge of teaching from those who taught them. These types of experiences often lead to deeply entrenched beliefs and conceptions about teaching and learning, which can be difficult for preservice teachers to overcome. Their experiences, which are traditionally didactic in nature (Bryan, 2003), play a major role in their development of conceptions about teaching and learning and most preservice teachers view their experiences as students as a "guide to good teaching" (Yerrick & Hoving, 2003, p. 399). As Mellado et al. (1998) noted, preservice teachers' prior experiences lead to the development of pedagogical knowledge far before they enter teacher education programs. However, the quality of these experiences (Dewey, 1938) and their long-term effects on preservice teachers' beliefs, values, and preconceptions of teaching of must be questioned.

Preservice Experiences

As preservice teachers enter the formal training component of their teacher education program, they are typically provided with experience in three areas: foundation classes, methods classes, and field experiences (e.g., student teaching) (Anderson & Mitchener, 1994). Foundation classes typically serve as a link between "education, the humanities, and the social and behavioral sciences" (Anderson & Mitchener, 1994, p. 16). These classes serve as the first step in the development of a preservice teachers' professional identity. Methods classes include

general and content-specific methods that help preservice teachers begin to develop connections between the subject matter knowledge they have learned and the act of teaching (Anderson & Mitchener, 1994) and can influence how the preservice teacher will teach once they enter the profession (Bryan & Abell, 1999). Field experiences, which include observations, teaching practicum, and student teaching, are important for preservice teachers in learning to teach and becoming socialized to the culture of classrooms (Lortie, 1975). Additionally, experiences in the field offer preservice teachers the opportunity to put to use the skills they have developed as part of their training to become professional educators (Anderson & Mitchener, 1994).

Of all their experiences in a teacher education program, field experiences may be the most important component of preservice teachers' training. Oft noted is the importance of experience and its role in the development of teaching knowledge (Bryan & Abell, 1999; Lortie, 1975; Osborne, 1998). During their preparation program, many preservice teachers expect their coursework content to transfer exactly and without consequences to their field and student teaching experiences (Russell et al., 1988). Activities such as observations of teachers in the field lead to the development of preservice teachers' rules for teaching and frameworks for the cultural norms of classrooms (Bryan & Abell, 1999). In addition, student teaching helps preservice teachers develop ideas about students' abilities (Bryan & Abell, 1999) and may strengthen the beliefs, ideas, and values they held when they entered the program (Tabachnick & Zeichner, 1984). Research on conceptual change and constructivism has identified how beliefs about teaching and teaching and learning experiences are interwoven (Russell & Martin, 2007). Despite all efforts by faculty and teacher education programs, preservice teachers face many dilemmas in acquiring and making use of their own teaching knowledge as part of their teacher preparation.

Knowledge of Teaching

At the beginning of the 20th century, the early emphasis in education was on the amount of content knowledge a teacher possessed. As time passed, a more technical approach to education was developed and a strong tendency towards developing teachers' pedagogical knowledge in teacher preparation programs came to fruition (Shulman, 1986b). However, in the last twenty years the emphasis in teacher education has shifted towards a philosophy of identifying the professional as one who "holds knowledge, not only of how – the capacity for skilled performance – but of what and why" (Shulman, 1986b, p. 13). The knowledge essential to preservice science teachers is comprised of many different components: subject matter, pedagogical, curricular, craft, and pedagogical content knowledge.

Subject matter knowledge. A strong understanding of subject matter knowledge is an essential component of teaching (Abd-El-Khalick & Boujaoude, 1997; Shulman, 1987). Possessing subject matter knowledge requires teachers to be knowledgeable of individual scientific concepts and their relationships with other concepts (Abd-El-Khalick & Boujaoude, 1997), which is important because it allows teachers to explain and validate the subject matter, know what is true, why its true, when the content is warranted for explanation, and when justifications can be weakened or strengthened (Shulman, 1986b). However, in science, studies have shown that not all science teachers have a strong understanding of the relationships between science concepts (Abd-El-Khalick & Boujaoude, 1997; Haidar, 1997: Zembal-Saul, Krajcik, & Blumenfeld, 2002). Thus, it is particularly advantageous for science teacher preparation programs to provide preservice science teachers with subject matter knowledge in accordance to the four dimensions described by Grossman et al. (1998).

The first dimension is content knowledge, which are the basic truths and topics specifically important to a domain (Shulman, 1986b). For example, a clear understanding of the content knowledge of physics enables teachers to understand why Newton's Laws are particularly important to that domain. Anderson and Mitchener (1994) stated that teachers' knowledge of the subject "is at the center of teacher education" (p. 14). Without a strong understanding of the content knowledge in a domain, preservice teachers abilities to use teaching strategies aligned with their philosophical beliefs may be limited or have to be altered altogether (Abell & Roth, 1992; Shulman, 1987).

Substantive knowledge, the second dimension, is essential to preservice teachers because it is the framework that guides inquiry in a specific domain (Grossman et al., 1989). Substantive knowledge can be defined as the multiple ways a domain's basic concepts and principles are organized to represent facts (Shulman, 1986b). This type of knowledge provides teachers with frameworks for interpreting data and guiding inquiry within a field. In science education, substantive knowledge (e.g., the continental drift theory or the sun-centered solar system model) allows data to be organized, interpreted, and evaluated in lieu of new and preexisting models (Nichols & Koballa, 2005). Disciplines consist of not only knowledge of concepts and organizing structures, but also the knowledge of how those concepts and structures were developed or gathered (Thorén, Kellner, Gulberg, & Attorps, 2005), which leads to the third dimension of subject matter knowledge, syntactical knowledge. Syntactical knowledge is the "set of ways in which truth or falsehood, validity or invalidity, are established" (Shulman, 1986b, p. 9). It is the knowledge of how other knowledge is acquired in a discipline (Grimmett & MacKinnon, 1992; Grossman et al., 1989; Thorén et al., 2005). In science, inquiry is the method for developing and investigating scientific knowledge (Nichols & Koballa, 2005). If preservice

teachers do not understand the set of rules that guide inquiry in their domain, then they will be unable to introduce this into their curriculum, which may (a) misinform the students about the true nature of the subject and (b) limit the preservice teacher's ability to acquire new knowledge (Grossman et al., 1989).

The final dimension of subject matter knowledge is related to teachers' beliefs about content (Grossman et al., 1989). Beliefs impact not only what and how preservice teachers teach (Bryan, 2003; Bryan & Abell, 1999; Grossman et al., 1989; Yerrick & Hoving, 2003), but also their conceptions and orientations of what is important to teach in a particular domain. For example, a preservice physical science teacher may believe that the structure and properties of matter is most important to his class. Thus, he or she may spend a significant amount of time in the course covering the set of topics around that concept. As Grossman et al. (1989) pointed out, "beliefs about subject matter are as powerful and influential as their beliefs about teaching and learning" (p. 32). However, as mentioned earlier, the development of preservice science teachers' subject matter knowledge is primarily dependent upon their experiences outside of departments of education. In those departments (e.g., biology), their main goal is to create scientists, which can conflict with the goals of teacher education. The goal of teacher preparation programs is not to develop subject matter experts, but to develop experts in teaching subject matter knowledge (Cochran, DeRuiter, & King, 1993).

Pedagogical knowledge. Another type of knowledge essential to preservice teachers of science is pedagogical knowledge. This type of knowledge refers to the art or science of teaching and includes knowledge of teaching strategies. It is grounded in knowledge of learning and knowledge of assessment (Morine-Dershimer & Kent, 1999). If preservice science teachers lack knowledge of teaching strategies, they will likely face many hurdles when they enter the

classroom (Bryan, 2003; Bryan & Abell, 1999; Smith & Neale, 1989). Science teacher education programs must equip their preservice teachers with a plethora of methods for teaching students with diverse learning needs and an understand reasons for making certain pedagogical decisions (Yerrick & Hoving, 2003).

Curricular knowledge. Curricular knowledge is an understanding of the curriculum that guides education programs and/or the teaching of subject areas. This form of knowledge consists of the courses and programs that designate what particular topics should be covered at specific grade levels (Shulman, 1986b). It is grounded in knowledge of content and knowledge of assessment (Morine-Dershimer & Kent, 1999). Shulman (1986b) describes it as the "pharmacopeia" of materials and guidelines that enable a teacher to present specific content and describes it as the most ignored aspect of teacher education. In addition to the curriculum that is mandated by schools and states, teachers must also be aware of national standards and criteria that are deemed valuable to students' learning (e.g., National Science Education Standards (National Research Council, 1996). Additionally, Shulman (1986a, 1986b) described two other forms of the curriculum of which teachers must be aware. First, preservice teachers must be aware of the lateral curriculum, which is the set of topics being covered in the other classes of their students. By being aware of the topics students have covered in other classes, teachers are able to better know the prerequisite knowledge of their students and determine the topics they might need to spend more time covering. Second, preservice teachers must become aware of the "organizational, interactional, social, and management aspects of classroom life," which Shulman (1986a, p. 8) deems the hidden curriculum. That type of knowledge is principally contextual in that preservice teachers, through their own experiences, must discover much of the

hidden curriculum because each school has its own unique characteristics (Shulman, 1986a). Teacher education should help these teachers begin to develop this knowledge (Shulman, 1986a).

Craft knowledge. Craft knowledge, of which preservice teachers should also be aware, is the collection of wisdom from teachers' and researchers' understandings of the dilemmas of teaching (Grimmett & MacKinnon, 1992). This type of knowledge, which is based on judgments when maxims of teaching and research are not applicable (Grimmett & MacKinnon, 1992), enables preservice teachers to understand how teachers apply certain routines to specific circumstances that arise in teaching and learning situations (Cope & Stephen, 2001). Preservice science teachers can gain craft knowledge through two avenues: experience (Grimmett & MacKinnon, 1992) and through shared experiences with in-service teachers (Zuckerman, 1999). As Grimmett & MacKinnon (1992) note, craft knowledge is neither a technical skill of simply applying a theory nor is it a type critical analysis; it is the "knowing how" aspect of teaching. This type of knowledge is important to preservice teachers because, as they develop it, they are better able to handle those situations of teaching that require thinking on your feet and being able to better assess instructional decisions as they are taking place.

Pedagogical Content Knowledge. Pedagogical content knowledge (PCK) (Shulman, 1986b) is the link between the two areas of subject matter and pedagogical knowledge (Cochran et al., 1993; Shulman, 1986b) and is defined by its relationship with subject matter knowledge and pedagogical knowledge (Carlsen, 1999). Specifically, PCK is the "subject matter knowledge for teaching" (Shulman, 1986b, p. 9) that distinguishes subject matter experts from teachers who are experts with the subject matter (Cochran et al., 1993). It can be described as a teacher *transforming* the subject matter for teaching through (a) *reflection* and *interpretation* of the subject matter, (b) the identification of multiple ways to *represent* the content (e.g., metaphors

and analogies), (c) *adaptation* of the subject matter to the students' capabilities, and (d) *tailoring* the instruction to the specific group(s) of students that will be taught (Shulman, 1986b, 1987; Smith & Neale, 1989).

Development of PCK, which is a type of knowledge unique to the profession of teaching, is important to preservice teachers because it affords them the capability to design opportunities for learning specific content in ways that are more understandable to students (Shulman, 1986b, 1987). Additionally, PCK requires that preservice teachers equip themselves with multiple means of addressing the needs of their students. This requirement requires preservice teachers of science to extend their arsenal of teaching strategies and methods for addressing content (Shulman, 1986b). However, preservice science teachers should not be expected to leave teacher education programs as PCK experts because of two factors: time and learner knowledge. PCK development requires a significant amount of time and authentic, meaningful experiences to foster its growth (Cochran et al., 1993; Van Driel, De Jong, & Verloop, 2002). Additionally, preservice science teachers have limited knowledge of the learners they are teaching and the classroom environment (Zembal-Saul et al., 2002), two areas in which preservice teachers must be aware in order to become proficient in PCK (Shulman, 1987; Van Driel et al., 2002). Becoming aware of the learners and classroom environment helps preservice science teachers address the needs of their students (Cochran et al., 1993) and requires them to look at learning from the students' perspective. Even though PCK development may take years to acquire, teacher education programs must help preservice science teachers begin to develop this type of knowledge.

Summarizing preservice teachers' development of knowledge

As this section has noted, the development of teaching knowledge is perhaps the most fundamental goal in teacher education. Hence, teacher education programs utilize several strategies and techniques, such as requiring strong understanding of subject matter, increasing Science Technology and Society focus, and using a reflection-orientation to teaching, to achieve this goal (Abell & Bryan, 1997; McCray, DeHaan, Schuck, 2003; Thorén et al, 2005; Yager & Roy, 1993). In science education, these strategies are based upon current standards-based reform movements (e.g. inquiry-based learning, scientific literacy, and Science Technology and Society focus), which have established important criteria to be infused into teacher preparation programs (NSTA, 2003; NRC, 1996; AAAS, 1993). Infusing standards has clarified expectations of preservice teachers and challenged preparation program's benchmarking of progress towards the science education community's valued outcomes towards, in particular, the development of teaching knowledge. The NSTA (NRC, 1996) standards, for example, state that teachers of science must be able to "grow and change, personally and professionally, to meet the diverse needs of their students, school, community, and profession" (p. 30). One mechanism often recommended for supporting preservice teacher knowledge development is formative assessment. Formative assessment is a process that enables learners, or practitioners, to take control and self-regulate their own learning (Nicol & Macfarlane-Dick, 2006). In teacher education programs, formative assessment is most often realized through reflection or self-assessment (Artzt, 1999; Beck, Livne, & Bear, 2005; Bryan, 2003; Boud, 1995; Boud & Walker, 1998; Darling-Hammond & Snyder, 2000; Hoover & Carroll, 1987; Ostrander, 1986; Ross & Bruce, 2007). Furthermore, formative assessment of teaching practices provides the possibility

and potential for preservice teachers to critically examine their teaching and identify ways in which they may better their teaching practices.

Formative Assessment in Teacher Education

This conceptual framework is informed by literature on both self-assessment and reflection. Reflection and self-assessment are types of formative assessment that support preservice teachers' development of teaching knowledge (Bryan, 2003; Darling-Hammond & Snyder, 2000; Ross & Bruce, 2007). In the subsequent section, these forms of formative assessment are defined and explanations of their use for teachers' development of knowledge are presented.

Reflection

The idea of improving one's practice through reflection is neither new nor revolutionary. Reflection is an ancient concept that dates back to Aristotle and Confucius (Houston, 1988). In the early 1900s, Dewey advocated reflection as a means to understand and improve teacher practices. He made the argument that teacher education programs should support and promote reflective thinking in order to enable teachers to address problems or dilemmas related to their teaching practice (Dewey, 1933). He asserted that if teachers are not able to inquire about and examine their own practices, professional development would be stymied and teachers would become dependent on others to make instructional decisions for them.

Over the last couple of decades, works based on the principles of Dewey have developed an abundance of theory and philosophy related to reflection. Calls for the use of reflection to increase knowledge of teaching and learning have been suggested (e.g. Artzt, 1999; Bryan, 2003; Bryan & Abell, 1999; Zembal-Saul et al., 2002). In addition, there has been a shift in the image

of the teacher from that of a technical rationalist, one who makes predictable and rigid decisions, to that of reflective practitioner (Anderson & Mitchener, 1994; Schön, 1987).

Elements of Reflection

Reflection is a systematic process in which practitioners examine specific aspects of their practice. At the core of reflection is the critical and careful examination of one's practices (Schön, 1987). However, reflection is not simply recalling and replaying ideas. Instead, reflection is a process for examining the outcomes and looking back on the actions that preceded an event (Dewey, 1933). By examining events of classroom practice, reflection not only allows the teacher to propose changes in practice, but also requires the teacher to predict the consequences of making those actions (Dewey, 1933). At the core of reflective practice is addressing the "indeterminate zones of practice" (Schön, 1987), which are the "messy" and unique situations that arise during teaching practice. The key to making reflection meaningful is identifying the similarities and differences between the messy situation and previous experiences, which must be done through framing the problem (Barnes, 1992; Schön, 1987). For preservice teachers, three essential components of reflection are needed: framing, reframing, and coaching.

Framing. A teacher's frames are the components of teacher practice that can be critically examined (Barnes, 1992). Frames, which are the set of assumptions that inform and guide a teacher's teaching (Barnes, 1992), are influenced by several factors (e.g., beliefs, values, conceptions about teaching and learning, etc.). Preservice teachers' develop pedagogical knowledge, subject matter knowledge, and beliefs about teaching and learning through their experiences before and during their teacher preparation programs. Through those experiences, they develop frames for teaching, however naïve or incomplete they may be, that will guide their

practices. As stated by Russell and Martin (2007), "a fundamental challenge [of learning to teach science] resides in the prior teaching and learning beliefs and experiences of those learning to teach" (p. 1151). Experienced teachers, on the other hand, have had years to develop a repertoire of frames (Barnes, 1992), which allow them to adapt and apply different frames to unique situations or circumstances as they arise. However, preservice teachers do not have this luxury and must make use of the limited number of frames they have for teaching.

Framing as a component of reflection is a non-technical process that enables teachers to begin to identify the problem in their teaching practices (Schön, 1983). The process of framing allows teachers to reflect on their practices meaningfully by identifying situations from the complex web of classroom events in measurable and manageable fashion (Barnes, 1992). The framing of the dilemma (Schön, 1987), perturbation (Bryan, 2003), or conflict enables teachers to critically examine and identify areas of their teaching frames they may deem complete or those that need modification (Barnes, 1992). The act of framing is a critical first step towards enabling teachers to reflect on their practices (Barnes, 1992). This process gives practitioners a place to start and allows them to begin to understand their underlying cognitions (Artzt, 1999) and begin to understand and address their beliefs about teaching and learning (Bryan, 2003; Bryan & Abell, 1999).

Reframing. After teachers have identified a problematic situation of their teaching and recognized that either the frame used to guide and structure their teaching is incomplete or missing altogether, they must develop a new frame that can be incorporated into the situation (Schön, 1987). This act of developing a solution for issues of practice (Dewey, 1933; Schön, 1987) involves reframing, which is a process of teacher inquiry where teachers reflect on their "puzzling" frame for teaching and develop a solution for solving the puzzle (Russell & Munby,

1991). The key to reframing is seeing the problem differently (Schön, 1987) and formulating a new perspective, preconception, and/or theory about practice to develop a new frame for teaching (Russell & Munby, 1991). Thus, reframing enables teachers to constantly refine, develop, and grow as professionals.

Coaching. The final component of reflection particularly critical to preservice teachers is coaching. Coaching allows the preservice teacher to see reflection modeled and share and develop knowledge in coordination with teacher educators (Basile, Olson, & Nathenson-Mejia, 2003). As described earlier, preservice teachers have little experience in teaching and struggle with pedagogical and content knowledge. However, teacher educators, who assume the role of coaches, have well developed repertoires of teaching knowledge resultant of their extensive experiences and time in education (Schön, 1987). Coaches allow preservice teachers to see the reflective process modeled (framing and reframing), which can help preservice teachers begin to seek alternatives in their practices, examine the intended and unintended consequences of their solutions, and address their underlying beliefs about teaching and learning.

Strengths and Weaknesses of Reflection

Reflection is not without its share of criticism. One of the weaknesses of reflection is that it is not always enacted as a systematic process that critically examines teaching practices. This problem is related to two specific issues: a) the definition of reflection has become watered down in the last ten to fifteen years (i.e. there is not agreed upon definition of what reflection is and what it should look like) (Boud, 2006; Boud & Walker, 1998; Laboskey, 1993) and b) reflection has too often become a set of procedures that does not produce careful thought and consideration to the issues being examined (Boud & Walker, 1998; Laboskey, 1993). Subsequently, the use of reflection for examining teaching does not always result in significant changes in teaching

practices. If reflection is to be a critical component of self-assessment, then we must revisit its roots embodied in the work of Dewey (1933) and Schön (1987). They grounded reflection in evidence of teaching practice rather than on recall and intuition. Addressing this need will allow teachers to set a course of action (i.e. a detailed process for addressing issues of practice) to improve their teaching practices.

Summarizing Reflection

As this section noted, three main elements, which are framing, reframing, and coaching, are essential to teachers' reflective practice. It is through these processes that teachers are able to engage in a reflective conversation with their teaching situation (Schön, 1987). Through the critical examination of their teaching practice, teachers can identify areas of their teaching that require further exploration. Since there is not a specific framework for engaging in reflection, many teachers are unsure of how to reflect on their teaching practice. However, practitioners, who are able to systematically and thoroughly engage in reflection by critically examining their teaching, are able to develop a deeper understanding of their teaching practice.

Research Findings about Reflection

A study by Bryan and Abell (1999) examined how preservice science teacher's developed professional knowledge through reflection. Their case analysis examined and identified the tensions one preservice teacher, Barbara, experienced as she reflected on her teaching practice. Those tensions resulted from Barbara's confrontations with her beliefs about teaching and learning and her actual teaching practice as she reflected on her teaching. By reflecting on her teacher, Barbara identified that her beliefs about teaching were inconsistent with her actual teaching practices. Through reflective practice Barbara was able to confront those inconsistencies and develop solutions for teaching in a manner that resonated with her beliefs.

Bryan and Abell's study identified and underscored the significant role that (a) beliefs about teaching and (b) previous experiences have on preservice teachers' development of professional knowledge. Additionally, Bryan and Abell (1999) identified the need to begin providing reflective experiences to preservice teachers early in their teacher education program.

In another qualitative study, Land and Zembal-Saul (2003) used case study methodology to examine preservice science teachers' use of computer-based scaffolds to support the development of scientific explanations and reflection on those explanations. In their study, the researchers developed two cases from two pairs of students enrolled in a science course designed for prospective teachers. Land and Zembal-Saul (2003) collected data as the students completed a computer-based module on the nature of light. They discovered that computer-based scaffolds could support scientific explanation and reflection if certain conditions were met. Specifically, they found that the preservice teachers' prior knowledge had a significant impact on their ability to articulate, explain, and reflect on their scientific understanding. Preservice teachers with low prior knowledge had difficulty in developing explanations and reflecting on their teaching. Those preservice teachers would either ignore the scaffolds or respond that they did not know the answer. Yet, preservice teachers were able to develop explanations and reflect on their scientific understanding if they had higher levels of prior knowledge. Furthermore, the computer-based scaffolds increased the level of interaction between the participants and prompted them to more fully develop their explanations and reflections. This study highlighted the need to provide appropriate levels of assistance in order to encourage explanation and reflection. Scaffolds and additional support, if needed, should be provided to encourage meaningful reflection to augment low levels of prior knowledge.

Working Definition of Reflection

In this study, reflection is defined as a systematic process for the analysis and examination of specific, well-defined issues or events of teaching. Through this process, teachers deconstruct and analyze events or issues of practice in order to further develop their knowledge of teaching and learning (Shulman, 1987). Furthermore, reflective practice should be informed by evidence in order to accurately analyze issues and events so that solutions can be developed.

Self-Assessment

Like reflection, self-assessment of teaching practices should be looked at through the lens of formative processes for teacher development (Barber, 1990), which are intended to assist teachers in their own decision-making practices in order to improve, or change, their own teaching practices (Barber, 1990). One of the primary concerns with teacher self-assessment is that it often does not take into account reform-based efforts in teacher education (Wilson, 1995; Darling-Hammond & Snyder, 2000). Specifically, most forms of self-assessment were entrenched on a teacher-centered, didactic view of teaching (Wilson, 1995; Darling-Hammond & Snyder, 2000; Rennert-Ariev, 2005). However, studies (e.g., Hoover & Carroll, 1987; Ross & Bruce, 2007) have shown that self-assessment can lead to change in teaching practice. With recent shifts in perspectives on self-assessment, both the value and nature of self-assessment is changing dramatically.

Components of Self-Assessment

Self-assessment is the formative assessment of one's teaching process or products. Self-assessment is comprised of multiple elements that complete the entire process. Barber (1990) describes an early effort in the reformation of self-assessment. He describes the components of self-assessment through three primary steps: 1) the identification of teaching behaviors, 2) the

identification and improvement of problem areas, acknowledgement and maintenance of teaching strengths, and the implementation of new behaviors, and 3) a continued examination of new behaviors. This cyclical framework for self-assessment can be described as "data collection, behavior modification, and reevaluation" (Barber, p. 218).

Darling-Hammond and Snyder (2000) provide a more recent framework for self-assessment, which has been labeled as authentic assessment. They stated that authentic assessment is comprised of four steps: 1) making use of the contexts in which teaching and learning take place to sample the knowledge and skills of teachers, 2) integrating multiple forms of skill and knowledge, 3) making use of evidence from multiple sources, and 4) using professional standards to evaluate teaching. They also detailed four mechanisms for supporting authentic assessments in teacher education programs – "cases, exhibitions, portfolios, and problem-based inquiries (or action research)" (p. 523).

Even though there has been an urgency to promote and support self-assessment, the use of frameworks for conducting self-assessment has often been met with criticism and skepticism. One criticism that teacher educators have raised is that many self-assessment frameworks are de-contextualized and focus only on teacher-centric practices and behaviors (Darling-Hammond & Snyder, 2000; Wilson, 1995; Rennert-Ariev, 2005). Another criticism of available self-assessment frameworks is that they do not "reflect the complexity of teaching" (Darling-Hammond & Snyder, 2000, p. 526). As Hoover and O'Shea (1987) noted, teachers examine fewer aspects of teaching when using de-contextualized assessment instruments that include narrow set of teaching behaviors. That is, they do not examine issues of teaching and learning outside of the behaviors and concerns provided by the assessment instrument. Another concern with self-assessment frameworks and instruments is that they are often "insufficiently context

sensitive" (Darling-Hammond & Snyder, 2000, p. 525) and do not make use the necessary forms or types of evidence necessary required to understand and interpret complex teaching and learning environments (Darling-Hammond & Snyder, 2000). Finally, as noted in Chapter 1, the processes and procedures for assessing one's own practices remain ill-defined (Darling-Hammond & Snyder, 2000; LaBoskey, 1993). Thus, we have little understanding about a systematic approach for conducting self-assessment is known. In the following section, studies in which self-assessment has led to change and professional growth are presented.

Research Findings of Self-Assessment

Hoover and Carroll's (1987) study of 53 K-7, inservice reading teachers found that teachers were able to change their teaching behaviors through self-assessment. The participants in their study, who used audiotaped recordings of teachers' own classroom practices, analyzed their own teaching practices in coordination with a self-assessment checklist. The checklist identified narrow, basic components of classroom teaching (e.g., lesson introduction, lesson closure, student-teacher interaction, etc.). To complete their self-assessments, each of the participating teachers completed the self-assessment checklist while listening to their own audiotaped lessons. After analyzing their first audiotaped lesson, the teachers were asked to note the specific changes they would like to make in their teaching practices. A second lesson was audiotaped and the teachers completed the self-assessment checklist again. From their two self-assessments, Hoover and Carroll were able to identify that teachers could change their own teaching practices through self-assessment. Furthermore, they also noted that teachers were willing to use self-assessment instruments (i.e. the checklist) because the items on the instrument were valuable to the teachers' own classroom practices (Hoover & Carroll, 1987).

In another study, Ross and Bruce's (2007) exploratory qualitative study examined ten, seventh-ninth grade mathematics teachers use of self-assessment for professional growth. The study presented their findings primarily through a case of an individual teacher, Barry. In their study, the researchers designed a self-assessment rubric based on the National Council of Teachers of Mathematics (NCTM) mathematics standards, which was made available on the Internet. The study's intervention included classroom observations, self-assessments, and peer observation. From their study, the researchers were able to identify that their self-assessment process and rubric prompted Barry to a) modify how he defined mathematics teaching excellence, b) better identify his teaching successes and areas in which he needed to change, c) set goals for implementing change, and d) better understand the goals and standards of his academic discipline. However, the study also highlighted that some teachers are resistant to self-assessment in that they either found the self-assessment instrument to be too narrow or they rejected it altogether. Also, some teachers did not demonstrate professional growth because their own teaching values and beliefs were more closely aligned with traditional views of teaching, which contrasted the progressive, contemporary mode of teaching that their self-assessment instrument supported.

Working Definition of Self-Assessment

In this study, self-assessment, like reflection, is defined as a systematic process for the analysis and examination of specific, well-defined issues or events of teaching. The process of self-assessment enables preservice teachers to address specific areas of their teaching practice. However, unlike reflection, the act of conducting self-assessment implies the use of an instrument that scaffolds or prompts preservice teachers' to examine specific, narrow issues or events of their teaching practice (Beck, Livne, & Bear, 2005; Hoover & Carroll, 1987; Ross &

Bruce, 2007). Those instruments may be a checklist (e.g., Hoover & Carrol, 1987), a rubric (e.g., Ross & Bruce, 1987), or teacher portfolio requirements (Beck, Livne, & Bear, 2005).

Technology-based Support Mechanisms

Considering that self-assessment is widely valued by teacher education as a whole, several technologies have been developed to support teachers' self-assessment of their own teaching practices. In this section, I discuss in detail the following tools used to support self-assessment: electronic performance support systems, case-based reasoning technologies, and video based-technologies.

Electronic-Performance Support Systems

With the influx of faster, cheaper computers in the mid-1980s, instructional designers began to shift their attention toward using and incorporating the computer for classroom teaching and learning to address performance related issues (Reiser, 2001). Concurrently, constructivist views of learning had begun to be adopted and strongly promoted in education. Because of this shift, the task for instructional designers and educators became to design and develop authentic learning activities to help learners construct knowledge (Reiser, 2001). One way to accomplish that goal is through the use of Electronic Performance Support Systems (EPSS).

EPSSs "are computer-based systems designed to provide workers with the help they need to perform certain job tasks, at the time they need that help, and in a form that will be most helpful" (Reiser, 2001, p. 63). Furthermore, EPSSs should be unobtrusive and "*embedded* in the work process" providing just-in-time support from information resources to help learners perform and gain competence (Duchastel & Lang, 1995, p. 57). Gery (1995) stated that EPSSs should help learners complete tasks by providing them with usable knowledge and tool sets. Additionally, EPSSs should guide, or scaffold, tasks to help learners generate meaningful, valid

products. Over time EPSSs may improve performance by reducing the burden of training demands and allow expertise to be developed more quickly (Duchastel & Lang, 1995). When expertise is developed, the scaffolds supporting the learner's needs may no longer be needed as they become more content and satisfied with their performance (Sherry & Wilson, 1996). Those findings imply that EPSSs may support learners autonomously – helping them to perform tasks without the need for additional, external support. However, research has found that users of EPSSs do not want systems that are entirely standalone. Instead, learners expressed the desire for external, human guidance and support (Duchastel & Lang, 1995; Sherry & Wilson, 1996). In the following section, how EPSSs have been used to support learning is briefly discussed.

Learning with EPSSs. Duchastel and Lang (1995) described two aspects of learning that must be addressed and understood when developing and/or using an EPSS. First, one must understand the internal processes that guide learning, which are the underlying cognitive principles. For example, if a developer believes that learners construct knowledge, the EPSS should be designed using constructivist approaches. Second, the learning context has to be taken into account. That is, both the learning environment and the needs of the learner must be considered during the design and implementation of the task in order to ensure desired outcomes.

Hannafin, Hill, and McCarthy (2000) stated, "EPSSs may provide a different type of learning activity, one characterized more by manipulation than accumulation, and more by construction than compilation" (p. 31). Their statement implies that EPSSs allow learners to develop and build knowledge by working with and through the use of resources. This notion becomes more apparent when examining the differences between traditional instructions and instruction provided by EPSSs. Typically, traditional modes of instruction present opportunities for learning supported by practice, or example, problems. Conversely, with EPSSs, the learning

situation, or demand, provides the problem context, which then presents learning opportunities (Duchastel & Lang, 1995). EPSSs have been used in several contexts (e.g., teacher education and workforce training). The following section discusses three studies that examined the use of EPSSs to provide support in educational settings.

Implementations of Electronic Performance Support Systems

Bastiaens (1999) examined the abilities of instructional designers as they conducted a task analysis using an EPSS. The study was comprised of two groups – a control group that used traditional classroom instruction and an experimental group that made use of an EPSS. Bastiaens identified that the EPSS group exhibited lower levels of learning than that of the control group. He speculated that this was resultant of the EPSS group's lack of resource use, which was provided through the forms of Information (e.g., definitions and principles) and Computer-Based Training (e.g., tutorials). However, the EPSS group members did produce better, higher quality products than the control group. This difference was attributed to the subdividing of tasks for the EPSS groups based on the premise that task division made the problem easier to solve. In addition, both groups required the same amount of time to produce products and exhibited similar levels of satisfaction in performing the task analysis.

In-service teachers. Moore and Orey (2001) investigated inservice teachers' use of an EPSS in their daily activities and its impact on the work performance. The study, which involved four novice teachers, identified, like Bastiaens, that the teachers did not make use of or take advantage of all of the components afforded to them by the EPSS. Instead, the teachers primarily used only those components that granted them better use of their time. For instance, most of the teachers took advantage of the student-progress reporting component in which their productivity was increased. However, the researchers noted that the gain in performance could have been

easily attributed to their school's traditional, inefficient policy for generating progress reports. Overall, teachers in this study displayed positive attitudes towards the system, but they primarily saw it as a tool for more efficiently using time and record keeping.

Preservice teachers. Wild and Kirkpatrick (1995) compared the differences between first year and third year preservice teachers and Wild (2000) investigated only first year preservice teachers. Both of these studies examined preservice teachers' abilities to develop lesson plans using an EPSS, the Lesson Planning System (LPS). The primary findings of both of these studies indicated that through the use of LPS, preservice teachers were able to develop lesson plans more quickly. Additionally, over time, preservice teachers decreased their use of instructional support components of the LPS (e.g., principles and facts) and increased their use of performance support (e.g., lesson plan examples and reflection).

Each of the EPSS uses described above illustrates the potential to improve the performance of learners. However, does improving performance imply that users of EPSSs' practices are being changed and/or improved? According to Duchastel and Lang (1995), performance is practice. However, I contend that improving efficiency (e.g., generating lesson plans or student progress reports more quickly) or providing convenience, as most research identifies, does not illustrate a significant shift in practice. Instead, learners only accommodate those components of EPSSs that address their specific needs, giving little notice to the learning opportunities or resources made available to them.

Furthermore, what seems to be missing is a systematic approach for providing learners with meaningful resources and scaffolds to help them improve their practices. Hannafin, Hill, and McCarthy (2000) provide a possible solution for EPSSs to improve practices through resource-based approaches, which include the components of resources, contexts, tools, and

scaffolds. In addition to the types of declarative knowledge commonly found in EPSSs, resource based-approaches for EPSS design "offer the situational relevance in a flexible development/delivery environment" (Hannafin, Hill, & McCarthy, p. 5). Thus, the meaning, or purpose, of resources can be situated within and applied to multiple contexts. For example, a preservice teacher might be asked to develop a lesson plan for a 12th grade mathematics class as part of his teaching practicum. The teacher educator might have the preservice teacher use a specific resource in the EPSS to address his needs. Conversely, a career professional teacher might be using the EPSS to seek resources for her class. Upon finding the same resource provided to the preservice teacher, the career professional teacher interprets and adapts the resource to address her needs and situation whereas the preservice teacher might have to adopt the resource "as is" because of his limited knowledge and experiences.

Another dilemma facing EPSS designers and developers is the transfer paradox (Hannafin, Hill, & McCarthy, 2000). Human knowledge takes on many forms and the difficulty inherent to developing systems that support learning are limited by our capacities to capture and represent knowledge structures, particularly tacit knowledge (Hannafin, Hill, & McCarthy, 2000). Tacit knowledge is knowledge that is readily available and deliverable without conscious thought (Schön, 1987). This type of knowledge is deeply engrained and cannot be easily described or defined. For instance, a career professional teacher might be using inquiry-based teaching strategies in her physics course. She might know the exact time and place to ask a meaningful question to promote student engagement and participation. However, when asked to describe how and when she knew to ask that specific question, she cannot describe the thought processes and knowledge that led her to pose the query. This dilemma leads to the question as to whether tacit knowledge can be captured and represented within EPSSs.

Case-based Reasoning Technologies

Case-based reasoning (CBR) is rooted in the work of Schank and the subsequent work of Kolodner who developed the first CBR system (Aamodt & Plaza, 1994). CBR, which was originally developed in the mid-1980s for enhancing computer cognition and is grounded in artificial intelligence (Kolodner, 1997; Aamodt & Plaza, 1994), is both a methodology and a machine learning paradigm (Aamodt & Plaza, 1994). CBR is based on the premise that people learn by participating in and performing authentic, realistic problems – with the belief that students (e.g., preservice teachers) can learn from the knowledge of others who have experience in solving similar problems (Kolodner, 1992, 1997). CBR also gives special value to failure in promoting learning (Kolodner, 1997; Aamodt & Plaza, 1994). For example, a science teacher may use another teacher's case of a specific questioning strategy to teach photosynthesis. If the old solution is applied with negative outcomes, the science teacher can use the non-desirable experience to generate new solutions for addressing the problem.

Cases are often represented through other peoples' stories (Schank, 1990; Jonassen & Hernandez-Serrano, 2002), which provide a natural, powerful way of understanding and addressing problems (Aamodt & Plaza, 1994). Because "[s]tories are the oldest and most natural form of sense making" (Jonassen & Hernandez-Serrano, 2002, p. 66), they provide preservice teachers with an excellent opportunity for developing professional knowledge through other teachers' or educators' experiences. Jonassen and Hernandez-Serrano (2002) described three ways in which stories can be used for the development of knowledge: 1) exemplars of practice for use in direct instruction, 2) problem cases to be solved by learners (e.g., anchored instruction, goal-based learning), and 3) as advice for solving problems.

When practitioners, or preservice teachers, make use of CBR, they are afforded many opportunities for developing professional knowledge. For example, preservice teachers have difficulty in both teaching and evaluating their teaching due to their lack of experience (Bryan, 2003; Gess-Newsome & Lederman, 1993; Mellado, Blanco, & Ruiz, 1998). Large case libraries augment this problem by providing novices with the knowledge and experience of those who have "been there, done that" – enabling them to work beyond the level of what they know (Jonassen & Hernandez-Serrano, 2002). In addition, CBR provides opportunities for identifying important issues of practice on which to focus and help practitioners develop and formulate ideas about progressing, or improving their practices (Kolodner, 1997). Other benefits of CBR are the fact that cases can continually be updated to sustain learning for future situations (Aamodt & Plaza, 1994) and working with/through others' solutions helps practitioners project and predict the effects of old solutions (Kolodner, 1997).

Case-Based Reasoning Methodology

CBR is typically supported through the use of case libraries (Aamodt & Plaza, 1994; Jonassen & Hernandez-Serrano, 2002; Kolodner, 1997) or specific cases (Abell, Bryan, & Anderson, 1998; Abell, Cennamo, Anderson, & Bryan, 1996). Case libraries are built by collecting stories from skilled, expert practitioners in a domain (Jonassen & Hernandez-Serrano, 2002). These experts help develop cases representative of the knowledge and experiences relevant to the domain for which the library is built, and they supply experiences and solutions to problems that "make a difference" (Kolodner, 1993, p. 12). Specifically, useful cases are those that help the learner reach their goals and warn them about future problems or failures they may encounter (Kolodner, 1993). Thus, cases cannot be constructed without specific outcome goals in mind.

CBR has been implemented in several different contexts, for example, turfgrass studies (Jonassen & Hernandez-Serrano, 2002), technology integration strategies for teachers (Wang, Moore, Wedman, & Shyu, 2003), and preservice teacher preparation (Abell et al., 1998; Abell et al., 1996). When practitioners, or preservice teachers, make use of CBR, they are afforded many opportunities for developing professional knowledge. Preservice teachers, for instance, have difficulty in both preparing and evaluating their teaching due to their lack of experience – a significant issue facing preservice teachers (Bryan, 2003; Gess-Newsome & Lederman, 1993; Mellado et al., 1998). Large case libraries augment this problem by providing novices with the knowledge and experience of those who have "been there, done that" – enabling them to work beyond the level of what they know (Jonassen & Hernandez-Serrano, 2002). In addition, CBR provides opportunities for identifying important issues of practice on which to focus and helps them develop and formulate ideas about progressing, or improving their practices (Kolodner, 1997). Other benefits of CBR are that cases can continually be updated to sustain learning for future situations (Aamodt & Plaza, 1994) and working with/through others' solutions helps practitioners project and predict the effects of old solutions (Kolodner, 1997).

The CBR methodology is defined by the four REs: retrieve, reuse, revise, and retain (Aamodt & Plaza, 1994). In retrieving practitioners identify a problem in their practice and select a case from the library that is most similar to their problem. For example, a preservice mathematics teacher might identify a problem of incorporating technology into her lessons and seek ideas and strategies from the experiences of other teachers. After selecting the case that is most similar to her own, she begins the reuse phase. In reuse practitioners can choose to either copy or adapt the knowledge from the old case to address their problem. For example, the preservice mathematics teacher may choose to adopt the old solution "as is" – simply copying

the retrieved case. However, if she wishes to make some alterations to the old case's solution, she adapts it to fit her needs.

If the old solution is found to be incorrect, practitioners should revise the old case. In this phase, teachers evaluate and adjust the old solution by identifying and repairing its faults. The preservice teacher, for example, makes use of the old solution in her classroom and discovers that it did not help her reach desired outcomes, which allows her to learn from failure. In order to develop knowledge, she must repair the faults and retain her new knowledge for later implementation. The retainment phase, which requires extracting and storing meaningful components of the solution, provides opportunities for knowledge development based upon evaluation outcomes and subsequent repairs made.

In the following section, the use of video for analyzing teaching and learning is discussed. Additionally, a technology that makes use of video evidence for supporting self-assessment is introduced. This tool, Video Analysis Tool (VAT), is a web-based technology that allows teachers to examine digitized videos of their own teaching practices.

Video Technologies

The use of video replay for analyzing teaching has been alive for decades (Bloom, 1969; Winn, 1974). However, early on there were limitations due to the bulky equipment, limited access to playback systems such as a VCR (because of initial cost), and the time it took to codify the events. Basically, one had to locate a VCR, travel with a tape in hand, and sit to watch the video with paper and pencil in-hand to watch and write down time codes from the scrolling numbers on the VCR. Furthermore, all too often, the use of video replay in the analysis of one's teaching is neither purposeful, nor systematic.

New video annotation tools have become more accessible and more powerful as the cost of technology decreases. Powerful video cameras now fit in your hand and are available to most consumers. Video annotation tools have been developed using Web 2.0 technology and made accessible through web-based applications on the Internet. In fact, researchers have found systematic methods for assessing one's own and others' practice is possible (Pea & Lemke, 2007; Sherrin & van Es, 2002). The use of the methodology instantiated in a technology-based tool enables users to examine specific teaching-learning events that often are embedded in the complex, multi-dimensional environment of a classroom, and simultaneously reduces the "noise" from extraneous classroom aspects while amplifying critical actions and consequences within the event (Recesso, et al, 2009; Hill, Hannafin, & Recesso, 2007). In effect, the methodology guides the user in strategically deconstructing teaching events. That is, the tools enable one to capture teaching, hold it still in frame through the use of the web-based tool, and then apply instruments that help even the most novice learner of teaching to grasp a critical part of what makes an instructional strategy successful.

The latest video capture and annotation tools, such as the Video Analysis and Content Extraction (VACE, http://www.ic-arda.org/InfoExploit/vace/index.html) and the Digital Video Exploration and Reflection (DIVER, http://diver.stanford.edu/) provide video capture and analysis tools used to define and reflect upon evidence of events. For each of the tools, practices are recorded through video cameras and stored on a secure server for review and analysis. The technology enables on-demand support of the prospective teacher as defined by needs and no longer limited by geography or schedule conflicts. The faculty supervisor, for example, may participate in the field experience without having to travel long distances.

The purpose of many video annotation tools is to encourage prospective teachers to begin untangling the web of deeply entrenched, and often unexplored, mental models of teaching (Bryan & Recesso, 2006). New video analysis tools take this a step further and promote assessment for the purposes of determining growth towards expected outcomes (e.g., standards) and clearly defining needs for support (e.g., professional learning) (Recesso & Zepeda, 2008). In addition, these video annotation tools promote reflective practice and assists prospective teachers in *thinking and acting* on those aspects of teaching that frustrate, confuse, and perplex (Bryan & Recesso, 2006). From these principles and advances in technology, VAT was developed by the Learning & Performance Support Laboratory (LPSL) at the University of Georgia.

VAT is an innovative web-based tool that enables multiple audiences (e.g., researchers, teacher educators, inservice teachers, and preservice teachers) to analyze and examine video evidence of teacher practices (Recesso et al., 2009; Rich & Hannafin, 2008a, 2008b, 2009; Shepherd & Hannafin, 2008). VAT is a powerful tool because it affords its users with the opportunity to work with direct evidence of teacher practices in multiple facets. Those uses include the collection and organization of evidence, observation of teaching practices to the analysis and interpretation of teaching.

Video evidence in VAT can be collected and stored through two means, using a traditional video camcorder or via Internet Protocol (IP) cameras (Recesso et al., 2009). Using a video camcorder to capture teaching practices is often the simplest because common, household video capture technologies can be utilized (Recesso & Zepeda, 2008). However, this form of video capture does have its downsides. First, a teacher or another person must set up and control the video camera, which can be disruptive in K-12 classrooms. Second, after a lesson has been captured via video camera, the video must be converted into a digital format recognized by VAT

and then manually uploaded into the system. However, the use of IP cameras can overcome those issues.

IP cameras are beneficial because they allow classroom practices to be captured remotely (Recesso et al., 2009). Additionally, they allow the conversion and upload process to be automated (Recesso et al., 2009, Recesso & Zepeda, 2008). That is, the teacher or researcher, for example, can schedule a time for a lesson, or set of lessons, to be recorded and the teaching practices are electronically transmitted back to the system. Another benefit of IP cameras is that classroom practices can be observed live or archived and stored for later observation. Additionally, IP cameras do not require a person to be present in the classroom to capture a lesson and the technology does not require the use of videotapes. However, IP cameras do present some challenges. First, the technology is much more expensive and not as readily available as common video camcorders. Second, not all school networks can handle the bandwidth required to transmit video to the VAT system (Recesso et al., 2009). However, as technological capabilities continue to advance, the process of collecting, digitizing, and uploading video evidence will become more streamlined and take less time.

Once video evidence has been uploaded in the system, users can access their videos via VAT's web-based interface. Before a user analyzes a video, they can select a lens to aid in their analysis (Recesso et al., 2009). Lenses are frameworks or attributes of practice that help users assess specific attributes of teaching practice. For example, a lens might be a state or national standards or a set of guiding questions or prompts that focus a user's analysis. The frameworks are designed to prompt users to systematically and purposefully assess their own practices (Recesso et al., 2009; Recesso & Zepeda, 2008).

After a video has been selected, users access the video through the "Analyze Video" interface in VAT (see Figure 1). Through this interface, video playback in can be controlled and manipulated through standard video controls similar to those of a VCR (e.g., play, pause, rewind, fast-forward). With the "Analyze Video" interface, users can create clips of the lesson. Clips are segments, or chunks, of the video that represent a specific section of the video. Once a clip has been created, users can code, or annotate, the video in the "Comments" window. This annotation can take on represent several forms, such as reflective writings, self-assessments, or narrative descriptions. For example, inservice elementary science teachers used VAT to develop evidence-based explanations when reflecting on their teaching practice (Deaton, 2007). Users can also associate lens attributes with their annotation if a lens was selected before they began their analysis (Recesso et al., 2009; Recesso & Zepeda, 2008). After users have completed their annotation the clip can then be saved and accessed later for review or modification.

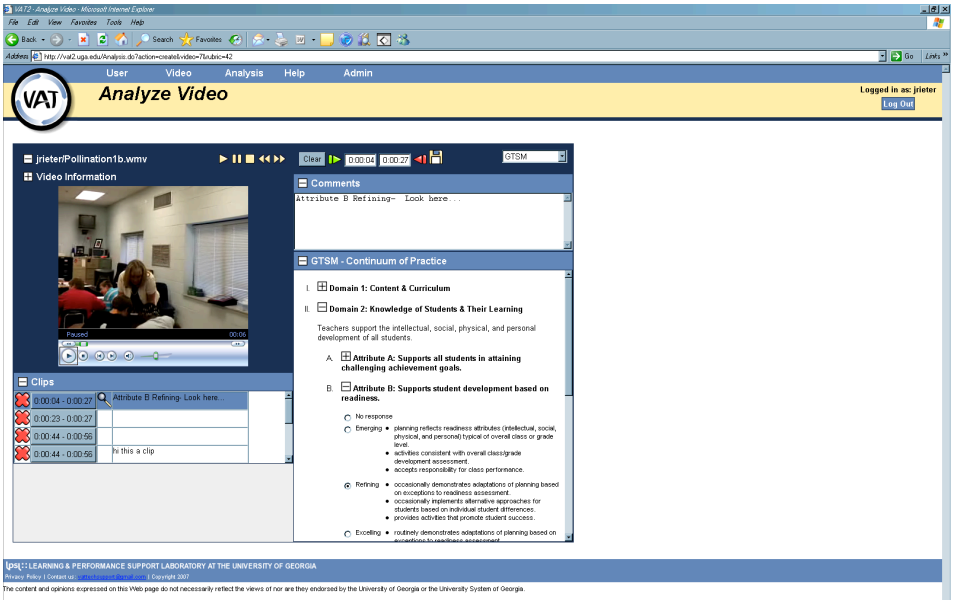

Figure 1. Analyze Video interface in VAT.

After users have completed their analyses of video practices, users can view or share their analyses with other users of VAT (Recesso et al., 2009; Recesso & Zepeda, 2008). For example a preservice teacher could go back and review her own analysis or she could share her analysis with a university supervisor or mentor teacher. This capability is accomplished through the "View Analysis" interface (see Figure 2). For privacy and security purposes, the owner of the video controls who can access video of their teaching practice and their written analyses. That is, the owner is the only person who can authorize another user to access or analyze video of their teaching practices (Recesso et al., 2009, Recesso & Zepeda, 2008). In the following section, the history of the methods used to support the interpretation of evidence with VAT is discussed.

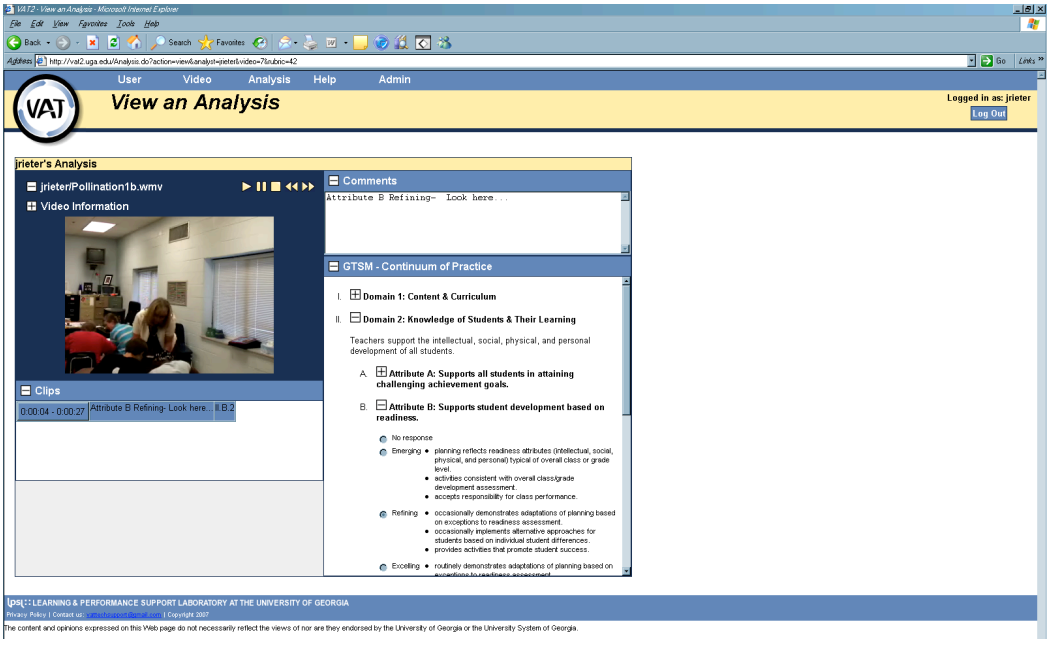

Figure 2. View Analysis interface in VAT.

Systematic Methods to Interpret Evidence.

The LPSL has a history of receiving external funding to pursue a line of research on systematic uses of video. This section is an account of research activities led by Recesso and Hannafin from 2003 to 2008 through the Evidence Based Decision Support Research Collaborative in the LPSL (LPSL, 2008). This background information provides context and a historical perspective about how the how the methods and tools emerged over time. The story is based on personal accounts, unpublished documents (some working documents), and annotated artifacts of the work that went into developing a new approach to performance assessment (Recesso & Hannafin, 2003; Recesso, Hannafin, & Cohen, 2005).[1]

Background

Evidential Reasoning and Decision Support (ERDS) is a conceptual break from the reliance on testing and commonly used statistical approaches to explaining the quality of teaching. The approach has emerged over time through research and development efforts that involved both close collaboration with practitioners in the field of education and scholars from other sectors such as law, artificial intelligence, and medicine. This is an effort to chronicle the development of this systematic approach and how it can be used for performance assessment to support growth, specifically preservice teacher self-assessment.

An Evidence-based Approach

Recesso and Hannafin (2003) received a US Department of Education Preparing Tomorrow's Teachers to use Technology (PT3) Program grant to study evidence-based approaches to assessment of preservice teachers' technology integration. Goals of the Evidence-based Technology Enhanced Alternative Curriculum in Higher Education (ETEACH) project at

[1] Materials retrieved from Dr. Recesso's files from the grants, weekly meetings, unpublished working documents, and project files. Used with permission.

the Learning and Performance Support Laboratory (LPSL) at the University of Georgia (UGA) included the design and development of new evidence-informed methods for assessing preservice teacher practice. Prior to the grant being written, the approach was known as Evidence Based Practice (EBP) reflecting a literature review of methods used to inform practices in the health sector, specifically nursing. However, it became clear that evidence-based practice, a term widely used in the health sector, had a widely shared association with the use of empirical research, and especially clinical trial, to inform the choices of practice. Education, it was reasoned, was more in need of an investigative approach, one that would improve understanding and make accessible the intricacies of teacher practice. Very soon, the approach was redeveloped to include a five-stage methodology and renamed Evidence Based Inquiry (EBI) (See Figure 3).

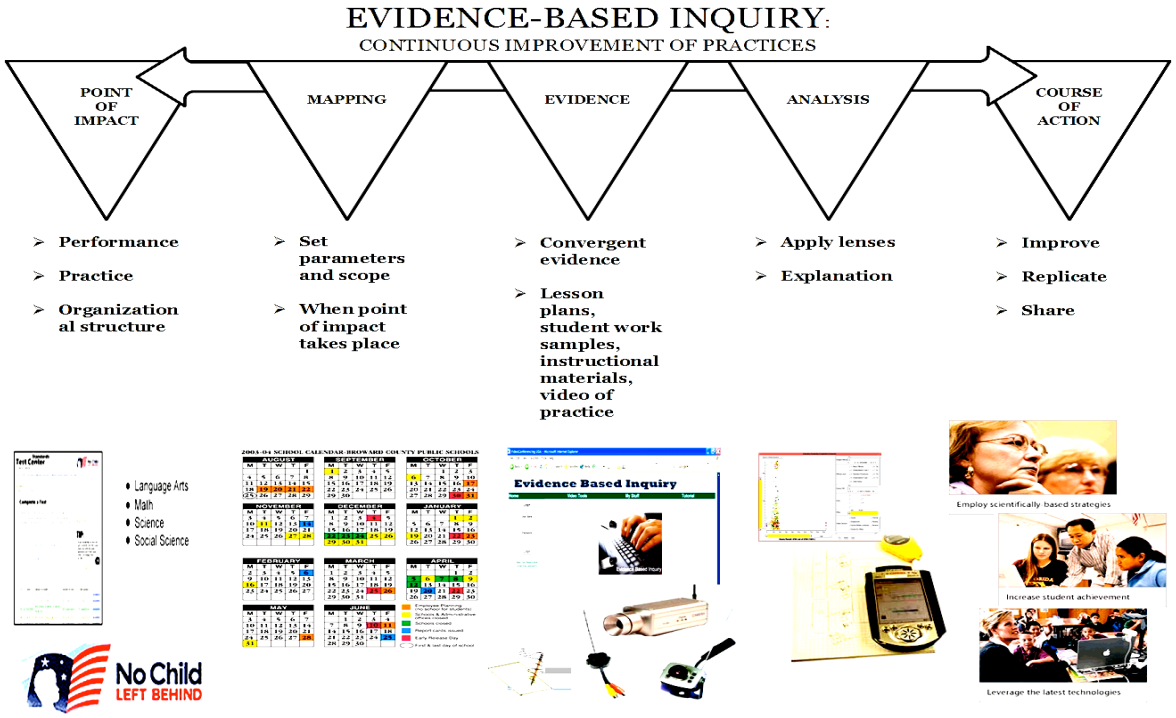

Figure 3. Stages of Evidence Based Inquiry (from Recesso et al., 2009)

The idea for EBI emerged from earlier research Recesso (1999) had conducted investigating the extent to which Elmore's (1982) backward mapping was an effective approach to policy analysis. Recesso found the backward mapping approach to assist in the localized analysis of events (Recesso, 1999). Furthermore, it was Elmore's concept of a 'point of impact', the closest proximity to the event of interest (e.g., reform represented as change in teaching practices), was a way centering attention in the midst of chaos. Building on the idea of using a point-of-impact as a focal point, EBI emerged to extract understanding through systematic collection, interpretation, and explanation of events.

EBI was presented as an iterative process centered on using evidence to plan and monitor a trajectory of progress. Practitioners (e.g., teacher), support professionals (e.g., mentor), and raters (e.g., principal) refine both knowledge and practices by using authentic learner and instructor evidence, reifying performance goals and identifying inconsistencies between espoused and actual practices. EBI inquiries consisted of five stages based on numerous assumptions (Recesso et al., unpublished document).

Stage 1: Define Point of Impact

The Point of Impact (POI) was thought of as a prepositional statement, one that would define the deficiency or success in performance or practice to be addressed. It was also intended that the Point of Impact as an initial assumption, one that would be refined through the stages – often evolving from very global (decision making) to fine grained (selecting appropriate instructional strategies for teaching fractions content) elements of performance, practice, or organizational structure. The assumption was that any rater or practitioner would generate the POI based on intuition, unsubstantiated evidence, or corroborated evidence that suggests or delineates a weakness (or strength) that can be systematically addressed. Hence, the intent was

for EBI users to improve their practices by systematically pinpoint a POI (i.e. the attribute of performance they want to improve or replicate) and associate it with evidence to better understand the attributes and even causes. Early trials of the approach proved that the POI terminology was foreign to educators and the concept of stating a specific attribute of performance as the center of attention was more difficult than expected.

Stage 2: Mapping Parameters and Scope of Work

The second stage of EBI involved systematically connecting the point of impact (e.g., stated expectations of student achievement) to scheduled events (e.g., deliberate practice for improvement in student performance), further specifying the evidence as needed. Practitioners, support professionals, or raters specify the scope of the inquiry process (e.g., an instructional strategy) and set parameters for the inquiry in closest proximity to the point of impact (e.g., a series of activities focusing on specific learning standards).

Mapping, it was thought would help raters and practitioners actively set the scope and parameters for *collecting evidence* and *analyzing the POI* by using existing artifacts or actions defining the scope and parameters of the *event* surrounding the POI. Calendars and syllabi are examples of instruments defining the temporal placement of a practice also enabling observation of the POI. Utilizing the existing forces and instrument acting on the POI, we were able to more clearly define when and how we will observe the POI. To the extent we cannot pinpoint the scope and parameters of the POI meant we must further refine the scope of the POI (from global to fine-grain). This stage proved difficult to implement for several reasons. However, there were no means of linking calendars and syllabi or other useful resources. Most of these artifacts were paper-based and cumbersome to locate and work with. Thus, pursuing the use of those artifacts

eventually seemed like more of a hassle than an affordance with the potential for improving teaching.

Stage 3. Gather Complementary, Converging Evidence

Even in the early development of the evidential approach to understanding practice, systematic use of evidence was a core function. Evidence can be represented by several different forms of data, which included teaching artifacts (e.g., lesson plans), student artifacts (e.g., student work samples), or direct evidence of teacher and student performance (e.g., video) (Deaton, Recesso, & Hannifan, 2005; Recesso et al., 2009). In the early stages of development with EBI, evidence was conceptualized as a representation of the constitutive elements of knowledge, action, or product enabling the decomposition of complex environments and events into their most intricate parts for thorough analysis and interpretation. A primary influence of this idea was the work of Spillane, Halverson, and Diamond (2001) and their work on distributive leadership. Their scholarship generated, in par, an understanding of artifacts generated through interactions of actors in education. Those artifacts could be used, as embodiments of practice, representative not only the espoused vision, but more likely a reflection of the actual events (e.g., teaching and learning) that took place.

Stage 4: Analyze Evidence

The primary intent of the analysis stage was to isolate practices associated with the POI to be reinforced or changed based upon the available evidence. Three distinct functions within this stage were to 1) use lenses to decompose and interpret evidence, 2) generate explanations based on evidence-based reasoning, and 3) create solutions for the POI. The metaphor for the approach to analysis was that of a lens (e.g., camera lens) (Hill, Hannafin, & Recesso, 2007), which are used to filter and amplify. Specific lenses (e.g., frameworks, rubrics, and standards)

would be used to help the user interpret evidence in order to generate explanation(s) and solution(s) centered on the POI. Through this process, users would be able to examine evidence using a lens so that they can filter out extraneous events and data in order to more closely examine the POI. Furthermore, the lens would allow user to focus their attention on critical actions and events centered on the POI.

Lenses for analysis. An analysis lens is an assessment instrument enabling measures of broad constructs or multiple dimensions within performance, practice, and organizational structure (Hill, Hannafin, & Recesso, 2007). Through the use of lenses, users are able to codify the evidence and pinpoint and describe specific attributes of practice that should be analyzed. A domain specific lens in science education, for example, will help any preparing teacher to differentiate between broad dimensions of practice such as classroom management and instructional strategies. Existing standards frameworks (e.g., National Science Teaching Standards) can be and have been converted into lenses. The lens metaphor was further extended to include analysis filters and analysis gradients. Analysis filters remove noise that exists in the large categories of the lenses (Recesso et al., 2009; Hill, Hannafin, & Recesso, 2007). Filters add power by allowing users to be more specific in their analyses. For example, a person examining classroom management might apply a filter of questioning strategies. Through the application of that filter, the analysis can then focus on how the teacher's use of questioning keeps students engaged. Analysis gradients are fine tuned instruments able to delineate variance along an interval, which is a subcomponent of a single dimension (Recesso et al., 2009; Hill, Hannafin, & Recesso, 2007). That is, gradients allow users to define attributes of success or deficiency at a finite level. However, it is expected the value of the interval may vary due to influences (e.g., teacher's content knowledge of a specific concept) embodied in representative and direct

evidence within absolute proximity to the POI. Furthermore, using the methodology has left a clear path traveled to the final assessment enabling the next steps.

Stage 5. Implement and Evaluate Course of Action

The first four stages of the EBI process deliberately focus on an individual and purposely selected attribute of practice. Once users have reached this stage of the process, they should have developed a) a clear understanding of what they were examining, b) evidence-informed explanations of the events, and c) solution(s) for addressing the POI. The Course of Action stage was developed with the specific purpose of taking action and implementing at least one of the solutions. If a user was able to identify the solution, the EBI process does not end. Due to the cyclical nature of EBI, the user should then begin the process again in order to examine their implementation of the solution. That is, the chosen solution becomes the next POI in the process. However, if users are not able to fully develop a complete solution or address all dimensions or intervals of the POI, the user should begin the EBI process again. However, the user may need to collect and analyze more, or different, pieces of evidence in order to better address the attribute of practice.

Summary of EBI

The ETEACH project provided multiple opportunities for iterative cycles to develop, test, and refine the EBI process. Preservice teachers actively used the EBI methods and tools, specifically VAT, in teacher preparation courses and to support field experiences. Feedback was collected and used during weekly meetings of the research collaborative and regular meetings with ETEACH participants. The collaborative work revealed several improvements that were needed and resulted in the complete redesign of the methods. Critical areas of improvement included revisions to the stages and underlying assumptions about the process.

The EBI methods users found achieving the focus in the first stage was problematic. Stating a point of impact, it became clear, was something that needed to emerge from the process of analyzing evidence, not something that could done up front. Additionally, preservice teachers using the process tended to only choose broad, global issues (e.g., good practice or classroom management) as their POI. Thus, they needed assistance in refining their focus on practice. Adjustments in the methods were needed to make focus on fine grained elements of practice something the resulted from using the process, not an assumption that one would know up front. Thus, the first stage was completely redesigned.

Another assumption inherent to the EBI process was also addressed, people do not just make decisions (Recesso & Zapada, 2008). Something, an event stimulus causes them to stop and think and then act. EBI needed to be revised to reflect this first stop. Thus, the point of impact would come later in the process and emerge from the interpretation of evidence and would be more readily used as the focus for action – the intervention used to replicate success or improve deficiencies in practice.

The Course of Action stage also needed adjustments to its underlying logic. Action was not as simple as choosing a solution to improve a deficiency. Users would need to find appropriate resources and professional learning opportunities in order to successfully implement the solution. While interventions abound, it is not always clear how to align the need with what is available. Revisions to the model reveal how this stage is now considered to be the actual decision making (i.e. the choice in action to improve or even replicate practices).

Transformation to Evidential Reasoning

In a review of the literature on evidence and methods for interpreting evidence, it became clear that evidence-based approaches were to serve a purpose different from the goals of the

research collaborative. It was also clear that the term evidence-based was problematic and was an ill-defined term in education. The intent was to develop a set of methods and tools to support better decision-making, especially as it applied to growth of educator's practices. From the research collaborative's findings with the E-TEACH and EBI projects, the methods were refined in order to form a probabilistic approach for interpreting evidence. Furthermore, the method was refined so that events found in evidence could better inform decision-making. The primary change was that teachers do not just generate decisions about what will be examined in their teaching (Recesso & Zepeda, 2008). Instead, an event or piece of evidence triggers a need for an issue or event of practice to be analyzed. This change resulted in the refinement of the process to four stages: trigger, marshalling evidence. Each of those stages is briefly described below.

Stage 1: Trigger

The trigger causes a teacher to consider or seek to understand an issue or event that emerged from practice (Recesso & Zepeda, 2008). This notion implies that teachers' do not haphazardly make decisions. Instead, teachers are prompted by an event or piece of evidence to search for understanding. For example, a teacher delivers a lesson and immediately identifies that the lesson did not meet her expected learning outcomes. Based on her observations and recollection of classroom events, the teacher may have recognized, or felt intuitively, that her students did not understand the content.

Stage 2: Marshalling Evidence

Schum (1994) describes marshalling evidence as the identification and collection of multiple forms of evidence to help explain events or issues that occurred. However, the evidence must be relevant in order to represent and event (Schum, 1994). For example, video evidence is often deemed to have high relevance because it allows for all classroom instruction to be

captured (Deaton, 2007; Recesso & Zepeda, 2008). Continuing the example from above, the teacher who felt her lesson did not foster student learning may collect multiple forms of evidence to better understand her teaching. She could collect evidence of planning (lesson plans), student learning (student work samples), or teaching (video) (Deaton, 2007; Recesso & Zepeda, 2008). In this case, each of those pieces of evidence would allow the teacher to utilize the evidence in order to understand her issue of practice. Yet, if the teacher only utilizes cooperative or group learning strategies in her facilitation of the lesson, video capture from a single camera in the back of the classroom may not allow her to properly understand or make sense of the evidence because it does not capture student-to-student or teacher-to-students interactions. Thus, the evidence is not relevant to her needs and would require her to make use of other forms of evidence.

Stage 3: Interpretation: Making Sense of the Evidence

Recesso and Zepeda (2008) define this stage as the interpretation of evidence through the use of instruments that align with common frameworks of teaching practice, which should utilize attributes that influence student learning. The interpretation of evidence allows teachers to generate explanations (Deaton, 2007; Recesso & Zepeda, 2008). Continuing the example above, the teacher may analyze the video evidence that is available to her as well as student work samples. From her analysis and interpretation of the evidence, she realized that the learning materials she provided did not provide clear instructions and that the student tasks were too advanced for her learners. Thus, she needs to develop a solution for this issue, which is the final stage of ERDS, setting a course of action.

Stage 4: Course of Action

The course of action stage is the selection and implementation of a solution to either improve or replicate an event (Recesso & Zepeda, 2008). That solution may be to utilize a new resource or introduce an intervention (i.e. a change in practice). For instance, the teacher may identify from the evidence that the learning materials that she used in her lesson were too complex for her learners. Thus, she selects new resources and redesigns her learning materials in order to make the learning more appropriate.

Convergence of Technology and Evidentiary Interpretations

Emerging technologies are providing means through which teachers can easily and systematically collect and analyze evidence (Lampert & Ball, 1998; van Es & Sherin, 2002 Stigler et al., 1997; Frederiksen et al., 1998). The Video Analysis Tool (VAT) is a web-based software program that was developed as an initial instantiation of the EBI methods (Recesso et al, 2009; See http://vat.uga.edu). As discussed above, VAT enables researchers and practitioners to upload and analyze video evidence using pre-developed assessment instruments called lenses. Assessing teaching practice is a three step process. First, preservice teachers setup a video camcorder in the classroom to capture classroom events for further analysis. Second, the preservice teacher uploads the video through a web-based interface to VAT. Third, preservice teachers use VAT to code and analyze their teaching.

Research Findings of VAT Studies

The use of VAT and ERDS to support the examination of teaching practices by both inservice and preservice teachers' practices has been examined in several studies (see Bryan & Recesso, 2006; Deaton, 2007; Rich & Hannafin, 2008a, 2008b, 2009, in press; Shepherd & Hannafin, 2008; in press). This section briefly discusses three of those studies and their findings.

Deaton (2007) examined inservice elementary science teachers' use of VAT to reflect on their own teaching practices. Specifically, her case study explored the teachers' use of VAT and an analysis framework to help them develop evidence-based explanations of their teaching practices. One of the key findings of this study was that the use of VAT and the analysis framework did not always provide enough support for them to develop evidence-based explanations without significant follow-up support and coaching. Instead of developing explanations, the study's participants often only provided narratives of classroom events. The study also found that VAT was beneficial in that the tool allowed the participants to analyze their teaching without distraction. Another finding of the study was that the participants were reluctant to respond to all of the analysis framework prompts, particularly a prompt that asked the teachers to associate their clip with a state standard. Overall, this study indicated that VAT showed great potential in helping teachers' develop evidence-based explanations of their teaching, but noted that additional feedback and support mechanisms are needed before teachers can meaningfully reflect on their teaching on their own.

Rich and Hannafin's (2008a) case study of four preservice teachers' examined their use of VAT and EBDS[2] as they completed their student teaching. Their study also examined the role, influence, and support mechanisms provided by mentor teachers and university supervisors as the preservice teachers reflected on their teaching practices. Rich and Hannafin's study presented several findings of preservice teachers' use of VAT and the EBDS methodology. One of those findings indicated that both the preservice teachers and mentor teachers "did not meaningfully use the state-standard lens to examine [their practices]" (Rich & Hannafin, 2008a, p. 1437). They suggested that the either the lens did not provide enough support or that the participants simply resisted using standards to assess their teaching practices. Instead, the authors found that the

[2] Rich & Hannafin's study was completed before the adoption of ERDS as the name for the methodology.

preservice teachers preferred either developing their own lenses or focusing on issues provided to them by their mentor teacher or university supervisor. This finding indicated that the preservice teachers strongly valued feedback from the mentor teachers and university supervisors and would often defer to their guidance. The researrchers also found that the mentor teachers' use of the tool varied widely and often provided guidance to their preservice teacher that allowed for little independent analysis. The study also found that the participants solely relied on video evidence to examine their teaching practices. While they were encouraged to use other forms of evidence, the participants' did not examine additional evidence that would allow them to more fully examine the complexities of K-12 classrooms. Finally, the study found that mentors play an important role in preservice teachers' examination of classroom practices, but they too need additional support and training when using tools for the analysis of classroom practices.

In another study, Shepherd and Hannafin (2008) examined three preservice teachers use of VAT to reflect on the student teaching experiences as a component of their capstone electronic portfolio (e-portfolio) development. The study found that "video captured and examined during e-portfolio development helped them to examine current practices from diverse perspectives, draw inferences regarding those practices, and consider additional evidence to strengthen claims" (Shepherd & Hannafin, 2008, p. 33). That is, VAT and guiding prompts provided support to preservice teachers in the identification of issues of practice and allowed them to view their teaching from multiple perspectives. However, they found that the video evidence also inhibited the preservice teachers from examining all of the nuances in a complex classroom environment (e.g., student comments and student work). They posited that additional forms of evidence should also be available to be captured and analyzed in VAT, but noted that the inclusion of additional evidence may lead to increased complexity in analyzing one's

practices and may be overwhelming to preservice teachers. Shepherd and Hannafin also found while e-portfolios are widely used in teacher education programs, the preservice teachers indicated reluctance in using them as assessment instruments as well as tools that support the systematic examination of evidence because of their lack of use outside of teacher education programs.

The Significance of Formative Assessment and Technologies That Support It

The primary purpose of teacher education programs is to prepare prospective teachers to enter K-12 classrooms. Part of that preparation is providing preservice teachers with a wide array of knowledge necessary to being effective teacher practitioners (Russell, Munby, Spafford, & Johnston, 1988). However, knowledge of teaching extends beyond that which exists in textbooks and can be discussed in teacher education courses. As Shulman (1986b) noted, teachers must possess multiple forms of knowledge in order to be successful practitioners. That is, it is simply not enough for preservice teachers to singly be knowledgeable of the content or to be only knowledgeable of pedagogy. Instead, effective teachers must be knowledgeable of both and pedagogy in order to do well in the classroom (Shulman, 1986b). However, this type of knowledge, which is known as PCK (Shulman, 1986b), often takes years to develop (Cochran et al., 1993; Van Driel, De Jong, & Verloop, 2002). Thus, teacher education programs must prepare prospective teachers to be able to control and self-regulate their own learning (Nicol & Macfarlane-Dick, 2006), which is most often realized through formative assessment (i.e. reflection and self-assessment).

The use of and enthusiasm for formative assessment of teacher practices is grounded in the attempt to help preservice teachers develop an understanding of the uniqueness and complexity that exists in the teaching profession (Calderhead & Gates, 1993). The goal of most

teacher education programs, which are based on the ideals of formative assessment (e.g., reflection and self-assessment), is to "[adopt] an analytical approach towards teaching" (Calderhead & Gates, 1993, p. 2). To help preservice teachers assess their own practices, educational researchers have often made use of video-based technologies (e.g., Bloom, 1969; Pea & Lemke, 2007; Sherrin & van Es, 2002; Recesso et al., 2009; Rich & Hannafin, 2008a, 2008b, 2009; Shepherd & Hannafin, 2008). These tools allow preservice teachers to analyze their own teaching by deconstructing and interpreting classroom events in order to develop knowledge of teaching (Deaton, 2007; Recesso et al., 2009; Recesso & Bryan, 2006; Rich & Hannafin, 2008a, 2008b, 2009; Shepherd & Hannafin, 2008). The study presented in Chapters 3 through 6 examines how preservice teachers make use of a specific tool, VAT, to assess their own teaching practices. This study will aid in our understanding as to how the tool can be refined and how specific resources scaffold their analyses.

CHAPTER 3

METHODOLOGY

The purpose of this chapter is to present the research design that guided this exploratory study of preservice teachers' formative assessment. The design of this study, which aligns with the focus of my research, is intended to understand the processes preservice science teachers use to assess their own teaching practices. The goals of this study are to (a) understand preservice teachers' conceptions of formative assessment (i.e. reflection and self-assessment), (b) identify the processes they apply to conduct self-assessment, (c) understand how they identify specific issues of their teaching practices using the Video Analysis Tool (VAT) and Analysis Frameworks, and d) identify the constraints and enablers of formative assessment. By examining how preservice teachers assess their own teaching, I will be able to develop an understanding of how they engage in the self-assessment of their own teaching.

Research Questions

The research questions emerged from a gap in the research and practitioner knowledge-base about how to systematically assess and address critical attributes of practice (NRC, 1996). As identified in Chapter 2, preservice teachers have several types of knowledge that influence their own teaching practices (e.g., pedagogical, content, and craft), which implies that several factors influence the learning environment. The need to possess such a vast set of knowledge implies that the identification and assessment of narrowly focused, or fine-grained, attributes of teaching (Recesso et al., 2009) is a challenging and difficult task for preservice teachers.

Furthermore, because those attributes are embedded within a complex environment, a school classroom, the identification of those attributes are a challenging task, particularly for preservice teachers. Teachers should be given tools for analyzing evidence that allow for the systematic examination of teaching practice (Deaton, 2007; Land & Zembal-Saul, 2003). Thus, this study was designed to investigate preservice teachers' use of evidence to identify attributes of practice, those that are successful and those that need to be altered in the assessment of their own teaching. The research questions that guided the investigation of this study are:

- To what extent do evidence-informed methods and tools influence preservice teachers identifying and describing specific attributes of practice?
    - How do preservice teachers assess their own teaching? What do they look at and what processes do they apply?
    - To what extent do preservice teachers rely on intuition or evidence to define a need for change?
    - What situations, tools, or resources enable or constrain evidence-informed approaches to preservice teachers' assessment of fine-grained attributes of practice?

Research Design

Case study methodology guided the data collection and analysis of data in this study (Patton, 2002). Case studies allow issues to be examined in great detail and within the context the phenomena occur (Patton, 2002). Case studies are designed to "investigate a contemporary phenomenon within its real-life context" (Yin, 2003, p. 13). Because this study focused on preservice science teachers' assessment of their teaching practice during their student teaching

placement, the case study methodology provided me with the opportunity to examine their assessments within their unique teaching experiences.

The focus of each case in this study was a preservice secondary science teacher engaged in their final university practicum experience, student teaching. A total of four cases were developed for this study. Each case represented an individual participant. Because case studies require the collection of a large amount of data for each case (Patton, 2002), only four cases were developed. By developing four cases, I was able to examine four unique contexts. Each participant's case was presented and organized by the research questions. The organization and structure for each case is detailed in the beginning of Chapter 4.

Cross-case comparative analysis was utilized to identify the differences and similarities among the four cases (Patton, 2002). Unlike individual case studies, the use of multiple cases may "be more powerful than those coming from a single case" (Yin, 2003, p. 53). By using multiple case studies, I was able to develop an understanding of four different participants' experiences and contexts surrounding those experiences as they assessed their teaching practice during student teaching.

Context

The context of this study was an exploratory study with secondary science preservice teachers. The participants in this study were a) completing their student teaching field experience and b) enrolled in their science teacher education program's capstone course that focused on reflective practice. This study was able to leverage two ongoing research efforts being conducted at a large research university in the southeastern United States to develop my own study. The largest of the two research projects was the Evidence-Based Decision Support (EBDS) Research Collaborative. The EBDS project focused on the use of evidence-based methods and Video

Analysis Tool (VAT) for the evaluation and improvement of teaching practices. Central to this study's purpose was the preservice science teachers' use of VAT as a tool for self-assessment. Specifically, this study examines how preservice teachers use VAT to identify and self-assess issues of their teaching practice. Secondly, this project was also supported by a grant from the Partnership for Reform in Science and Mathematics (PRISM) Improving Teaching and Learning of Science and Mathematics at the Undergraduate Level program. The purpose of the PRISM project was to specifically examine preservice secondary science teachers' use of Analysis Frameworks for the self-assessment of teaching practices.

The design of this research study was planned to provide a meaningful experience for each of the participants. Furthermore, the activities the participants engaged in during this study were based on the theory of situated cognition. Situated cognition posits that learning is more likely to occur when the learning is associated with authentic and personally relevant experiences (Brown, Collins, & Duguid, 1989). To accomplish this goal, each participant's teaching was captured as digitized video at the school in which they were completing their student teaching experience. The students then reviewed and analyzed their own teaching. Thus, the participants' self-assessments were created based on the analysis of their own teaching practices.

Tools for Assessment

During their participation in this study, the participants were provided with tools designed to help them assess their own teaching practices. During each of the study's three phases, the participants were provided with two tools, VAT and an Analysis Framework (see Table 1). VAT was used to collect, examine, and develop written analyses of their teaching video. The Analysis Frameworks consisted of guiding questions designed to prompt the

participants' examination of their teaching video in VAT. Each tool is discussed below in more detail.

A note about terminology. While this study is informed by both reflection and self-assessment, the assessments that the participants developed during their participation will be referred to as self-assessments throughout the remainder of this study. This is due to the fact that during their second and third analyses, the participants were provided with specific resources that required them to focus on specific attributes of their practice as they analyzed their science teaching practices. As Barber (1990) and Darling-Hammond & Snyder (2000) noted, the use of specific criteria to guide the analysis of one's own teaching implies that one is conducting self-assessment.

Table 1

Tools Used to Support Self-Assessment

Phase	Tools
Phase 1	Video Analysis Tool (VAT)
	Analysis Framework 1
Phase 2	Video Analysis Tool (VAT)
	Analysis Framework 2
Phase 3	Video Analysis Tool (VAT)
	Analysis Framework 3

Video Analysis Tool. To support preservice teachers' examination of their science teaching practices, the participants made use of the Video Analysis Tool (VAT) during each

phase of this study (Recesso et al., 2009). VAT was used to allow the preservice teachers to assess their science teaching. As a tool, VAT enabled preservice teachers to collect and organize digitized video evidence of their science teaching. The tool enabled the participants to select specific sections of their digitized video science lessons and create written VAT analyses pertinent to that specific section of digital video evidence. Through the systematic collection of teaching evidence, VAT supported the preservice teachers to formatively assess their teaching practices in order to develop a deeper understanding of their own teaching practices. Specifically, this tool enabled the preservice teachers to assess the aspects of their science teaching they thought they were doing well and those they needed to change.

VAT provided the preservice teachers with the ability to clip and annotate the digitized video lessons of their teaching. Clips are defined as small segments of teaching that can be more closely evaluated and assessed (Recesso et al., 2009). Additionally, the research participants could also add comments to any clip created in VAT. To add comments to their clips, participants would use a video-editing feature in VAT to clip video segments of their digitized video. Then, they would use the corresponding text box component to add and connect comments to the clip they created. For this study's purposes, any clip that a participant created and coded will be called an assessment clip. The written assessments of each clip that the participants completed using an Analysis Framework, which is discussed below, was collected as data for this study. The video of each participant's science teaching was not gathered as data in this study because of teacher and student privacy concerns.

Analysis frameworks. As mentioned earlier, each participant complete three VAT analyses. For each of their analyses, the preservice science teachers used an Analysis Framework. Three unique Analysis Frameworks were used in this study. Each framework

provided participants with questions and prompts to guide their examination of the digital video of their teaching practice. The Analysis Frameworks were designed to scaffold and support the preservice science teachers' self-assessments. All three frameworks were provided to the participants in electronic and paper format. Each participant was required to use an Analysis Framework as they completed their self-assessment in VAT. Furthermore, they were asked to use their digitized video lessons in VAT as evidence to support their assessment clips.

Each Analysis Framework had different components (see Table 2). Each of these components is discussed in detail below. Analysis Framework 1 included a set of guiding prompts for self-assessment (see Appendix A). Participants were required to use this framework as they completed their first analysis. Analysis Framework 2 (see Appendix B) was comprised of a set of guiding prompts as well as a list of seven Teacher Success Model (TSM) attributes (see Appendix C). The final framework, Analysis Framework 3, consisted of a set of guiding prompts (see Appendix D), the TSM attributes, and an Assessment Focus (see Appendix E). This framework guided participants' third assessment of their teaching. The TSM attributes and the Assessment Focus are discussed below.

Seven TSM attributes were selected for use in this study as components of Analysis Frameworks 2 and 3. The TSM attributes were developed from a larger project entitled the Georgia Framework for Teaching developed at the University of Georgia. The TSM Framework has been designed as a tool to support preservice and inservice teachers in a) the identification of specific attributes of accomplished teaching and b) the assessment and analysis of their own teaching practices and analyze their own teaching practices. In its entirety, the TSM framework is comprised of six core areas: content and curriculum, knowledge of students and their learning,

learning environments, assessment, planning and instruction, and professionalism. For this study, seven of the TSM attributes were selected to support the preservice teachers' self-assessments.

Table 2

Components of Analysis Frameworks

Framework	Components
Analysis Framework 1	Guiding prompts
Analysis Framework 2	Guiding prompts
	TSM attributes
Analysis Framework 3	Guiding prompts
	TSM attributes
	Assessment Focus

Another component of Analysis Framework 3 was the Assessment Focus. Analysis 3 was the only self-assessment that made use of the Assessment Focus, which was collected from an interview the researcher conducted with the participants immediately after video capturing their lesson. The Assessment Focus was a specific issue of practice or event of the participants identified should be assessed when they examined their lesson in VAT. The researcher used the participants' own words and summarized the participants' comments to create the focus they would use to assess their video during Analysis 3. Thus, each participant had his or her own unique Assessment Focus, which was identified from an interview they participated in immediately following the teaching of one of their digitized video lessons. Each participant's Assessment Focus will be identified in Chapter 4.

Participant Selection

The primary requirement for participation in the study was the need to find participants completing their student teaching requirements. Based on my aforementioned experiences with science education, participants selected for this study were secondary science preservice teachers. During the timeframe of this study, approximately 15 students were completing their student teaching in secondary science. Additionally, in order to identify participants who would be relevant for the study's purposes (LeCompte & Preissle, 1993), I identified specific criteria to allow for purposeful sampling (Patton, 2002). Specifically, I tried to establish criteria of the typical preservice teacher enrolled in a science teacher education program. The criteria used to identify the participants included:

- Undergraduate or graduate preservice teachers in science education
    - If a graduate student, you must have entered the teacher education graduate program immediately after completing your undergraduate degree
- Preservice teachers placed in school districts that allowed for the videotaping of preservice teacher practices for the purpose of conducting research, and
- Willingness to participate.

Graduate students were allowed, because it is not uncommon for secondary science preservice teachers to have already completed an undergraduate degree in a specific science content area (e.g., Biology or Physics). In additional to purposeful sampling, convenience sampling was also used (Patton, 2002). That is, I needed to identify participants who would be willing to participate and complete the study's requirements within the timeframe of the study's design.

To better understand which preservice teachers in the secondary science education program met the aforementioned criteria, I met with the science education program's student

teacher coordinator. The student teacher coordinator had detailed knowledge of each of the potential participants' academic histories and was able to provide their student teaching placement sites. Working with the student teacher coordinator, I was able to identify that approximately six of the preservice teachers were unable to participate in the study due to their student teaching placements. That is, either the school districts either would not allow research to be done or the schools would not allow videotaping for research purposes. From the remaining pool of potential participants, the student teaching coordinator identified five potential participants. The researcher contacted those five preservice teachers through both e-mail correspondence and face-to-face conversations. Each was provided with a detailed list of the study's requirements and was told that they would receive a $400 stipend for completing all phases of the study by the PRISM grant.

Originally, all five student teachers chose to participate in this study. However, one of the participants had to drop out of the study due to family obligations. The four student teachers that did complete this study were comprised of three females, Erica, Laura, and Mariska, and one male, William. Three of the participants were white, Western European Americans (Erica, Laura, and William). The other participant, Mariska, who moved to the United States around the age of twelve, was white and of Eastern European descent. Both Erica and Mariska's student teaching placements were at the same high school within District A. They had the same university supervisor (Supervisor A), but different mentor teachers. William and Laura were placed in different high schools within District B. William and Laura each had their own mentor teacher, but they shared a university supervisor (Supervisor B). Even though the participants were located within three different schools in two school districts, each of the school sites had similar

characteristics. All schools were located in small, rural towns in northeast Georgia. Each participant is introduced in the sections below.

Participant Descriptions

This section introduces and provides background information on each of the study's participants. These introductions provide a context for their beliefs and knowledge about the teaching of science. Data excerpts from interviews identify each of the participants' beliefs about science teaching from the roles of the learner and teacher.

William. Of all the secondary science education students enrolled in the teacher preparation program, only two were male. William was one of those males and the only male participating in this research study. William, who is of European-American descent, presented himself as a relaxed, energetic, and extremely confident student teacher. His science emphasis was in Biology, but he planned to obtain broad-field certification in science, which would allow him to teach any subject area in secondary science. Among the three participants, William displayed the most openness throughout the study. He was quick to identify his weaknesses and lack of teaching experience and knowledge openly and honestly. Of the three participants, William was the only one who did not expect to be a career professional in teaching, noting that he wanted to pursue pharmaceutical sales after a few years of teaching.

> In his initial interview, William shared his belief on why science is important to students. I think all students should learn science just because science is pretty much all around us. Everything you do in life is going to involve some sort of science whether it being working on a car or working at Wendy's or whatever you do everything involves science. (William, Initial Interview)

He noted that a student of science should be an

> … active learner on their own. Rather than waiting for the teacher to tell them everything. For them to go ahead and develop those skills too. Come up with questions, question belief, and question what is going on around them and stuff like that. [sic] (William, Initial Interview)

As a teacher of science, he believed that the science teacher should be "more of a facilitator" (William, Initial Interview). He stated

> I mean we are there to teach but we help facilitate learning and we need the students to learn on their own in science … it is better to let them figure things out on their own rather than having to spoon feed everything to them. (William, Initial Interview)

When asked to describe how he supports the idea of teacher as facilitator, William noted

I like to give them little projects and kind of let them figure it out on their own. Same with some of the labs that we do; they are really inquiry based where there is a few questions to get them thinking about what is going on. For the most part they are doing learning on their own. (William, Initial Interview)

Erica. Erica, who is of western European-American descent, was the youngest of the participants and had a very outgoing personality. Before the completion of her student teaching and her undergraduate degree, she had already secured a middle school teaching position in a rapidly growing, urban school district in the southeastern United States. She was the only one of the participants to already have secured a teaching position during the data collection phase of this study. Her content specialty in secondary science was Biology. As a student teacher, Erica demonstrated a great concern for having an active and engaging classroom. In describing why students should learn science, Erica states

> I think science is really important because not only are you learning the scientific content, you are learning how to constantly question things and examine them very closely. I think students can take that and apply it to all parts of their life. This new law that comes out. Is this good for me? How does this affect me? It gets them to analyze everything. I think science teaches students both analytical skills that they can use every part of their life whether they are in school or not. (Erica, Initial Interview)

She notes that students should learn science because

> Science students need to, well, they need to keep an open mind about everything. As should the teacher. So much of science can [be] mind boggling and really difficult to understand so I think it is important for students to keep their mind open to new possibilities and new thoughts and to understand that even though this what they may be learning at this point things may change later on. They have to keep an open mind to learn that the facts that they are learning right now might sometimes change because we are constantly making new discoveries. (Erica, Initial Interview)

In her interviews, Erica often identified the student as those who question the world around them. In describing how she could support that view, Erica describes what she believes a teacher of science should be

> Like any teacher, it is to guide students. I think a big role of science teachers because you are teaching analytical process is to show students how that process can be used not just in science but you know in any problem that you come to. Anything that you do not understand you can apply this process. The scientific and analytical process to it and I think science teachers play a major role for students on how they analyze things. (Erica, Initial Interview)

Thus, she envisioned herself as a science teacher in the following statement.

> I really want to encourage my students, like when they walk out my classroom I want them to be able to take … that open mind with them and apply it to all situations. Not just science situations. I want them to be able to see that while someone else might have another opinion from them to keep an open mind and look at it from all points of view. That is the only way that you can truly informed decisions. Keep an open mind about everything. I think that is very important. I also want my students to take away a curiosity. To want to find out anything they can not just keep an open mind when people present that information but go and seek out information themselves. I want them to be analytical of everything. Go out, find information yourself and find out what that information means. How does it apply to them? (Erica, Initial Interview)

Laura. Laura was one of two graduate student teacher participants in this study. Upon the completion of her undergraduate degree in Exercise Science and Athletic Training, she immediately enrolled as a full-time student in science education. Her specialty area in science was Biology. Laura was of European-American descent. During her interviews, she presented herself as being very open and demonstrated a great deal of care and concern for her students. She described science as an extremely important aspect of life, which is evident in her statement about why students should learn science.

> One main reason I think kids should be able to learn science is because almost all of it will apply to something in their everyday lives. Especially right now a lot of it is applying to politics and what's going on and what laws are going to be passed. That is going to directly affect them. An example would be our big gas crisis right now and the stem cell research. All of that is science and so that is something that will directly affect

them. And by then being able to have a better knowledge base on subjects of that matter then they can I think be better informed citizens and be able to make better decisions and actually read through some of the issues that are going on and understand them. As well as, just understand things that are going on their everyday life and natures and all that is around them. They all have to do with science and science concepts. (Laura, Initial Interview)

In describing her beliefs about science students, Laura stated

> Well, I think trying to get the kids to come in with more of an open mind. Kind of thinking out of the box so that they cannot come in with perceived notations, which they are going to. But hopefully teach them in a way that they can maybe say well I thought this but I can see how it could be something else. Just letting them is almost like an empty pitcher that you are filling up with all of this knowledge. That they may have conflict with, but still they are going to know that it exists. Some people think it is this way and others believe a different way. Having them become analytical thinkers and being able to compare stuff. Make their own decisions about things and I think that is their big role. You would hope that they are going to want to learn a lot but some may not. To get to gain some knowledge that they you did not have prior coming into the class. (Laura, Initial Interview)

Laura wanted her students to challenge themselves and challenge what they know about the world. To support those beliefs, Laura describes her beliefs about the role of the science teacher in the following statements.

> Well, first and foremost is obviously to give the kids some kind of knowledge of science more than they had previously when coming into the classroom. Specifically right now a

lot of kids don't see or what I see in the classroom is most kinds don't understand how science has anything to with them. If the don't [sic] already like science or don't have a previous knowledge to learn more about science and then they are not going to want to. So having the teacher being able to relate those concepts where they can better understand them and relate them to their everyday life that is one way to make it better for the kids. See that it does relate and it does have an impact us in what we do. Making science more relevant to the kids. That is a big issue now you know America's children are not interested in science and don't want to having to do with it. So I feel in this day and time one main role is letting them see how science affects them. How important it actually is. (Laura, Initial Interview)

In her statement, Laura identified her perceptions that science is not of particular interest to today's learners. To address that issue, she noted her desires to make science relevant to her students in order for them to see science's value in their lives. In describing the vision of herself as a teacher of science, she emphasizes those wishes further in the following statement.

One of the main things that I hope I can do, as a science teacher is to stay as up to date as possible on things. Try to continually relate stuff to the kids with what is going on. I think that is how you get them interested in the subject as making it applicable to their everyday life. Being up to date and if you have out dated information and they hear otherwise then they are going to doubt you as a teacher. Trying to bring in the most current information to the kids. Hands-on activities and things that are just amazing to them that they had no idea existed or how they happened. Basically just trying to be enthusiastic about the subject and show the kids how much I like it. Maybe even if they don't like it when they leave they might say, "Wow she was crazy about science". Just

portraying my love for the subject to them and hopefully rubbing off a little bit of that on them. (Laura, Initial Interview)

From her statements, it is clear that Laura wanted to share her enthusiasm for science with her students. She wanted her students to be engaged in the learning process and envisioned herself as a science advocate.

Mariska. Mariska was the oldest of the participants in this study. She held an undergraduate degree in Biology, but like Erica, she immediately began a graduate degree in science education upon the completion of her degree. Mariska's Eastern European heritage and childhood influenced both her confidence and comfortableness in the classroom. Being a non-native English speaker, Mariska often felt uneasy with her students because she sometimes mispronounced or avoided words. This issue also affected Mariska's participation in interviews with the researcher. She was very concise and guarded during the interview process. However, Mariska was very enthusiastic about teaching and being in the classroom with her students during her student teaching experience.

In describing why students should learn science, Mariska believed that science should be integrated into all aspects of teaching and learning. She stated.

I think that science is all around. There is no you know you go to school and you say this scientist discovered this. But it is science is not just an empty vacuum. It is like everywhere. It is political. It is based on socio-economics. There are so many branches of where you can relate a scientific issue out. It is really important to teach students science. (Mariska, Initial Interview)

In describing the role of the science student, Mariska commented

> [T]he ideal role of the science student is to think critically and write down notes. Ask questions but usually that is not the option. Any kid of feedback and questioning from the students is always welcome. But a good science student is always wondering why something is happening or how did this occur. (Mariska, Initial Interview)

In her statement, Mariska noted that she expected students of science to be inquisitive and self-motivated to seek out new knowledge.

Mariska's view of a science teacher was primarily to remain active and keep the content current and relevant to better engage the students in the learning process. She noted

> The role of a science teacher is to educate his or her students in science and my field would be Biology. To the best of her ability. To provide the most current scientific information and to provide the information biases. (Mariska, Initial Interview)

As she described how she viewed herself as a science teacher, she also expanded on her beliefs about the role of a science teacher. As she closed her statement, Mariska's lack of confidence and doubt about teaching was illuminated. She said

> My vision of myself as a science teacher really is the same thing as why I want to teach science. I just really want to educate my students and be able to tell how important recent scientific information is. Just like with especially with global warming. I want them to understand that if this problem continues it could lead to this and this can lead to this. They might be they are sixteen and seventeen years old and they might not care about something but ten, twenty years down the road when it is a factor it will be nice that they remember that term. That would be the ideal thing to say, "I remember Miss M talking bout this" but I am sure that no body does that. (Mariska, Initial Interview)

Research Tools

This study utilized VAT and Microsoft Word as research tools. The preservice teachers used VAT to self-assess their teaching by developing written assessments using the Analysis Frameworks in the comment feature of VAT. The written assessments consisted of all comments developed by the participants as they responded to the Analysis Framework prompts by typing in the textbox feature of VAT. As a researcher, I collected the participants' written VAT analyses of their science teaching by cutting and pasting their written assessments (i.e. typed comments corresponding to each video clip) into a Word document. Only the participants' written assessments in VAT were collected. Since this study focused only on their written assessments, neither the digital video of each lesson nor the video segments that the participants created in VAT were interpreted for the purposes of this study.

Data Collection

Two forms of data were collected for this study. The first form of data collected was interviews. The interview data was comprised of the preservice teachers' a) identifying their conceptions of self-assessment and reflection, b) discussing their written VAT analyses, and c) sharing the constraints and enablers of self-assessment. The preservice teachers written VAT analyses were the second form of data collected. There were three written VAT analyses conducted by each participant using three different Analysis Frameworks. Within each VAT analysis, participants assessed multiple video clips from their science teaching video. The written components for each VAT analysis, which consisted of annotations of multiple clips created in VAT, were also collected for this study.

The data were collected in two phases (see Figure 4). The first phase consisted of the collection of interview data only. The second phase was comprised by the collection of written

VAT analyses and interview data. Each of these phases and the data types are described in more detail in the following sections.

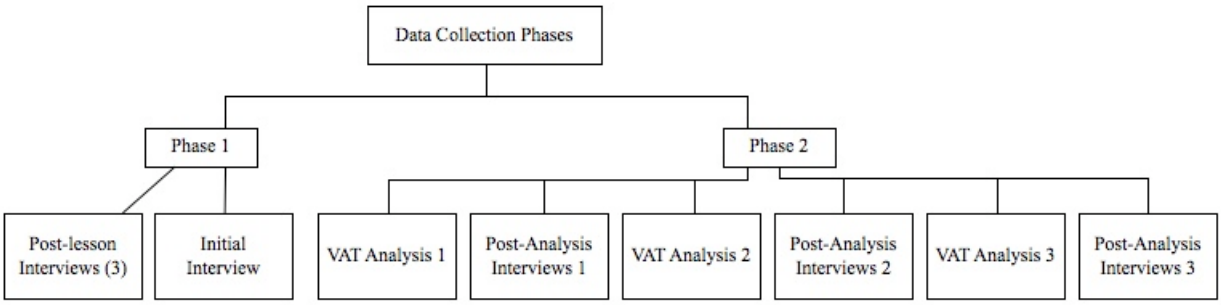

Figure 4. Data collection phases.

Data collection phases. The first phase of data collection occurred before the preservice teachers began using VAT to self-assess their own teaching. During this phase, I visited each teacher on three consecutive school days to collect digital video of an entire class period. After each lesson was captured, I conducted a short, post-lesson interview, approximately five to ten minutes in length, with each preservice teacher to understand their initial thoughts about the lesson they just implemented. The protocol for the post-lesson interview is located in Appendix F. After the three lessons and post-lesson interviews had been completed, I used an interview protocol (see Appendix G) to conduct a longer interview with the participants that allowed me to develop an understanding of the preservice teachers' knowledge of and experiences with formative assessment (i.e. reflection and self-assessment). For the purposes of this study, this interview will be called the initial interview since it was the participants' first long, formal interview.

After all the participants had completed Phase I, I brought them all together to a) introduce them to and train them on how to use VAT and b) introduce them to Analysis

Framework 1 and clarify any questions they may have about their first self-assessment. Participants then completed their first VAT analysis. Each preservice teacher was allowed to choose which digitized video lesson they wanted to self-assess in VAT. After they completed VAT Analysis 1, each participant was interviewed about their VAT analysis. The interview, which used the Post-Analysis 1 Interview protocol (see Appendix H), focused on their self-assessment and their perceptions of VAT and Analysis Framework 1. Each interview lasted approximately 30-45 minutes.

Once all three preservice teachers completed their first written VAT analysis, I again met with them as a collective group. At this meeting, I addressed any questions they had about VAT and introduced them to the seven TSM attributes. We covered each attribute individually and I addressed any questions they had. The participants then completed their second VAT analysis. Again, the participants were able to choose from any of their available digitized video lessons in VAT. After completing their second VAT analysis, the participants were interviewed again using the Post-Analysis 2 Interview Protocol (see Appendix I). The interview focused on their self-assessment and perceptions of VAT and Analysis Framework 2.

Finally, I met with all of the preservice teachers again as a group. In our third face-to-face meeting, I addressed any questions they had with VAT and the TSM attributes and introduced them to Analysis Framework 3. I then provided each of the participants with their own, unique Assessment Focus. Each unique Assessment Focus was identified through the post-lesson interviews (Phase I). During those interviews, I asked each of the participants to identify an issue of practice they would like to examine or evaluate about the lesson they had just delivered. Their response to that question became their Assessment Focus. I reviewed the Assessment Focus with the participants individually to ensure that I had clearly identified what they had originally

identified as an issue of practice. After the meeting, the participants conducted their third, and final, VAT analysis. After they completed their VAT analyses, each participant was interviewed using the Post-Analysis 3 Interview Protocol (see Appendix J). The interviews focused on their self-assessment and Analysis Framework 3 as well as their final perceptions of and recommendations for VAT. Each interview lasted from 45 to 60 minutes.

Interviews

During the completion of this study, each participant was interviewed multiple times. Structured protocols were used for each interview and each utilized a conversational approach (Patton, 2002). The primary purpose for the use of structured, open-ended interview protocols was to allow consistency in data collection (Patton, 2002). Furthermore, structured interviews allowed the instrument to be evaluated and assist in the data analysis process (Patton, 2002). The interviews took place during Spring 2006. Each participant completed a total of seven interviews. Three of the interviews were post-lesson interviews that were 5-10 minute structured conversations immediately following the completion of their science lessons that were captured via camcorder. The remaining four interviews utilized unique interview protocols due to the nature of each VAT analysis. All audio interviews were transcribed verbatim and stored as Word documents.

Written Data

The written data collected for this study were the participants' written assessment they developed in VAT. An excerpt of a written assessment is provided in Appendix K. Each participant's science teaching experiences were digitized video three times during the study's duration. During the study, each participant completed three VAT analyses. The participants' analyses were supported by a set of scaffolds developed by the researcher and a project advisor.

To complete their VAT analyses, the participants divided their video, which ranged from 45 to 90 minutes in length, into more usable, smaller segments. After the segments had been created, each participant used a scaffold to create a coded clip of video. As they coded a clip of video, they commented on the video segment using an Analysis Framework as a guide. By creating clips and coding them, the participants were able to conduct a self-assessment of their own teaching practices.

Data Analysis Procedures

Individual Case Analyses

According to Patton (1987) and Merriam (1998), case analysis requires the researcher to first develop individual cases before examining the cases as a collective. This section details the method I used to develop each participant's case narrative. Patton (1987) provided three distinct phases for the construction of case studies. He noted that the researcher should:

1) Assemble the raw case data,

2) Construct a case record, and

3) Write a case study narrative (p. 149).

This section details the process I used to develop the individual cases of each participant in this study.

In order to develop a case study, the first phase of my analysis was aggregating all the data for each participant. This process required me to "pull together the data relevant to each case" (Patton, 1987, p. 147). After that process was completed, I used the research questions as guide to analyze the data through open coding (Strauss & Corbin, 1990). Through the process of open-coding, I was able to identify “possible categories, patterns, and themes” (Patton, 2002, p. 453). Patton (2002) noted that this data analysis technique allows researchers to be “open to the

data" (p. 453-454) and use the own words of the study's participants. To complete the open-coding process, I used pencil to write initial codes on printouts for each participant's interview transcripts and written assessments. All four participants complete data sets were coded in this fashion.

The initial process of coding the data involved reading and reviewing the participants' data sets multiple times in order to ensure that I was extremely familiar with the data. After initial codes were generated, I began developing and organizing a case record for each participant (Patton, 2002). The case records were organized in tables in Microsoft Word documents. Each entry in the case record included the data source, line numbers or location of each data sample and code. After each participant's initial case record was developed, I again re-read each participants' data set and further refined the codes using print-outs of the case record. During this stage of the analysis, I used the constant comparison method to identify categories and patterns (Merriam, 1998; Strauss & Corbin, 1967). Stake (1995) noted, "the search for meaning often is a search for patterns" (p. 78). This process continued until I finalized categories for each individual case. This was done using pencil on printouts of the participants' data tables. The printouts with my written comments served as the final case record. An excerpt of one of the case records (William) is provided in Appendix L, which is displayed as a Microsoft Word table. After completing the case record for each participant, I wrote the case study narratives for each participant (see Chapter 4).

Cross-Case Analysis

After the analysis of each individual case was completed, I began the cross-case analysis. Cross-case analysis "seeks to build abstraction across cases" (Merriam, 1998, p. 195). Merriam (1998) also noted that cross-case analysis is very similar to individual case analysis. The primary

distinction is that instead of looking at individual participants, the researcher seeks to find patterns and themes across multiple cases (Merriam, 1998; Patton 2002).

To complete the cross-case analysis, I used the individual case records for each participant to identify similarities and differences among the cases, which resulted in the development of themes. Once again, the analysis for and the organization of the cross-case was conducted according to the research questions. Themes were only identified when the data presented a similar finding in at least two of the cases. However, many of the themes were developed when Additionally, cross-case analysis allowed me to identify and highlight unique findings. After I finalized the development of themes and organized the data in Microsoft Word tables, I wrote the narrative for the cross-case analysis (see Chapter 5), which identifies and delineates how preservice teachers conduct self-assessment through the use of evidence-interpretation tools.

Researchers' Statement

Methodological Perspective

This study and my research are grounded in the constructivist perspective, which asserts that learners are unique. Additionally, the constructivist perspective contends that learners individually construct knowledge and understanding of the world. Furthermore, constructivism posits that the construction of knowledge is dependent on resources, personal experiences, interactions, and motivation (Grandy, 1997). The constructivist viewpoint establishes basic principles that guide my research. First, individuals construct knowledge based on their own personal experiences (Gergen, 1995; Grandy, 1997). Second, how individuals "[make] sense of the world" (Crotty, 1998, p. 58) should be valued and respected. Third, the representations of knowledge and understanding that individuals construct is neither easily, nor directly accessible

(Grandy, 1997). Finally, learners develop knowledge through self-regulation and the construction of conceptual understanding with "reflection and abstraction" (von Glaserfeld, 1995, p. 14). Through these four principles, the intricacy of constructivism is illustrated. However, I believe that constructivism provides us with a perspective that allows us to more meaningfully examine and better understand how knowledge is developed and formed.

Application to Study

The constructivist perspective is applicable to this study because of the characteristics and nature of self-assessment. This study centers on how preservice teachers use, analyze, and interpret evidence of their own teaching experiences to self-assess their practices in order to develop knowledge of practice. How preservice teachers develop that knowledge is influenced by their previous experiences, knowledge, and beliefs about teaching. To make the experience meaningful for the participants, the study's participants were allowed to make use of their own classrooms from their student teaching experiences. Tobin, Briscoe, and Holman (1990) noted the importance of allowing teachers to examine their own experiences. They asserted that teachers are better able to make sense of and further develop their understanding of teaching and learning based on experiences and events that occurred in their own classrooms.

In order to better understand how they made sense of the teaching and how they analyzed events, I needed access to data that represented their understanding and interpretation of their own teaching. However, as Grandy (1997) noted, that type of information is not directly accessible. Thus, written self-assessments and interview data were collected in order to understand how the participants interpreted and reasoned with their teaching practices to develop teaching knowledge. These forms of discourse allowed me to better understand how they conceptualized and implemented self-assessment. Furthermore, the data allowed me to better understand (a) how

preservice teachers make use of evidence to analyze and interpret teaching and learning and (b) the affordances, and limitations, of technologies and frameworks to support self-assessment.

Subjectivities Statement

My work as a graduate assistant within the Learning and Performance Support Laboratory (LPSL) at the University of Georgia led me to design and conduct this study. Those experiences allowed me to (a) collaborate with faculty and other graduate students in further designing and developing VAT, (b) design and implement research studies with VAT, (c) design and implement professional development experiences with VAT, and (d) develop and implement funded projects related to VAT. Thus, I had several experiences using VAT and providing both preservice and inservice teachers with opportunities to examine their practices using VAT, which included both reflection and self-assessment. From those experiences, I became particularly interested in the design and use of VAT and support mechanisms to support preservice teacher self-assessment, which led to this study. Additionally, most of my work with VAT dealt with the science education program at the University of Georgia. Those experiences and the selection of participants are discussed below.

During my experiences as a graduate assistant in the LPSL, I frequently worked with faculty and students in the University of Georgia's Department of Science Education. Those experiences included: serving as a teaching assistant in a secondary science education course, collaborating on professional development experiences with science education faculty and graduate students, and conducting and collaborating on research projects related to preservice and inservice science teachers. Overall, most of my work with VAT specifically focused on preservice secondary science teachers using VAT during their student teaching experiences. From those experiences and opportunities, it was a natural fit for met to seek participants from

the science education program due to my familiarity of program. Additionally, I had developed a rapport and working relationship with several faculty members and graduate students within the science education department, which provided me with a non-invasive and ideal environment for gaining access to participants for this study.

The prior experiences described above influenced the way I approached and conducted this study. As I began this study, I expected the participants would enjoy taking part in this study, particularly in being able to observe and examine their own teaching with VAT. I also believed this experience would help them gain new knowledge about their own teaching. I was also aware that participation in this study might cause a strain on the participants' workload, which included student teaching and coursework. In fact, a fifth participant, who was married and had a young child, removed herself from this study. In lieu of those concerns and to minimize my biases, this study was influenced in several ways. First, I scheduled VAT training sessions and sessions in which I introduced the Analysis Frameworks at times when all of the participants could be present, which was done to ensure that each participant received the same level of support. I also made sure to avoid or redirect questions from the participants in which they tried to identify what they should examine or what other teachers had examined when using VAT, which would have biased the study and skewed the results. Thus, the final accommodation I made was to develop timelines and schedules as fairly as possible and schedule interviews and follow-up support at the participants' convenience as to minimize the impact on their daily schedules.

Role of the Researcher

One of my primary roles as a researcher for this study was to collect data on each participant's written VAT analyses. The participants' analyses were self-assessments of their science teaching practices. To organize the data, I converted their web-based, written VAT

analyses into Microsoft Word documents. I also conducted interviews with each of the participants. More extensive details on the data collection and research methods are located in the section entitled, Data Collection.

I provided the participants with training on the use of the VAT. Additionally, I introduced the preservice teachers to and provided any support related for the Analysis Frameworks. To provide training and support, I met with all of the participants at the same time in one of the university's computer labs. I met with all of the participants at the same time to ensure that I gave each of them the same VAT training experiences and introductions to the Analysis Frameworks.

CHAPTER 4

PARTICIPANTS' CASES

Introduction

The goals of this study are to a) understand preservice teachers' conceptions of formative assessment (i.e. self-assessment), b) identify the processes they apply to conduct that assessment, c) understand the specific issues of their teaching practices they identified using the Video Analysis Tool (VAT) and Analysis Frameworks, and d) identify the constraints and enablers of self-assessment. This study specifically examined the self-assessment practices of preservice secondary science teachers. In this chapter, I report the experiences of four preservice, secondary science teachers during their participation in a three-month study. The individual cases of each participant, William, Erica, Laura, and Mariska, consist of three sections. Those sections, which are illustrated in Figure 5, are organized using the following structure:

1) Conceptions of Formative Assessment: This section discusses the participants' understandings of self-assessment and reflection,
2) Processes and Foci for Self-Assessment: This section is comprised of four subsections: a) the participants' use of video evidence in VAT, b) the participants' abilities to focus on specific issues during their VAT analyses, c) the depth of their written assessments, and d) what the participants focused on during their VAT analyses.

3) Enablers and Constraints of Formative Assessment: This section details the situations, resources, and tools that support or constrain the participants' use of formative assessment to examine their own teaching practices.

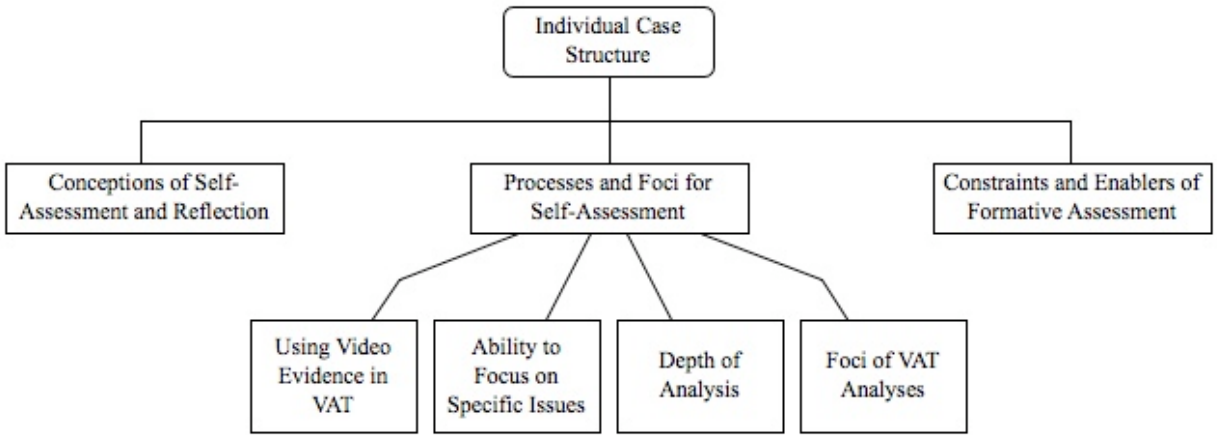

Figure 5. Organization of the Processes and Foci for Self-Assessment and Analysis Framework components.

Through the discussions within each case, I provide data and specific examples to address the following research questions:

- To what extent do evidence-informed methods and tools influence preservice teachers identifying and describing specific attributes of practice?
    - How do preservice teachers assess their own teaching? What do they look at and what processes do they apply?
    - To what extent do preservice teachers rely on intuition or evidence to define a need for change?
    - What situations, tools, or resources enable or constrain evidence-informed approaches to preservice teachers' assessment of fine-grained attributes of practice.

William

Conceptions of Formative Assessment

During William's initial interview, he described how he operationalized formative assessment. He also identified what it meant to formatively assess his teaching. Like the other participants in this study, William indicated that formative assessment, whether through reflection or self-assessment, was for identifying areas of his teaching that were not working well. He further specified that identifying problematic areas of his teaching would allow him to become "a better teacher in the future" (William, Initial Interview). However, beyond noting that formative assessment was for identifying problematic areas or issues of his teaching, William did not have a clear conception of formative assessment. That is, he did not have a well-defined, systematic process or approach for conducting formative assessment beyond the identification of an issue.

His lack of a clear conception was evident when William was prompted to further define the purpose of self-assessment. He noted that self-assessment allowed him "to see what I am doing wrong or what I can work on better or what I can work on" (William, Initial Interview). However, when probed to describe how the process of self-assessment was conducted, William stated, "Self-assessment is just more looking at how you are doing at that point in time. So, [I] would see how well I did this week or how well I did teaching this assignment" (William, Initial Interview). His statements illustrated that he was uncertain about the role and purpose of self-assessment. Hence, he did not see self-assessment as a process that systematically examined a specific, focused aspect of his teaching practice.

William's concept of reflection also mirrored a lack of specificity. When asked to describe a process for reflecting on specific issues of practice, William commented, "Reflection

would be just looking to see how I have done in the past. Not necessarily assessing to see what you can change but just more looking on what you have done and discussing it" (William, Initial Interview). His statement indicated that he did not perceive reflection as a systematic process. Instead, Williams' conceptualization of reflection was that it was for merely "looking back" and thinking about what had occurred in the classroom, which did not necessarily, if at all, lead to any change in practice.

William's statements also indicate that he perceived that the two processes varied in frequency and scope. For example, William stated that "self-assessment is something that [should be done] day-to-day" (William, Initial Interview) in order to change his teaching practices. That is, William perceived that self-assessment was a process that teachers should engage in each day in order to continually examine teaching practices. Conversely, reflection was for "looking at your teaching … as a whole, like a whole semester" (William, Initial Interview). William's statement implied that he perceived that reflection was a process that one did not engage in regularly and was principally for the examination of large, global issues of practice, not specific, well-defined issues.

Overall, the data indicate that William had a very naïve understanding of formative assessment. However, the differences he identified between the two processes were quite striking. While he viewed both processes as approaches for improving his teaching, the data illustrate that he did not have a systematic process for conducting either. It was also evident from the data that William had little experience identifying specific issues of practice that necessitated further examining. Thus, William would have to develop his own process for assessing his teaching with VAT. The process he developed, and how he refined that process, is discussed in the following section.

Processes and Foci for Self-Assessment

During his participation in this study, William's conception of formative assessment made it challenging for him to analyze and interpret his teaching. However, through his participation in this study, William was afforded the opportunity to develop and test his own process for self-assessing his teaching. Throughout this section, the processes and strategies William employed to assess his teaching and the focus of those assessments are detailed in four subsections which discuss: a) his use of video evidence in VAT to assess his teaching, b) his struggle to focus on issues consistently as he developed his written assessments, c) a lack of analysis depth, and d) a tendency to focus on similar issue throughout his three analyses.

Using Video Evidence in VAT

The manner in which William made use of video evidence in VAT throughout this study continued to change. For example, during Analysis 1, William analyzed his lesson on food webs and biomes. However, instead of identifying issues to assess what emerged from the video, William pre-selected aspects of his teaching to analyze before watching his lesson in VAT. Describing the process he used to identify issues and create clips for Analysis 1, William stated, "I sat down and I thought about [what] I wanted to look at … before I watched the video" (William, William, Post-Analysis 1 Interview). When asked to identify what he pre-selected, William noted that he chose to examine "how I introduced, how I transitioned, and how I delivered the lecture, [and] how well I interacted with the students" (William, Post-Analysis 1 Interview). First, William's decision to focus on these areas of his teaching indicated that he did not have a systematic process for analyzing evidence of his teaching. Second, he did not select fine-grained issues of practice to assess. Instead, he chose to create clips based on pre-selected,

general aspects of a lesson that principally represented basic segments, or components of a lesson (e.g., introducing the lesson).

For Analysis 2, William's approach to using video evidence shifted after being introduced to the TSM attributes. Instead of pre-selecting aspects of his teaching to assess, William adopted a completely different approach for observing his lesson on the Nitrogen cycle in VAT. He stated, "I just watched the whole [lesson] through. Then, I decided that I [would skip] the first .. 45 minutes" (William, Post-Analysis 2 Interview). After completing his first observation of his lesson in VAT, William then began creating clips before associating them with a TSM attribute. After originally creating sixteen clips, he "read through the TSM [attributes]" (William, Post-Analysis 2 Interview) and associated a TSM attribute to each clip. However, after associating a TSM attribute to each clip, William did not immediately respond to the Analysis Framework prompts. Instead, he waited until he had created all of the clips before identifying six clips for assessment. When asked to justify why he chose those six clips, William responded, "I picked the ones that I could get the most information from … [and I did] not [want to] just focus on one of [the TSM attributes]" (William, Post-Analysis 2 Interview). William pointed out that it was important for him to assess several aspects of his teaching because focusing on one attribute of his teaching "doesn't [sic] really help me out" (William, Post-Analysis 2 Interview). Furthermore, William added another caveat to his selection of clips to be assessed. He stated, "If I am doing something okay, I am not going to look at it. I [only chose clips that showed] something that I am not doing very well at all or something that I am doing really well" (William, Post-Analysis 2 Interview). William's statement demonstrated that not only did he not want to focus on a recurring attribute in his written assessments, he also only

wanted to focus on extreme issues – things he was doing really well or those that he was doing poorly.

When considering the approach William employed to make use of video evidence during Analysis 2, his process was much different than his approach for Analysis 1. While his observation of the video was more systematic (i.e. multiple passes), his decision-making process for what clips would be chosen for in-depth assessment was extremely complicated. First, William did not want to focus on single attribute because that would be meaningful even though they might have demonstrated a frequently occurring issue of practice. Second, he made several interpretive decisions about the quality, or usefulness, of the clip before responding to any of the Analysis Framework prompts. That is, William only wanted to analyze clips that he perceived would be valuable, which implied that he did not carefully interpret the video evidence. Instead, he tried to predict which clips would provide him the most meaningful information.

For Analysis 3, William yet again adopted a new approach for using video evidence. Using the same lesson he analyzed during Analysis 1, William's analysis was completely driven by his Assessment Focus. Similar to the approach he used during Analysis 2, William "reviewed the whole [lesson]" (William, Post-Analysis 3 Interview) in VAT before creating any clips. However, he did "[note] the times of the clips that I wanted to [assess]" (William, Post-Analysis 3 Interview). After completing his initial observation of the lesson in VAT, William then used the timestamps that he wrote down and then created a clip "every time [he] saw [himself] doing something around assessment" (William, Post-Analysis 3 Interview), which was his Assessment Focus (i.e. assessing student understanding). After creating those clips, William then used the Analysis Framework prompts to complete his written assessments. William's approach to using video evidence changed during Analysis 3; he adopted a more systematic approach to using

video evidence. He reviewed his Assessment Focus and then systematically observed the video evidence in order to create clips to be assessed.

William's use of video evidence continually changed throughout his participation in this study. In observing and talking to William during the three phases, it became apparent that William's lack of understanding about and inexperience with self-assessment made it challenging for him to assess his teaching. Because of those limitations, William continued to modify and seek ways that would best allow him to systematically assess his teaching in order to get the most out of the process. During Analysis 1, William pre-selected common, technical components of his lesson to assess, which was similar to the approach Laura used. For Analysis 2, William more systematically observed the video evidence, but also applied an extremely complex decision-making process to identify the clips that warranted further assessment. Finally, for his final analysis, William simplified his approach to using video evidence by systematically examining the evidence to identify his Assessment Focus. However, even though William's approach to using evidence became more systematic, his assessment of his teaching was problematic throughout the study's completion. In the following sections, his difficulty remaining focused on one issue throughout his written assessments and the subsequent lack of depth during his assessments is discussed.

Ability to Focus on Specific Issues

Upon closer examination of William's written assessments, it was evident that he had difficulty assessing his teaching. His unclear conception of self-assessment, as well as the variation in the approaches he used to assess his teaching, affected his three VAT analyses. William, along with Erica, was one of the most consistent in focusing on one issue throughout a written assessment. Part of William's success in focusing on one issue can be attributed to the

scope of his written assessment. The data indicate that when William examined an issue globally, he was able to examine the issue without deviation. However, when William was provided with his Assessment Focus, which required him to analyze a specific aspect of his teaching, he faced the same problem that the other participants encountered – difficulty in closely examining one specific issue. These issues are briefly discussed below.

The written assessments William created during his first two analyses remained focused on the issues of practice he chose to analyze. Even though it appeared that William was successful in focusing on only one issue during Analyses 1 and 2, the data indicate that he was only able to do this by identifying a broad issue of practice and examining it globally. For example, in one of his Analysis 1 written assessments, William identified that he was focusing on his lesson transitions so that he could " see how well [he] transitioned from one activity to the next" (William, Analysis 1, Clip 7794). Throughout this written assessment, he focused his analysis only on lesson transitions even though he noticed other issues, such as "background discussions [the students were having] while [he was] trying to talk" (William, Analysis 1, Clip 7794). While an examination of that issue (i.e. classroom management) might have been a better selection for analysis, William chose to ignore that issue because he was satisfied in showing that he could identify and demonstrate a transition in his lesson. In the closing statement of his written assessment, William noted that he had "done a good job of making the point to my class when we are starting a new activity" (William, Analysis 1, Clip 7794). William's reasoning for focusing on this broad technical aspect of teaching was to demonstrate that this component was present in his lesson.

As with Analysis 1, William's Analysis 2 examined global issues of teaching and did not deconstruct the clip created in VAT. Again, using a broad focus for his assessment clips allowed

William to stay on point when discussing his clips. This ability to focus on one concept changed with the introduction of an Assessment Focus. After being provided with this focus for Analysis 3, William, like the other participants, had difficulty remaining focused as he tried to assess that issue using the evidence available to him in VAT. By using a more narrow focus, he had difficulty identifying and discussing teaching events related to his focus. His lack of knowledge about teaching and learning influenced his ability to see how his focus related to the events in his video.

During Analysis 3, William's strategy for conducting self-assessment changed when he used his Assessment Focus (i.e. assessing student understanding) to examine his lesson in VAT. While the data indicate that he tried to use the Assessment Focus as the primary issue, his written assessments demonstrated that he was unable to remain focused on that issue when analyzing his lesson. In one written assessment, for example, William identified that he was examining his "content knowledge [of] food webs and food chains" (William, Analysis 3, Clip 8815). However, based on the data, it appears that William did not connect how his content knowledge impacted his ability to assess student understanding. Furthermore, as he continued his written assessment, he switched the focus from himself to his students. Specifically, he noted that one student was "attempting to draw arrows and connect the animals in the food web" diagram on the board and that it was "not going well" (William, Analysis 3, Clip 8815). While the event did represent an activity that would allow him to examine his Assessment Focus, assessment of student understanding, he did not examine why the student was having difficulty. Instead, he switched directions again by noting that he did not want his students to "feel as uncomfortable" (William, Analysis 3, Clip 8815) like the student in the clip. While William's statement implied that he understood the student was having difficulty with the content and activity, he did not

explore strategies he could have used to facilitate the activity. Instead, he closed his written assessment by discussing how ineffective his strategy was and that he should have been "explaining the lesson and drawing the arrows" (William, Analysis 3, Clip 8815).

William's ability to consistently focus on issue in his written assessments varied throughout his three analyses. Data show that when William examined global issues (e.g., Analyses 1 & 2), he was able to consistently address one issue of practice. However, as he attempted to assess fine-grained issues of practice during Analysis 3, William had difficulty focusing on this narrow issue. Thus, the inclusion of an Assessment Focus did not appear to help William focus on one issue consistently. Furthermore, William's approaches to his three VAT analyses prevented him from being able to deeply assess his teaching despite whether he examined issues globally or at a fine-grained level, which is discussed in the following section.

Depth of Analysis

For all three of William's VAT analyses, his written assessments provided little, if any, insight and depth. Even though his approach to using video evidence in VAT continued to evolve and become more systematic for each of his analyses, data show that William faced challenges in deeply examining issues that emerged from the video evidence. As noted above, the written assessments William developed for both Analysis 1 and 2 were examined globally, which prevented him from interpreting the video evidence. During those analyses, he developed written assessments either the technical components of teaching, not issues of practice, or that demonstrated that he could associate one of the TSM attributes with a segment of his lesson in VAT. Subsequently, his written assessment provided no interpretation of the video evidence. Instead, he only provided a brief narrative of the event. For example in one of his written

assessments, William created a clip to examine his interactions "with individual students and accommodating their learning styles" (William, Analysis 2, Clip 8174). He wrote

> I am explaining to a couple girls how the carbon cycle works because the way that I taught it to the class was not understandable to them … [This clip] shows that I am able to meet the needs of all my students no matter who they are. I am satisfied with this clip, and it is something that I feel I did well. (William, Analysis 2, Clip 8174)

In his written assessment, William was able to describe what was occurring in the clip. However, when responding to the Analysis Framework prompts that asked him to explain why this event was important to analyze and why it was successful, William provided no explanation. His lack of explanation may indicate that he was unable to identify why this interaction was successful and how it could be replicated in his teaching. This type of analysis was recurrent throughout all of William's VAT Analyses. Regardless of the support mechanism provided to him (i.e. Analysis Framework prompts, TSM attributes, or Assessment Focus), William was unable to move beyond describing or narrating the clips he created. Thus, throughout his participation in this study, William was unable to frame and reframe issues of practice, which prevented him from developing solutions or changes to be made in his teaching practice.

Foci of VAT Analyses

In his three VAT analyses, the data indicate that William examined many different issues related to his science teaching. However, the issues William examined in his written assessment were contained within four pedagogical themes. Those themes, which are briefly discussed below, were a) the act of teaching, b) factors related to learning, c) addressing the needs of students, and d) preparing to teach.

Act of teaching. As William examined his teaching, he focused several of his written assessments directly on his science teaching. The areas of teaching that William analyzed were either from his facilitation of the lesson or a technical aspect of his teaching. The clips that focused on lesson facilitation examined classroom management, his interactions with students, or his delivery of instruction. Of those three areas, William most often focused on classroom management because, as he stated, teachers "must have good classroom management skills" (William, Analysis 2, Clip 8177) in order to be successful. William was also interested in technical components of teaching, which was especially prevalent during Analysis 1 in which he almost exclusively focused on: introducing the lesson, transitions, and delivering clear instructions.

Addressing the needs of students. One area of his teaching that William noted several times throughout his VAT Analyses was his desire to meet the needs of his students. For instance, in one his written assessments, William noted that he was "still figuring out ways to [communicate with his] students" (William, Analysis 2, Clip 8174). That is, he noted that it was important to "meet the needs of all [his] students" (William, Analysis 2, Clip 8174). Another area in which William discussed the needs of his students was demonstrated through his desire to provide appropriate levels of support. He indicated that it was important to create a comfortable learning environment where students were encouraged to participate and where they were provided with opportunities to succeed.

Factors related to learning. Even though William's Assessment Focus was on the assessment of student learning, his third analysis, as well as his first two, spent little time addressing factors related to learning. However, when he did examine issues related to student learning, he mostly associated those with selection of teaching strategies and making content

relevant. That is, in a few of the clips he created, he noted that he should choose appropriate teaching strategies to support student learning.

Preparing to teach. The final area that William discussed in multiple clips was a need to better prepare for teaching. The two areas of preparation that William identified as needing improvement throughout his three analyses was a need to a) better plan for the identification and use of multiple resources and tools to support his teaching and b) strengthen his own content knowledge. For example, when discussing his own content knowledge, William identified that he was not "able to elaborate on the topic" and that should have "done some more research before [he] taught the subject" (William, Analysis 2, Clip 8173). William's statements illustrated his understanding that a lack of content knowledge inhibited his ability to expand on and address student questions properly and should be addressed through more extensive classroom preparation.

Summary of Processes and Foci for Self-Assessment

Throughout the duration of this study, William was able to examine several aspects of his teaching practice. Additionally, William's approach to self-assessment progressed. One of the primary changes William made throughout his participation in the study was the manner in which he approached and observed his lesson in VAT. For each cycle of VAT analyses, he became more systematic and observant in his viewing of his teaching. The data indicate that William was also able to move beyond examining issues solely at a global level when provided with his Assessment Focus, which suggested that it helped him focus on specific issues of practice at a fine-grained level. However, William's written assessments also began to switch foci after the introduction of the Assessment Focus. While he was able to clearly detail and narrate what was occurring in his teaching in all of his VAT analyses, data show that William's

use of VAT and the supporting mechanisms provided to him did not help him interpret and make sense of the video evidence. That is, the Analysis Framework prompts, TSM attributes, or Assessment Focus neither provided the support necessary to help him develop solutions for continuing successful practices nor did it help him address and develop solutions for areas of his teaching that needed change.

Enablers and Constraints for Formative Assessment

The situations, tools, and resources that supported or prohibited William's ability to assess his teaching are discussed in this section, which is organized by the enablers and constraints that he identified.

Enablers for Self-Assessment

Throughout his participation in this study, William identified several situations, tools, and resources that supported the assessment of his teaching practices. They included a) external support, b) VAT, and c) the Analysis Frameworks. Each of these is discussed below.

External Support. William indicated that he used support from multiple people, which included his teacher education program, university supervisor, mentor teacher, and students, as he assessed his teaching. As part of his teacher education program, William was required to attend a course that focused on reflection. He stated

> [My teacher education program] always encourage[s] reflection … we sit down as a class of science teachers and we reflect on the past week. . . We talk about what we did that week and reflect on it. Someone will bring up a good topic and then we will have a little discussion on why this happened, what could be changed in order for this to better next time or not to happen. (William, Initial Interview Part 2)

William enjoyed being able to discuss teaching issues with others in his field. However, he communicated a concern that the class talked about very general issues that were not always practical or applicable to his experience.

William also discussed the support he received from his university supervisor, mentor teacher, and students as being important in the assessment of his teaching. He used "what other people [told him]" (William, Initial Interview) to inform his understanding of his teaching. William stated that his university supervisor encouraged him to analyze his teaching and "…taught [him] to reflect more, and more in depth" (William, Initial Interview). William's mentor teacher also supported the assessment of his teaching through her feedback. He pointed out that her perspective of the lesson provided him with more information about his teaching practice. William noted " . . . having that other teacher in there really helped … [S]he was able to tell me what I was doing wrong or right in the classroom" (William, Initial Interview Part 2). However, when describing the experiences between himself and his university supervisor and mentor teacher, William did not describe experiences where he assessed his teaching. Instead, William indicated that his university supervisor and mentor teacher told him what needed to be changed in his teaching, which illustrated that William was not engaging in systematic assessment.

In addition to using other educators' views of his lessons to support his development, William also used student feedback to assess his teaching. He described a survey given to his students to elicit feedback on their class. As they responded to his survey, the students identified "what they liked about the class, what they [thought] could be changed, [and] what they [thought] could be left out" (William, Initial Interview Part 2). William stated

> [My students] did not like taking notes … I decided to give them guided notes to see if they would perform better in class discussions for me, perform better on their quizzes … If they were better, I would keep giving them guided notes. … It turned out that the quiz grades did go up and [there] was much more participation in class (William, Initial Interview Part 2)

William was willing to involve his students in the analysis of his teaching. His students' feedback led to the adoption of a new teaching tool (i.e. guided notes) that he thought to be beneficial to his classroom and one that he would incorporate into his future practices.

VAT. The data indicate that William viewed VAT as a tool that supported the assessment of his teaching practices. He indicated that VAT was beneficial because "[it] was great to sit down and see myself and teach – to see what I was doing wrong or what I thought I was doing right" (William, Post-Analysis 1 Interview). By using video evidence to support his self-assessment, VAT enabled William to assess parts of his teaching that he saw as positive or those he thought needed change. VAT also allowed him to view his teaching from another perspective. William stated

> It is a lot different when you actually see yourself teach and see what you do good and see what you do bad. For the most part, I felt like I was doing a good job, .. but watching the class and the reactions on the kids' face in the video, a lot of things did not go the way they went in my mind. (William, Post-Analysis 3 Interview)

VAT enabled William to see that there was a dissonance between his perceptions of his teaching and what took place in his classroom. William explained how VAT supported his self-assessment by stating

> I liked being able to see myself teach. I just like being able to go back and look. I never got the chance to do that before. This is just a great opportunity to see the things . . . from watching [the videos], well, I was like I have to work on this and this and this now. (William, Post-Analysis 3 Interview)

VAT provided him the opportunity to see his teaching practices, which was an option he had not been afforded in the past.

Analysis Frameworks. Another set of tools William identified as supporting the assessment of his teaching practices was the Analysis Frameworks. While each of his VAT analyses used a unique Analysis Framework, William found each of them important to the assessment of his teaching. After completing his first analysis, he stated that Analysis Framework 1 required him "… to look at other things in my teaching that I would not necessarily look at on a regular basis and analyze" (William, Post-Analysis 1 Interview). He recognized that the Analysis Framework helped him assess specific components of his teaching practice.

In describing his use of the second Analysis Framework, which was coupled with the TSM attributes, William noted that it helped him assess his teaching "because [he] was able to see how much work [he needed] to do for next year" (William, Post-Analysis 2). He also discussed how the Analysis Framework and TSM attributes scaffolded him to analyze his teaching and "get some feedback" (William, Post-Analysis 2). His statements indicate that the reflection framework and TSM helped him identify areas of teaching that he needed to change and gave him guidance and feedback as he completed his analysis.

While discussing his third analysis, William identified how the Analysis Framework, which was coupled with a focus and the TSM attributes, supported the assessment of his teaching. He stated that the focus "… helps you hone in on what you need to be looking at. ..This

was a good way for me to actually [focus on] something I said that I wanted to look at" (William, Post-Analysis 3 Interview). William perceived that having a focus for his analysis was important because it required him to focus on one specific aspect of his teaching and it was something that he originally identified as an issue of practice. William noted that this analysis was more "in depth than all the other [analyses]. .. [With the third analysis, it was] easier to get a little bit more in depth when I was able to look at just one [teaching issue]" (William, Post-Analysis 3 Interview). This statement further emphasized his belief that having a specific focus helped him better analyze his teaching. Again, William reiterated how the Analysis Framework scaffolded him through the assessment. He remarked, "I would have no idea of how [to] do an analysis … [I] need[ed] these questions to guide [me] throughout the analysis" (William, Post-Analysis 3 Interview). This statement illustrated William's view of and need for the Analysis Framework to assess his teaching.

Summary of enablers for formative assessment. William identified that several people prompted him to assess his teaching. One assessment experience that William conducted himself, using a student survey, did lead to change in his teaching. In that experience, William used student feedback to develop a new teaching tool, guided notes. However, while noting that his teacher education program, university supervisor, and mentor teacher provided support, the types of support they provided did not provide him with the types of knowledge and experiences necessary to conduct assessment on his own. The experiences he described were either not applicable to his needs or he was provided with direct feedback for change, which left William out of the assessment process. When William was afforded the opportunity to self-assess with VAT, he noted that VAT and the Analysis Frameworks helped him better assess his teaching. Specifically, VAT provided him with a new perspective that allowed him to see what was

actually occurring in his classroom. He also indicated that the TSM attributes and Assessment Focus were beneficial because they provided him with direction and helped him identify areas of his teaching that needed additional work. Finally, he noted that the Analysis Framework prompts enabled self-assessment because he noted that he had no idea how to do an analysis of his teaching.

Constraints for Self-Assessment

Through his interviews and assessments of his teaching practice, William also identified some constraints of being able to assess his teaching practices. Specifically, he mentioned the constraints as being certain situations, tools, and resources that influenced his ability to assess his teaching. The constraints he discussed included a) time and experience, b) VAT, and c) the Analysis Frameworks. Each constraint is discussed in more detail below.

Time and experience. Two of the primary issues that appear to have restricted William's ability to self-assess his teaching were time and experience. In one interview, he noted that if he had more available time during the day then he would be able to assess his teaching more. He identified his experience with both assessment and teaching as being constraints to self-assessment. He indicated that assessing his teaching was challenging because he never conducted "… [an assessment of his practice] in college or high school or anything before … [and] never had to do anything like this" (William, Post-Analysis 3 Interview). His statements indicated how his lack of experience with assessment made this process challenging because it was an idea that was foreign to his previous academic experiences.

VAT. While VAT was identified as an enabler for the self-assessment of his teaching practices, William also noted how it constrained his self-assessment. The constraints he described with VAT were primarily technical in nature. For example, he stated he had difficulty

analyzing some video in VAT because "I am walking around teaching [and] it is kind of hard to look at the [the video]. Especially, if you cannot hear what I am saying, or what [the students] are saying, or what they are asking" (William, Post-Reflection 3). William identified how difficult it was to assess certain parts of his lesson because of the camera's location and capabilities. Another technical issue that William had was with the system itself. He noted "… A couple of times, I was almost done and I saved [my assessment] and hit a wrong button somewhere on the screen . . . It did not submit it so I had to start all over again" (William, Post-Reflection 3). This statement illustrated his difficulties with saving, but not submitting his clips. Another constraint that William reported as influencing his ability to save and submit his written assessments was when VAT would freeze on occasion.

Analysis Frameworks. As with VAT, William also identified the Analysis Frameworks as both enablers and constraints. After his first analysis, William did not identify Analysis Framework 1 as a constraint. However, during his discussion of Analysis Framework 2, which also included the use of the TSM attributes, he noted how this framework affected his ability to assess his teaching. He remarked that "It was just kind of hard finding good clips . . . That was probably the hardest thing for me, finding something that demonstrated [TSM attributes]" William, Post-Analysis Interview 2). William noted how difficult it was to find evidence of specific TSM attributes in his VAT video. His inability to locate attributes of his teaching was influenced by his interpretation and understanding of the TSM attributes. The data illustrate that William did not have a deep understanding or clear picture how each attribute should look.

William indicated that having an Assessment Focus for his third analysis limited his assessment of his teaching. He stated, "This [analysis] was [a] little bit tougher to find the clips because I … had something to focus on. It was harder to try and find that focus in each clip"

(William, Post-Analysis 3 Interview). William indicated that the focus limited how he examine and clip his video. He pointed out that associating a TSM attribute with his focus was also challenging. He noted the challenges of "trying to pinpoint the one [attribute]" (William, Post-Analysis 3 Interview) that related to the focus that guided his third VAT analysis. Again, this issue primarily related to William's knowledge of and comfortableness with the TSM attributes.

Summary of constraints for formative assessment. When William was asked to identify issues that limited his ability to assess his teaching, he identified time and experience. That is, he noted that assessment takes a considerable amount of time and that he had very little free time to assess his teaching during his student teaching because he had many other responsibilities. Furthermore, he had little, if any, experience assessing his teaching on his own. He also noted that his lack of teaching experience provided him with little opportunity to compare his teaching to other issues. Other challenges that William faced were based on his experiences with VAT and the Analysis Frameworks. With VAT he encountered some technical challenges and noted that the video evidence available to him did not allow him to analyze everything he wanted to examine (e.g., individual student discussions). Concerning the Analysis Frameworks, William associated inhibitors with challenges. William indicated that the TSM attributes and Assessment Focus made his analyses more difficulty. However, this challenge was not due to the nature of the support mechanisms themselves, but the fact that the TSM attributes and Assessment Focus increased his workload in assessment. That is, those support mechanisms required him to more carefully examine his teaching practices in VAT.

Erica

Conceptions of Formative Assessment

Through her participation in this study, it was evident that Erica did not have a strong conceptual or operational understanding of formative assessment. Like the other participants in this study, Erica perceived that formative assessment, whether through self-assessment or reflection, allowed her to examine her teaching. However, beyond that similarity, Erica's conceptions of self-assessment and reflection were quite different.

First, Erica indicated that self-assessment and reflection had differing results. With self-assessment she identified that it led to change. She noted that self-assessment allowed her to "figure out what [she] did wrong and how [she could] change it so that next time [she did not] make those same mistakes" (Erica, Initial Interview). She also noted, "[When] you're [sic] towards the end of [self-assessment], …you figure out ways to fix [the problem]" (Erica, Initial Interview). Erica's statements implied that self-assessment required her to identify specific issues that arose in her teaching in order to address and change them. However, she, like Laura, did not perceive that reflection necessarily led to change in practice. Instead, reflection was for thinking about her teaching. She stated, "If I were to reflect, I would just think if [my teaching went well or not". She went on to note, "[W]ith reflection, you don't [sic] always think about ways to correct or things to change" (Erica, Initial Interview). That is, she did not perceive that reflection led to change in her teaching because, while it may help her identify an issue of practice, it is not a process that required her to generate solutions.

Second, Erica described the formality of the two processes as different. She indicated that reflection was less formal than self-assessment. She stated, "[w]hen I think about doing reflection, I think about maybe writing in a journal, where it is more personnel" (Erica, Initial

Interview). Conversely, she pointed out that self-assessment was more formal and seemed "like testing" (Erica, Initial Interview). Through her statements, it was evident that Erica perceived reflection as an informal process, which contributed to her conception of reflection as an approach that does not lead to change in teaching. Also, she equated self-assessment to testing, which implied that she perceived self-assessment to be more rigorous and structured.

Overall, Erica's conceptions of self-assessment and reflection were not well developed. Furthermore, when she was asked to identify how the two processes were conducted, it was apparent that she neither had a clear understanding for conducting the two processes nor did she perceive them as systematic approaches. Additionally, she did not equate formative assessment to an ongoing process that required her to interpret and make sense of her teaching. Thus, by participating in this study, Erica would have to develop her own strategies and approaches for self-assessing her teaching. The processes she developed for using evidence of her teaching as well as the issues she assessed are discussed in the next section.

Processes and Foci for Self-Assessment

At the beginning of this study, Erica did not have a well-developed understanding of self-assessment. Thus, she would have to develop and refine her approaches for self-assessing her teaching practices. In the following section, how she used video evidence, her ability to focus on specific issues during her VAT analyses, the depth of her written assessments, and the types of issues she examined are discussed.

Using Video Evidence in VAT

Erica's approach to using video evidence in VAT to self-assess her teaching evolved during this study's duration. For her first analysis, Erica made use of her lesson on pollination. Her approach to selecting clips in VAT was very straightforward. She commented, "I started out

just watching [the lesson in VAT]. And when I saw something I thought was interesting, I [rewound] it and watched it again" (Erica, Post-Analysis 1 Interview). To create clips in VAT, she noted that she watched her lesson and created clips when she saw " ... parts that stood out from the lesson itself ... or something that [she] needed to fix or something that [she thought she] did well" (Erica, Post-Analysis 1 Interview). Thus, Erica's approach to using video evidence during Analysis 1 was very straightforward in that she let issues or events that caught her attention to emerge from her observation of her lesson in VAT. Also, she chose to focus on aspects of her practice that either needed improvement or showed her doing something well.

For Analysis 2, Erica made use of her lesson on plant hormones and asexual reproduction. During this analysis, her approach to self-assessment had already begun to evolve. For Analysis 1, Erica reported that she watched her lesson in VAT and simply created clips based on what she thought was interesting, which resulted in her looking at common occurrences in her teaching. During Analysis 2, Erica noted that she reviewed the TSM attributes and then carefully observed the video in order to assign an attribute to the clips that she created before completing any of the Analysis Framework prompts, which resulted in the creation of 10 clips. She stated, "I used the attributes as a guide [and … I] went through and picked out any clip that looked like it represented [one] of the attributes" (Erica, Post-Analysis 2 Interview). One change that Erica did make during her second analysis was to search for repeated issues. She stated, "… [if] I saw that I had a problem in one part of the video, I would look to see if that problem repeated itself" (Erica, Post-Analysis 2 Interview). However, her final set of written assessments did not demonstrate that she paid special attention to repeated problems in her teaching. Instead of developing clips of repeated problems, she developed six written assessments of six unique TSM attributes, which contradicted her stated approach of using the video evidence to examine a

repeated issue of practice in her teaching. Thus, like William, she developed written assessments that dealt with as many TSM attributes as possible.

To complete Analysis 3, Erica once again used the science lesson she analyzed during Analysis 2. Her approach to using the video evidence was similar to the one she used during Analysis 2 except that she used her Assessment Focus (i.e. student engagement in the lesson) to guide her clip selection. During her analysis, Erica reported observing segments of her lesson multiple times before she created clips. She noted, "[If I] found something that thought was good or was applicable, I went back and watched it again to sure it was applicable [to my Assessment Focus]" (Erica, Post-Analysis 3 Interview). This approach demonstrated that Erica was more selective and observant of her lesson before creating clips. That is, she did not create a clip until verifying that the clip was directly related to her Assessment Focus. Additionally, the inclusion of the Assessment Focus also refined her use of the TSM attributes that she also associated with each clip. Instead of focusing on several attributes, as she did in Analysis 2, Erica only associated one TSM attribute with the clips she created.

Throughout her three VAT analyses, Erica's approach to using video evidence became more systematic. For example, during Analysis 1, Erica watched her video one time and created clips when she identified something "interesting" (Erica, Post-Analysis 1 Interview). However, with the inclusion of other support mechanisms (i.e., TSM attributes and Assessment Focus), Erica appeared to become more systematic in her observation of video evidence during Analyses 2 and 3. That is, she was more purposeful in her lesson observations in VAT and was more selective in creating clips. Additionally, as discussed below, Erica's written assessments also became more systematic as she progressed through this study. In the sections below, the issues

she examined and her ability to focus on specific issues within each written assessment are discussed.

Ability to Focus on Specific Issues

Of the four participants in this study, Erica was the only one to consistently focus on one issue throughout all three VAT Analyses. Unlike the other participants, the inclusion of the TSM attributes and Assessment Focus did not influence her ability to ignore other issues or events that may have been present in the clips. For example, during Analysis 2, she examined a problem that commonly occurred in her classroom, discussions that cause the classroom to lose focus. After associating the clip with the classroom management TSM attribute, she wrote

> The class [got] rowdy and confused so we had to step back and I had to calm my students down and get them back on track … Everyone was talking to each other and asking questions. I told the class we needed to calm down a bit before we resumed the lesson. ... This clip .. shows that I need to prevent my class from getting to this point. If I have better control of the class, it won't [*sic*] get to the point where we all have to take a little breather. ... I am dissatisfied because I should have been on top of the class and prevented them from getting this worked up, [which] is something I need to improve. … I need to be a better facilitator of classroom discussion .. [because] it can quickly escalate to the point where we all have to take a minute to regroup, wasting valuable class time. (Erica, Analysis 2, Clip 8274)

In her written assessment and through the observation of her lesson in VAT, Erica was able to maintain her focus on classroom management, an ability she consistently demonstrated. Based on the other participants' written assessments, they, unlike Erica, would likely have become concerned about other issues that arose during the clip or would have provided comments not

related to the original issue. Thus, Erica was very successful in focusing on one issue. However, like the other participants, Erica had difficulty deeply examining issues in her written assessments, which is discussed in the next section.

Depth of Analysis

During her first two analyses, Erica, like the other participants, struggled to self-assess her teaching. That is, most of written assessments lacked both evidence interpretation and analysis depth. However, unlike the other participants who continually switched foci within each written assessment, Erica was able to remain focused on one issue. This difference allowed for her written assessments to be categorized differently than the other participants. That is, all of her written assessments could be organized into three categories, which were written assessments that 1) verified a known problem, 2) justified a teaching strategy, or 3) taught her something new about her teaching practices. Of those three categories, Erica created most of her clips from the first two categories, verifying a known problem or justifying a teaching strategy. In those written assessments, her response to Analysis Framework prompts resulted in a narrative of the clips events and a discourse of her beliefs.

Erica created several written assessments in which she simply confirmed aspects of her teaching that she was doing well or those that needed modification. In those written assessments, which she developed for Analyses 1 and 2 only, Erica simply provided a description of the problem and a narration of the clip's events. For example, using the excerpt from the section above, Erica created written assessments in both Analysis 1 and 2 that confirmed her difficulty in preventing off-task discussions, which she stated, "[I]s something I have noticed that I do too much" (Erica, Analysis 1, Clip 6301). While it is important for Erica to recognize and confirm areas of her teaching that are both successful and unsuccessful, the written assessments she

developed for those clips did not offer new insights about her teaching or solutions for addressing those issues. Instead, she would summarize her written assessments by noting that the clips represented "something [she was] doing well" (Erica, Analysis 1, Clip 6300) or something she "need[ed] to work on" (Erica, Analysis 1, Clip 6301), which implied that she was not interpreting the evidence in order to make sense of what was occurring in her classroom.

Another type of written assessment that Erica developed during Analyses 1 and 2 were those that justified a teaching strategy or technique that she employed in the classroom. They included multiple written assessments for a) setting up and providing feedback for quizzes and b) why it is important to use concrete examples in her science teaching. In the written assessments that justified a teaching strategy or technique, Erica provided some narration, but most of her written assessment shared her beliefs about the strategy being used. For example, during Analysis 1, Erica shared her justification for providing students with immediate feedback. She noted that the clip was important to examine because of her belief that "it is beneficial to the students to immediately go over the quiz and know the correct answers … because it gives meaning to what the students just did" (Erica, Analysis 1, Clip 6300). Throughout the remainder of that written assessment, she neither provided reasoning why the strategy was successful in this clip nor did she identify how it was replicable. Instead, she only shared her beliefs about why she should continue to use this student feedback strategy. She wrote

> [This strategy] is a good way to use the quiz to not only evaluate the students' knowledge, but to also reinforce the ideas [that] the quiz covers. … I should always make sure I am using this [strategy] to its full advantage. (Erica, Analysis 1, Clip 6300)

This type of written assessment did not require Erica to deconstruct and interpret her lesson in VAT in order to make sense of what was occurring because she was not addressing an actual issue of practice. Instead, she was simply justifying what she was doing in her classroom.

Written assessments that demonstrated Erica learning something new about her teaching were the final type of written assessment that she developed. In those written assessments, it appeared she was able to better identify issues of practice and develop solutions for addressing the problem. Erica was also more systematic in her self-assessments as they offered the most insight and interpretation of her teaching, Additionally, she, unlike the other participants, examined one issue across multiple written assessments. One of Erica's written assessments created during Analysis 2 and all of her Analysis 3 written assessments fell into this category. For example, during Analysis 2, Erica learned that she had a lack of content knowledge. In that written assessment, she learned that she did not have a strong understanding of the "process of budding plants" (Erica, Analysis 2, Clip 8277), which she recognized after not being able to answer a student's question. From this event, Erica learned that she a) dodged the student's question because she was not comfortable in her role as the teacher, b) needed to be able to expand beyond "what the students' books tell them" (Erica, Analysis 1, Clip 8277), and c) missed an opportunity to illustrate that teachers also need to continue to learn and strengthen their own content knowledge.

In another example of learning something new about her teaching, Erica recognized that she "took the easy way out" (Erica, Analysis 3, Clip 8810) during a class discussion of the content. This issue was examined across three of the six written assessments that Erica developed for Analysis 3. Throughout those written assessments, Erica, with guidance from her Assessment Focus (i.e. increasing student engagement), learned that she was repeatedly allowing

only one student to reply to questions directed towards the entire class. By watching her lesson in VAT, Erica indicated that she was contradicting her teaching belief that "all students should have a chance to answer questions" (Erica, Analysis 3, Clip 8810). She was able to see that other students were trying to participate, but she did not let them respond because they "would have been less likely to have the correct answer" (Erica, Analysis 3, Clip 8810). She also recognized that "the other students are aware that I tend to let [Elliot] answer [all the] questions" (Erica, Analysis 3, Clip 8812), which was impacting the classroom dynamics. Because Erica examined this issue across multiple written assessments, she was able to see how this one event, or pattern, impacted the entire classroom. First, she recognized that she opted for the easiest route for covering the course content, which allowed her to identify that a gap existed between her teaching beliefs and practices. Second, by including only one student, the other students were discouraged from participating in the lesson. Thus, from her observation and interpretation of the video evidence, Erica was able to recognize that she created a lack of student engagement by not incorporating the other students and saw that it impacted both her ability to meet her teaching beliefs and manage the classroom. Furthermore, as she completed her written assessments, she confronted a disconnect between her beliefs and practice, noted that she needed to better manage the classroom environment, and posed a solution (i.e. select other students) for getting the entire class engaged in the lesson.

Overall, Erica was able to focus on one issue or aspect of her teaching more consistently than the other participants, which resulted in Erica's written assessments being quite different than the other participants. Yet, for Analyses 1 and 2, the products of her written assessments were very similar to the other participants in that she provided very little interpretation of the video evidence. In those two analyses, all but one of Erica's written assessments either

confirmed problems that she already knew existed or justified her use of particular teaching strategies. However, after being provided with the Assessment Focus for Analysis 3, Erica's written assessments demonstrated that she was interpreting and making sense of the evidence in order to make sense of what was occurring in her lesson, which was quite different that the other participants' written assessments. During Analysis 3, she was more observant of the video evidence and was more successful in identifying issues of practice that allowed her to develop an understanding of classroom events. Furthermore, Erica created multiple written assessments around one issue in her classroom, which allowed her to deconstruct events with more depth than the other participants. Thus, Erica was the most successful in framing a particular issue and examining that issue from multiple perspectives (e.g., classroom management, teacher beliefs, and from the students' point of view). This type of analysis allowed her to identify where her beliefs about teaching were not being enacted in practice as well as develop solutions for making changes in her teaching.

Foci of VAT Analyses

The focus of Erica's written assessments varied throughout her three VAT Analyses. She examined many different areas of her science teaching that could be categorized into three pedagogical themes, which were the act of teaching, addressing the needs of students, and factors related to learning. Each is discussed below.

Act of teaching. Throughout her three analyses, Erica developed several written assessments that focused on her teaching. The areas of her science teaching that she examined from this category were associated with technical aspects of teaching, which included classroom management and covering state standards. Of the four written assessments that dealt with her teaching, three of them were linked to classroom management. Erica also developed one written

assessment that demonstrated that she was meeting and covering state standards, which was important to her because, as she pointed out, she needed to confirm that she was "follow[ing] the curriculum" (Erica, Analysis 2, Clip 8278).

Addressing the needs of students. Another aspect of her teaching that Erica often addressed was meeting the needs of students. She reported that developing an understanding of her students and recognizing individual differences would allow her to "find what works best for a particular class" (Erica, Analysis 3, Clip 8807). For example, Erica developed a written assessment to confirm that her selection of a particular teaching strategy (providing multiple examples) supported her belief that all students' needs should be met. As she finalized that written assessment, she was satisfied that she met that goal by writing, "Some students are visual learners. By providing this example, I am helping those students" (Erica, Analysis 2, Clip 8280). The final aspect of teaching that she examined that addressed her meeting the needs of students was through her examination of classroom rapport. In that written assessment, Erica summarized her analysis by noting that humor allowed her to better relate and communicate with her students.

Factors related to learning. Erica developed at least one written assessment that examined issues related to learning across her three VAT Analyses, which was far more frequent than the other participants. Specifically, during Analysis 3, all but one of her six written assessments focused on factors related to student learning. For example, in one of her written assessments, Erica recognized that one of her students did not understand a question posed to the entire class. Erica was also able to observe that she provided a redirecting question, but identified that she did "not [modify] the way in which the question [was] asked" (Erica, Analysis 3, Clip 8809). Subsequently, Erica noted that she "need[ed] to improve the way [she] clarified concepts

to students who don't [sic] understand them" (Erica, Analysis 3, Clip 8809) in order to better support her student's learning. In other written assessments, Erica examined other factors related to student learning that included using effective student feedback strategies, presenting content in multiple ways, addressing her own lack of content knowledge, and interacting with students. While the other participants also examined these issues, they often examined them from a teacher-centered perspective. Erica, however, analyzed those issues by examining their impact on student learning.

Summary of Processes and Foci for Self-Assessment

Throughout her participation in this study, Erica demonstrated refinement and development in both her approach to and implementation of self-assessment. Like the other participants, the manner in which she observed and made use of the video evidence in VAT became more systematic. As she viewed her science lessons in VAT, she carefully observed her teaching and was selective in her choice of clips to be assessed. When Erica began developing her written assessments, she was also able to remain consistently focused on one issue, which was a trait the other participants did not demonstrate in their self-assessments. As she progressed through this study, it appeared that Erica became more comfortable in self-assessing her teaching practices. By Analysis 3, her written assessments became more systematic and insightful. For example, Erica made use of her Assessment Focus to deeply examine one issue across multiple clips and from multiple perspectives. Also, by Analysis 3, Erica's written assessment focused less on global, technical aspects of teaching at a global level. Instead, she examined issues that related to student learning. This shift allowed her to develop an understanding of what occurred in her classroom and create solutions to address problematic issues.

Enablers and Constraints for Formative Assessment

Erica noted several situations, tools, and resources that supported formative assessment as well as several that inhibited it. This section is organized in the following manner: a) enablers and b) constraints for formative assessment.

Enablers for Formative Assessment

The enablers for formative assessment that Erica articulated included a) external support, b) VAT, and c) the Analysis Frameworks, which are each discussed in the following subsections.

External support. Erica only mentioned two providers of external support that enabled formative assessment, her teacher education program and mentor teacher. She briefly mentioned that her university supervisor encouraged her to assess her teaching, but the encounters with her university supervisor were infrequent and informal. In describing the entirety of the process, she stated that her university supervisor would ask her "what went well [with the lesson and] what could have been improved" (Erica, Initial Interview). From those encounters, she did not indicate that anything meaningful came from their discussions.

In discussing her teacher education program, Erica noted that she had been provided with multiple field experiences prior to her student teaching. However, she did not formatively assess her teaching during those experiences. Instead, the types of formative assessment she described were based on reading science education literature. She stated, "[After reading the articles, we] write [about] what we think. They call them reflections. [We] write what previous information we already [knew] about the topic being presented and we write about our initial thoughts on it after reading it" (Erica, Initial Interview). Erica reported that she found this approach meaningful because "[our instructors] encouraged us to think about different perspectives" (Erica, Initial Interview). She then noted, "I always try to take a teacher perspective, student perspective and

parent perspective, [which] are the three entities involved in teaching" (Erica, Initial Interview). This approach to formative assessment was demonstrated during Analysis 3 in which she examined similar events from different perspectives. Thus, she garnered knowledge about formative assessment from her teacher education program other participants did not even though they were peers taking the same university courses.

The biggest influence on Erica's formative assessment practices was her mentor teacher. She noted that her mentor teacher asked her to assess her teaching "after every class period, not just at the end of the day or the end of the week" (Erica, Initial Interview). However, Erica also emphasized that her mentor teacher did not always provide her with solutions. She stated

> She was always asking me questions. She wouldn't [sic] tell [me] if she thought something didn't [sic] go as well as it could have. Instead of saying, "You need to fix this in particular", she would ask me, "Do you think your lesson went well? Do you think there is anything that you could improve upon?" And I think that was good. Making me analyze everything not just being told what I am doing. (Erica, Initial Interview)

From this approach (i.e. not telling her what needed to be changed), Erica perceived that her mentor teacher successfully prepared her to assess her teaching. That is, Erica's mentor teacher instilled the idea that formative assessment is an ongoing process that requires continued effort in order to better one's own teaching practices.

VAT. Another enabler for assessment that Erica noted was VAT. Specifically, she noted that VAT allowed her to be more accurate in her analyses because she could watch and review classroom events and interactions repeatedly. She stated

> [VAT] gets you more focused on what is going on. If you are just thinking back to a lesson you might remember details incorrectly or you might have missed something that

a student said. With the video you pretty much can catch everything and you don't [sic] remember things incorrectly. (Erica, Post-Analysis 1 Interview)

Erica's statement indicated that VAT helped her assess her teaching more accurately because the tool allowed her to see what actually occurred in her class. Most importantly, VAT allowed her to examine events and interactions beyond those that she could recollect, which she indicated allowed her to provide depth in her analyses.

Analysis Frameworks. The Analysis Frameworks were the final set of tools Erica identified as assessment enablers. She commented that the Analysis Framework prompts were helpful because they prompted her assess issues of practice to see if "I am doing it well or if I am doing it poorly" (Erica, Post-Analysis Interview 2). Additionally, she reported appreciating the prompts because they provided her with the opportunity to assess not only problematic aspects of her teaching, but also those the positive aspects of her teaching, which she indicated was extremely important. However, her written assessments indicated that she gained the most out of assessments that focused on problematic areas of her teaching. The clips that she assessed as being successful often had little, if any, interpretation, which did not result in the development of solutions or strategies for replicating her successes. Conversely, when she assessed issues that she denoted as problematic, Erica was able to develop solutions for implementing change in her teaching.

Erica also pointed out that the TSM attributes used for Analyses 2 and 3 were beneficial support mechanisms for self-assessment. She noted, "… it was really easy to pick out things that I had problems with especially when using the attributes" (Erica, Post-Analysis 2 Interview). In addition to making it easier to identify issues of practice, she specified that the TSM attributes prompted her to examine "things that are important to teaching" (Erica, Post-Analysis 2

Interview). In describing why she perceived that the TSM attributes were important, she stated, "[Preservice teachers] may not necessarily think to look for the fact that they are accommodating different students' needs. Having this for preservice teachers makes them [assess many] different aspects of teaching" (Erica, Post-Analysis 2 Interview). Her statement indicated that she, as well as other preservice teachers, needed guidance and support when doing self-assessment. Thus, she indicated that the TSM attributes were especially important to her analyses because she had a strong desire to assess meaningful aspects of her teaching that would help her grow professionally.

The final component of the Analysis Frameworks that Erica identified as supporting self-assessment was the Assessment Focus, which was introduced in Analysis Framework 3. She stated that by focusing on an individual aspect of her teaching, she was able to examine a specific aspect of her teaching "more in depth" (Erica, Post-Analysis 3 Interview). Based on the written assessments she developed for Analysis 3, it was evident that the inclusion of the Assessment Focus helped her examine a specific issue with more depth and insight. However, this may also be attributable to her familiarity with the lesson and her continued growth with self-assessment.

Summary of enablers for formative assessment. Throughout this study, Erica identified several situations, tools, and resources that supported the assessment of her teaching. First, Erica noted that both her teacher education program and mentor teacher provided her with meaningful experiences to assess her teaching. From her comments about her teacher education program, it also appeared that she acquired strategies for assessment that the other participants did not. Additionally, she learned from her mentor teacher to be self-reliant when doing formative assessment and that assessment is an ongoing process. Finally, the tools provided to Erica to

assess her teaching were also beneficial (e.g., VAT and the Analysis Frameworks). From VAT she derived value in being able to view and review evidence of her teaching. Based on her comments, the Analysis Framework prompts appeared to provide her with structure and direction in analyzing clips while the TSM attributes helped guide her in selecting issues to examine. Finally, the Assessment Focus narrowed Erica's assessments around a singular issue. With the Assessment Focus and other support mechanisms, she was able to more deeply examine and interpret classroom events.

Constraints for Formative Assessment

Erica was less detailed in the identification of constraints for self-assessment. The situations, tools, and resources that she indicated as prohibiting, or limiting, self-assessment were time, VAT, and the TSM attributes. Each is discussed in more detail in the following subsections.

Time. Erica, along with all the other participants, identified time as a constraint to assessing her teaching. However, she was the only participant who did not also suggest her lack of teaching experience as a constraint. Similar to other participants' responses, Erica noted that time was a major factor because she had many other responsibilities as a teacher that made formative assessment a low priority. She stated

> [T]eachers often just get overwhelmed with all the physical things that they have to do, take roll, grade papers, [and] manage [the] classroom, that at the end of the day they are about exhausted. They don't [sic] always take time and actively think – [self-assessment] is what I should do. (Erica, Initial Interview)

Erica's statement illustrated her understanding that the role of the teacher is complex and coupled with several administrative duties that teachers are obligated to complete. Thus, the assessment of her teaching is often neglected because of other tasks that must be completed.

VAT. Erica noted that VAT sometimes constrained the self-assessment of her teaching practices. The issue that she described was based on a technical issue that caused her to lose one of her written assessments in VAT. She stated, "one time when I went back to go modify one of [my] clips [in VAT] said [there] was an error and it did not save [my assessment]" (Erica, Post-Analysis 1 Interview, lines 164-165). Another problem that Erica faced was based on the limitations of using a single video camera to capture classroom events. She commented

> I did notice when I was watching the video [during Analysis 3] that I could not always tell what students were participating and what the other students, whose voices I did not hear, were doing because I could not see them on the video. (Erica, Post-Analysis 3, lines 158-160)

Because Erica could not identify which students were speaking and could not see all of her students in the video, she perceived this kept her from being able to analyze all aspects of her classroom practices.

Analysis Frameworks. The only time Erica mentioned having difficulty with the Analysis Frameworks was during Analysis 3. She perceived that the TSM attribute inhibited her assessment because "it was kind of hard to match [her Assessment] Focus with a particular [TSM] attribute" (Erica, Post-Analysis 3 Interview). She noted that without the inclusion of the TSM attributes, she would have been able to create clips "relevant to [her] focus" (Erica, Post-Analysis 3), but she did not because "they [did] not have had anything to do with one of the {TSM] attributes" (Erica, Post-Analysis 3). Thus, she indicated that her third analysis would

have been strengthened, or easier to complete, if she did not have to associate a TSM attribute with her Assessment Focus.

Summary of constraints for formative assessment. Like the other participants, Erica pointed out that time constraints prohibited her from being able to assess her teaching regularly. However, she differed from the other participants in that she did not identify her limited teaching experience as being a constraint. As she discussed the support mechanisms provided to her during her three analyses (i.e. VAT and the Analysis Frameworks), she identified three ways in which they hindered formative assessment. First, she encountered a technical difficulty in which one of written assessments was not saved. Second, the available video evidence inhibited her analyses. That is, the captured lesson in VAT did not allow her to see and hear everything that was occurring in her classroom. Finally, Erica noted that the inclusion of both the TSM attributes and the Assessment Focus impeded her third analysis. That is, she perceived that she missed an opportunity to assess event related to her Assessment Focus because she could not also associate them with a TSM attribute.

Laura

Conceptions of Formative Assessment

Based on her interviews, it appeared that Laura perceived formative assessment, whether through reflection or self-assessment, to be an inward looking process for examining one's own teaching that would lead to improvement. However, beyond the idea of formative assessment for improvement and change in practice, it was evident that Laura did not have a clear conceptual understanding of how to systematically conduct either process, which was not unexpected. This section briefly examines her conceptions and identifies areas in which her understanding of formative assessment is lacking.

When defining the goal of formative assessment, Laura had very similar beliefs about the goals of both self-assessment and reflection. She noted that the goal of self-assessment was "to make small steps to improvement every time you self-assess" (Laura, Initial Interview). Similarly, she noted that reflection was for the identification of what she "could [do] different[ly] to make improvements" (Laura, Initial Interview). Furthermore, she indicated that both processes should be conducted iteratively because they did not lead to sweeping, dramatic changes in practice, but, instead, small changes in practice. However, beyond her view of self-assessment and reflection for small, continual improvement of teaching, her perspective on the two processes diverged.

Three of the differences that Laura noted between the two processes were (a) the depth of analysis required, (b) the scope of the issue being examined, and (c) the product of the analysis. When discussing the depth, or intensity, of the processes, Laura perceived that self-assessment was "… more analytical. More [of an] analysis what you did. Whereas, reflection may be just thinking back on what you have done" (Laura, Initial Interview). Laura's statement indicated her belief that self-assessment was more in-depth and required greater analysis than reflection, which she noted could merely be "thinking" about one's own teaching. Her statement indicated that she perceived reflection to be a non-systematic process that does not require the purposeful examination of issues of practice. Laura also perceived that the scope of issues being examined were different. She commented that self-assessment focused on specific, well-defined issues to be assessed that allowed her to "get more into the detail[s] and smaller parts" (Laura, Initial Interview) of the problematic issue. Conversely, she noted that reflection was not "as critical, so you get more of a bigger picture" (Laura, Initial Interview). Finally, when discussing the outcome of the two processes, she stated that self-assessment would always lead her "to find

something … that you could make a little different the next time (Laura, Initial Interview). This contrasted with her belief that reflection might only produce a "general idea" (Laura, Initial Interview) of a problem or issue with her teaching, which contradicted her notion that reflection resulted in improvement or change in practice.

Overall, when Laura was probed to better understand her understanding of the purpose of and processes for both self-assessment and reflection, her conceptions were not consistent with educational literature, which was not unexpected given her limited experience. While she viewed both self-assessment and reflection as inward looking processes that would allow her to identify issues in her teaching, she was not able to identify specific methods for engaging in these processes. Thus, it became apparent that Laura would have to develop her own process for assessing her teaching with VAT, which is detailed in the following section.

Processes and Foci for Self-Assessment

Throughout her participation in this study, evidence indicates that Laura's conception of formative assessment influenced her ability to analyze and interpret her teaching. Subsequently, her participation in this study provided her with the opportunity to develop and refine a systematic process for conducting self-assessment. This section details the processes Laura used to complete her three VAT analyses as well as what she focused on during her written assessments. This section is organized into four sections that include: (a) how she used the video evidence in VAT to assess her teaching, (b) her difficulty in remaining focused on specific issues, (c) a lack of depth during her analyses, and (d) focusing on similar issues during her three analyses. Each of these is discussed below.

Using Video Evidence in VAT

Throughout her participation in this study, Laura's use of video evidence in VAT continued to change and evolve. During her first analysis, Laura analyzed a science lesson on natural selection. After completing VAT Analysis 1, Laura was unable to clearly define the process she used to assess her teaching. Statements such as, "[Introducing the lesson] was one thing that I wanted to look at and how well that went" (Laura, Post-Analysis 1 Interview), were the norm as Laura vaguely described process for creating clips and analyze self-identified aspects of her teaching. She pre-selected areas of her teaching such as changing activities and "transition points in the lesson" (Laura, Post-Analysis 1 Interview), as she described them, for examination in her first analysis. The data indicate that she chose to focus on technical aspects of a lesson (e.g., introducing a lesson), which was similar to William and Erica's approach, instead of allowing issues to emerge from the video evidence in VAT. Laura's choice to create clips around technical, common components of a lesson allowed her to quickly and easily create clips in VAT. However, she did not systematically examine her lesson to amplify critical and substantive issues of practice in her teaching.

For Analysis 2, Laura significantly changed her approach as she assessed her lesson on Darwin's Theory of Evolution. Her approach consisted of reviewing the TSM attributes, watching the entire videotaped science lesson without stopping, and then identifying specific parts of the lesson to clip in VAT. She noted that she "looked through and read all of the [TSM] attributes" and "watched the lesson through one time without doing anything" (Laura, Post-Analysis 2 Interview). Laura's statements implied that she was more purposeful in her observation of the lesson. After completing that process, she then watched the lesson again while keeping a list of the TSM attributes in front of her. Describing how she created clips, Laura

stated, "[W]hen I saw something that I thought represented one of the attributes, I would rewind it and then mark the clip off accordingly" (Laura, Post-Analysis 2 Interview). The process that Laura described indicated that she used the TSM attributes to explicitly guide the identification of issues to be assessed. Thus, Laura's use of the video evidence in VAT was much more systematic as she purposefully selected and created clips associated with specific TSM attributes.

During Analysis 3, Laura applied a process for identifying issues and creating clips in VAT that was very similar to her second analysis. The video she selected to assess was the same lesson on natural selection that she assessed during Analysis 1. The only change Laura made was her attention to the Assessment Focus, which was a specific issue she identified immediately after teaching the lesson that was captured for VAT analysis. She noted that she "read through [her Assessment] focus again" and "read over the [TSM] attributes" (Laura, Post-Analysis 3 Interview) to refresh her memory. Then, just as she did during Analysis 2, Laura watched her lesson without creating any clips. Not until her second viewing did she create clips, which she did by "specifically looking for [her Assessment] Focus" (Laura, Post-Analysis 3 Interview). Laura indicated that the process of identifying clips associated for this analysis was easier than her previous two analyses because she was provided with a specific issue to examine (i.e. her Assessment Focus). Using the Assessment Focus, she systematically examined the video evidence in VAT in order to assess her teaching, which allowed her to purposefully create clips associated with her Assessment Focus.

Overall, it was evident that Laura's lack of understanding about assessment made it challenging for her to assess her teaching. As a result of her unfamiliarity and lack of experience, the way she used the video evidence in VAT evolved throughout her participation in this study. During Analysis 1, Laura pre-selected issues of practice to assess in her lesson, which resulted in

her not using VAT to carefully observe the video and purposefully select clips. The introduction of TSM attributes and her Assessment Focus required her to develop a more systematic approach for observing her lessons in VAT in order to identify and create clips. Subsequently, Laura was required to more purposefully use her video evidence. Even though the process she used to observe her teaching in VAT was more systematic, Laura consistently had difficulty framing specific issues of practice and remaining focused on issues throughout her analyses, which is discussed in the following sections.

Ability to Focus on Specific Issues

From her written assessments, it became apparent that Laura struggled to assess her teaching. Her lack of a clear conception of the process and purpose of self-assessment impacted her ability to consistently focus on one issue or event during her written assessments. For example, during Analysis 1, Laura identified a need to improve student engagement in her classroom. However, as she developed her written assessment, she switched the focus from one of engaging students in class discussion to her assessment practices before returning again to the issue of student engagement. Laura wrote

> It is critical that the students learn to be confident and not afraid to talk aloud in the classroom or to be wrong. … I need to figure out a way to make it more interactive and not so boring. … In this part of the video, we are going over part of the worksheet aloud. For some of the answers, I am letting students raise their hands but for other answers, I am actually calling on individuals from a clipboard and at random. On the clipboard, I am awarding students for their answers by making a mark. Depending on the answer the students give, I will give them a certain mark. (Laura, Analysis 1, Clip 7977)

This type of inconsistency was prevalent in the majority of Laura's written assessments. Even with the inclusion of the Assessment Focus and TSM attributes, Laura continued to have difficulty remaining focused on one issue during her written analyses. For example, in Analysis 3, she analyzed an interaction she had with a student, which she associated with the TSM attribute of respect and rapport for students. However, during her written assessment, she changed her focus to a discussion about the importance of setting high expectations. When describing an interaction between her and a student, Laura wrote

> I am coming over to answer a student's question and the question she is asking is ridiculous. On the worksheet, she has the question [and] has page numbers to read over. I get so frustrated because this is just a lack of effort on the student's part. So, I tell her to go back and read over the information again. … I believe that you should hold high expectations for all of you students no matter what. (Laura, Analysis 3, Clip 8842).

Even though Laura's clip was representative of her Assessment Focus (i.e. keeping students on-task) and a TSM attribute, she once again had difficulty remaining focused on the initial issue that she identified. Thus, the inclusion of an Assessment Focus and the TSM attributes did not make it easier for Laura to consistently examine one issue as she self-assessed her teaching practices. Furthermore, switching between foci during her written assessments also prevented her from assessing her teaching deeply and meaningfully, which is discussed in detail in the following section.

Depth of Analysis

During Laura's three analyses, her written assessments consistently lacked depth and insight. While Laura systematically examined the video evidence in VAT to purposefully select clips for self-assessment, her written assessments principally provided only a narrative or

description of the clip's events. This issue was further compounded by her tendency to switch foci throughout her analyses. While this issue was consistent across all three of Laura's VAT analyses, it was especially problematic during VAT Analysis 1 in which she was allowed to analyze any issue she saw in the video evidence. For this analysis, she chose to examine issues and events she pre-selected before watching her lesson in VAT, which resulted in her choosing to examine either technical components of a lesson (e.g., lesson introductions) or events that commonly occurred in her class (e.g., managing a science lab activity. Her written assessments only provided a description and narrative of the clip's events. For example, in one written assessment, she chose to focus on addressing student questions. In her response to Analysis Framework 1 prompts, she only described what was occurring and shared her beliefs about the event. Laura wrote

> I chose this event because I feel like this happens all of the time in my classroom. Students always ask questions before they have even tried to find the answer themselves. … The worksheet I gave the students for the lab had page numbers in their books to go look at for questions. So, it is frustrating because you can tell that instead of reading one or two paragraphs of information she is just going to try and ask me the question to see if I will give the answer to her. (Laura, Analysis 1, Clip 7976)

In this clip, Laura did not assess any aspect of her teaching. Instead, she shared her beliefs about students seeking solutions on their own and provided no interpretation or explanation. That is, she neither addressed what led to this issue, which prevented her from developing possible solutions for solving the problem. This problem persisted throughout her analyses regardless of any support mechanisms that were provided to her (i.e., Analysis Framework prompts, TSM attributes, or Assessment Focus).

Overall, Laura's written assessments lacked depth and insight. Instead of reasoning with and trying to make sense of the video evidence in VAT, she only provided descriptions and narratives of the clips that she created. This issue prevented Laura from being able to frame specific issues of practices and examine them thoroughly. Subsequently, she was unable to reframe the issue, which did not allow her to develop solutions for addressing or duplicating the issue being examined. However, during VAT Analysis 3, Laura developed one written assessment that demonstrated a deeper understanding of an issue that was only recognized after the introduction of her Assessment Focus. In that written assessment, Laura examined a strategy that she often used to help develop rapport with her students. Through her analysis, she found that this strategy contradicted her Assessment Focus of being time efficient. She wrote

> I chose this clip … because I feel like spending a little bit of time with each student allows me to establish respect. … It is related to my focus because I do not see this as being very time efficient and it does not help me in keeping the students on task. ... I am dissatisfied with this clip when I think about it related to my focus because I do not believe it makes me more efficient. … This represents something that I should improve because I think it is still a good idea to have contact with each student during the day but maybe I could find a better way to do that. … Well, I am kind of torn because I really liked doing this everyday because it gave me a chance to talk to each student. And this is a huge part of my teacher beliefs, but it is not very time efficient. (Laura, Analysis 3, Clip 8789).

Laura was upset with this clip because it illustrated disconnect between a teaching strategy that she used (i.e. visiting each student to review homework) and her need to manage time more appropriately. She realized this approach for developing respect and rapport contradicted her

desire to get the lesson started efficiently and get through the lesson's content and activities. Not only did this clip cause conflict between her beliefs, it also contradicted a clip she made in Analysis 1. During that analysis, she created a clip on the same segment of video. In Analysis 1, she mentioned that her decision to check each student's homework individually "is something I am doing well because it does not waste a lot of time and is an efficient way to check homework and interact with every student all at once" (Laura, Analysis 1, 6346). She valued that aspect of her teaching because it allowed her to get to know her students. In her Analysis 1 written assessment, she wrote "[visiting each student allows me to] have some kind of contact between every student in the room, which I believe is crucial to my teaching" (Laura, Analysis 1, 6346). This clip demonstrated that once she was provided with an Assessment Focus (i.e. being time efficient), she was required to reevaluate the strategies she used in her classroom and examine the event from a different perspective. While she was able to frame and clearly identify the issues (i.e. develop and maintain rapport with students), Laura did not reframe the problem in order to develop and predict the impact of potential solutions.

Foci of VAT Analyses

As mentioned above, Laura had difficulty focusing on one issue and assessing it in-depth. However, the issues she examined throughout her three analyses focused on three similar pedagogical themes. Those themes included (a) the act of teaching, (b) addressing the needs of students, and (c) factors related to learning. Each is briefly discussed below.

Act of teaching. During each of her analyses, Laura used VAT to examine her teaching. She examined both her facilitation of the lesson and technical aspects of teaching. For her facilitation of the lesson, she created clips that analyzed her use of questions for discussion, engaging students in discussion, and examining her own content knowledge. However, she

mainly developed clips related to technical aspects of teaching, which included delivering instructions, classroom management, introducing lessons, and lesson transitions. Laura's focus on technical aspects of teaching was especially prevalent during VAT Analysis 1, where she almost exclusively focused on technical aspects due to her pre-selection of issues to examine before watching her lesson in VAT. Laura also examined those issues during Analyses 2 and 3 due to a TSM attribute that was associated classroom management and her Assessment Focus, which also dealt with an aspect of classroom management (i.e. time efficiency).

Addressing the needs of students. Laura was frequently concerned with nurturing her students and making sure they were comfortable in her classroom. She wanted to create a "friendly [classroom] environment where students are not afraid to share and be wrong ever now and then" (Laura, Analysis 1, Clip 7977). Throughout her three analyses, Laura analyzed several clips that dealt with addressing the needs of her students. Those clips focused on building rapport, accommodating students' needs, respecting students, and providing support outside of class.

Factors related to learning. Laura did not create and analyze many clips related to student learning. However, she addressed one particular issue in both Analyses 1 and 3. During those analyses, she created clips that demonstrated her concern and emphasized her desire to have students feel responsible for their own learning. She indicated this was important because "you should hold high expectations for all of your students no matter what" (Laura, Analysis 3, Clip 8842).

Summary of Processes and Foci for Self-Assessment

Laura's approach for using video evidence in VAT to analyze her teaching in VAT evolved during her participation in this study. During VAT Analysis 1, she did not systematically

examine the video in VAT to purposefully select clips for analysis. However, during Analyses 2 and 3, she refined her approach for using video evidence and more systematically identified issues of practice using the TSM attributes and her Assessment Focus. Even though Laura was able to systematically identified issues in the video evidence, she did not systematically analyze and interpret the video evidence. She continually changed the focus of her analysis and provided little depth and insight in her written assessments. Thus, Laura did not reason with the video evidence, which prevented her from being able to frame and reframe issues of practice. Her written assessments suggested that the TSM attributes and Assessment Focus helped her identify issues of practice and associate them with specific aspects of her teaching. However, the Analysis Framework prompts did not provide the necessary support for Laura to analyze and interpret her teaching, which prevented her from developing solutions for change. Those issues as well as other enablers and constraints for formative assessment are discussed in the following section.

Enablers and Constraints for Formative Assessment

This section discusses the situations, tools, and resources that supported or inhibited Laura's use of formative assessment to examine her teaching practices, which include both her experiences before and during this study's completion. This section is organized by the (a) enablers and (b) constraints for formative assessment that Laura identified during her participation in this study.

Enablers for Formative Assessment

During her participation during this study, Laura identified several enablers for formative assessment. They were a) external support, b) VAT, and c) the Analysis Frameworks. Each is discussed below.

External support. Laura noted that many people helped her examine and assess her teaching, which included her teacher education program, peers, university supervisor, and mentor teacher. However, these experiences did not provide her with a clear conceptual understanding of formative assessment. That is, the types of assessment experiences and activities she participated in did not result in her developing the skills and knowledge necessary for a systemic approach for conducting formative assessment. This lack of clarity was evident in both her interviews and her implementation of self-assessment with VAT, which were discussed in the sections above. A discussion of the types of experiences and the level of support that Laura was provided to assess her teaching during her preservice teacher education program is discussed below.

One type of experience that Laura noted as having a large impact on her understanding of formative assessment was her enrollment and participation in her teacher education program. She indicated that the teacher education program promoted formative assessment by providing numerous experiences where she and her peers could examine and discuss their observations of various classrooms and their student teaching experience. Laura stated, "In [my first practicum] ... I [was] just at the school primarily observing a classroom … We kept a journal the whole time we were there . . . we were reflecting on things that we saw" (Laura, Initial Interview). Similar to this activity, some of her coursework also allowed her to examine and reflect on someone else's classroom teaching. In describing a classroom experiences at the university, she commented

> We discuss[ed] things that happened in our classroom. [For example,] someone might bring up a discipline problem they have. Even though you don't [sic] get to bring up your [own issues, you get to think] … [about] a problem [that you had] similar to that. … Just

> being in a group setting … [allows] constructive criticism or shar[ing] ideas. (Laura, Initial Interview)

Since her this type of course did not allow students to strictly focus on their own classrooms experiences, she often had to relate her teaching experiences to those of her peer's discussion of their teaching issues. Even though she valued those experiences and perceived that they helped her gain teaching knowledge, both experiences she described did not provide her with a systematic approach for assessing her teaching. Instead, the experiences she discussed were either based on (a) the observation of others', not her own, teaching practices or (b) the recollection of her own or her peers classroom experiences, which may or may not have been relevant to her own needs. While these experiences are valuable to Laura's development as a teacher, they shaped Laura's conception of formative assessment as a non-systematic process for examining very broad, general issues of practice.

Another influence on Laura's understanding of formative assessment was her university supervisor. While her university supervisor did provide feedback on Laura's own teaching, the process Laura described did not include her in the identification and assessment of specific issues. She stated

> [My university supervisor] would talk to [me] about what [I] did in the classroom. [She] might ask you if there [was] anything that you would have changed. … Also [she] may tell you things that [she] saw that did not go so well. (Laura, Initial Interview)

Again, Laura valued feedback from her university supervisor but the process she described was not a systematic approach for assessing issues. Instead, the process was based on the identification of issues, not on the assessment of specific issues of practice. Thus, Laura did not

work through the process of systemically analyzing and interpreting classroom events to address issues of her teaching practice.

Of all the external assistance that Laura was provided, she noted that her mentor teacher provided the most support in assessing her teaching practices. She commented

> We would sit there and discuss if [the lesson] went well or what could have changed. We might do that after a period so we [would end] up changing something in that next period. … We actually made the changes during the day. (Laura, Initial Interview).

Laura strongly valued her experiences with her mentor teacher. However, the changes she described being made in her classroom were not based on the systematic assessment of classroom events, but based on direct feedback from her mentor. That is, Laura did not systematically work through issues of practice to change in her lessons with her mentor to develop solutions. Instead, he would directly provide her with changes to be made in her teaching.

Overall, the types of formative assessment experiences that Laura encountered throughout her teacher education program did not help her develop a strong understanding of self-assessment. Additionally, she did not identify any experiences where she assessed her teaching on her own. Instead, the types of formative assessment opportunities she was provided with were directed by others, or simply imposed upon her. That is, she did little in terms of reasoning with and interpreting evidence of her practice in order to address issues of practice in order to address and change those practices.

VAT. After being introduced to and using VAT to self-assess her teaching, Laura indicated that VAT helped her examine her teaching practices deeply and meaningfully. She noted that VAT allowed her to examine "really, really specific things. … It [was] helpful

because you can analyze thirty seconds and find five or ten things you could change. It helps [you] look very specifically and then go back and look at the big picture" (Laura, Initial Interview). Laura's statement illustrated her belief that VAT allowed her to examine specific, narrow aspects of her teaching. Furthermore, she reported that VAT allowed her to better recognize the greater impact that individual, small issues had on a lesson overall. However, this was not evident in the written assessments she developed in VAT. Another benefit of VAT that she noted was the ease in identifying specific issues of practice to be assessed. Laura concluded that VAT helped her recognize specific issues because VAT enabled her to view what actually took place in her classroom. She attributed this growth to the fact that "you get to see [your teaching] from a completely different perspective" (Laura, Post-Analysis 1 Interview) and "it is hard to remember things this specific if you can't [sic] go back and look at it" (Laura, Post-Analysis 2 Interview, lines 167-168). Not only did VAT allow her to see her teaching from a different perspective, but it also allowed her to review aspects of the lesson and her teaching based on tangible evidence versus that of recollection.

Analysis Frameworks. During her participation in this study, Laura recognized the Analysis Frameworks as a tool for helping her better assess her teaching. However, as evident in her written assessments, only certain components of the Analysis Frameworks appeared to help her assess her teaching practices. One element of the Analysis Framework that did not help Laura assess her teaching was the Analysis Framework prompts. Even though she found the prompts to be supportive, her written assessments did not demonstrate that they helped her systematically analyze and interpret the issue she identified to be assessed. In describing the Analysis Framework prompts, Laura noted that they helped her "go back and look at the clip even closer and maybe even more times so that you [can] describe it better. [They] allow you to

look at [teaching events] more specifically" (Laura, Post-Analysis 2 Interview). Laura's statement implied that the Analysis Framework prompts helped her examine her teaching more closely. However, they only helped her provide a description, not an interpretation of the events, which indicates that the Analysis Framework prompts need modification or the inclusion of additional training and support for them to better serve assessment needs.

While overall the frameworks did not intuitively promote the systematic assessment her teaching, two components of the Analysis Framework, the TSM attributes and Assessment Focus did provide benefits. Laura perceived that the addition of the TSM attributes and Assessment Focus components to the Analysis Framework helped her assess her teaching with even better precision. After her first use of the TSM attributes, she stated

> [The TSM attributes] help[ed] [me] look at specific areas that maybe I wasn't [sic] thinking about before, like classroom management and things like that. So this again just gives you a better outline and it is more specific. [They allowed me to look at] more of the small parts of the big picture than [I did for Analysis 1] (Laura, Post-Analysis 2 Interview)

Laura's statement indicated that the TSM attributes provided two benefits: a) they prompted her to examine specific attributes of her teaching that she would have otherwise ignored and b) they enabled her to examine narrow issues of practice instead of global, general issues. The Assessment Focus helped her become "a lot more specific" (Laura, Post-Analysis 3 Interview) because she had to focus all of her efforts on a single issue of practice. This component provided Laura with insight about specific teaching issues as she became aware that issues of practice often impact several areas of an individual lesson. She stated, "… there were so many things that had to do with [my focus] that I probably would not have thought of before" (Laura, Post-

Analysis 3 Interview). As noted above, the inclusion of the TSM attributes and Assessment Focus helped Laura assess her teaching, but not with the intended effect. That is, while they did help her identify issues to be assessed, they did not provide the support needed to consistently and systematically interpret the evidence that would have allowed her to develop solutions for addressing those issues.

Summary of enablers for formative assessment. Overall, the enablers for formative assessment that Laura described provided various levels of support in order for her to either (a) develop knowledge of formative assessment or (b) implement assessment of her teaching. However, the types of support provided from external agents (e.g., university supervisors and mentor teachers) did not equip her with the needed knowledge and experiences required to systematically assess one's own practices. Instead, the experiences Laura described often focused on global issues of practice and included very little interpretation and sense-making of actual teaching issues and events. When Laura assessed her teaching using VAT and the Analysis Frameworks, Laura demonstrated that these resources did not provide the needed support mechanisms as well. While she did show growth in identifying issues in VAT, her written assessments indicated that she needed additional support in order to move beyond the description of events and into the interpretation and assessment of issues of practice. In the following section, the assessment constraints that Laura identified are discussed.

Constraints for Formative Assessment

Laura identified several situations, tools, and resources that constrained her ability to self-assess her teaching. Those that she mentioned were a) time and experience, b) VAT, and c) the Analysis Frameworks. Each is discussed below.

Time and experience. When asked to identify what prohibited her from self-assessing her teaching, Laura immediately identified two expected factors – time and experience. She noted that "time constraints" (Laura, Initial Interview) were a major factor because meaningful assessment takes a significant of time. This problem was exacerbated by the fact that she had "… so many other things to do" (Laura, Initial Interview) as a preservice teacher. While she recognized a need to assess her teaching, she indicated that assessing her teaching would force her to neglect her other responsibilities.

Laura also indicated that her lack of teaching experience inhibited self-assessment. She stated, "[self-assessment] is kind of hard because I [feel] like I don't [have] much experience. So it is hard for me to think about [my teaching]" (Laura, Post-Analysis 3 Interview). Her statement highlighted her belief that limited teaching experience prohibited self-assessment because she had few experiences to draw from or compare. Even though she noted that a lack of teaching experience constrained her ability to assess her teaching, she did not mention her lack of experience in assessing her teaching as an inhibitor. The experiences she described in the "Enablers for Formative Assessment" may have provided her with the types of experiences necessary to assess one's own teaching.

VAT. Laura, who identified VAT as an assessment enabler, also identified that the tool hindered assessment. However, the constraints she identified were only related to technical issues with the system. She stated

> The only thing that was a pain [was] that when you make a clip and go back … again [to] make another clip, it will start at the beginning of the video. … [it was] just tedious to get it back to the point where you want [the video's position to be]. (Laura, Post-Analysis 1 Interview)

Even though Laura indicated this issue constrained her self-assessment, her concern was a technical issue that required her to spend additional time in VAT as she completed her assessment. This issue is a valid concern because she was already worried about the time required to conduct assessment. Thus, it is important for tools such as VAT to be as efficient as possible.

Analysis Frameworks. As she did with VAT, Laura identified the Analysis Frameworks as both as an enabler and a constraint for assessment. Her primary concern with the Analysis Frameworks were related to the TSM attributes. Laura had difficulty remembering and using all seven of the attributes. She stated, "[I]t was hard for me to keep in mind what all I was looking for while I was looking at [the video in VAT]" (Laura, Post-Analysis 2). This issue was compounded by her unfamiliarity with the TSM attributes. Additionally, she found that not all attributes could be found in the video evidence. She commented, "… it was kind of hard to see individual differences [attribute] in the [video]" (Laura, Post-Analysis 2 Interview). Her statement points to the fact that the type of evidence available to her (i.e. video) did not support the identification of or assessment of issues related to that attribute. The final constraint that Laura identified as a constraint was her use of both the Assessment Focus and TSM attributes. She pointed out that her Assessment Focus did not tightly align with the TSM attributes. In describing this concern, she stated that her focus "didn't [sic] really correlate with any [TSM] attribute. I was really stretching it when I picked one" (Laura, Post-Analysis 3 Interview). Because of this issue, Laura perceived she was stalled during Analysis 3. However, her written assessments did not demonstrate this issue.

Summary of constraints for formative assessment. Like all the other participants in this study, Laura noted time was a major constraint for formative assessment. She, like William and

Mariska, also noted that her lack of teaching experience prevented her from being able to assess her teaching. Another challenge that Laura overcame during this study was associated with technical problems with VAT, which required her to spend a significant amount of time navigating through her lessons. Finally, she identified the Analysis Frameworks as a constraint. Specifically, she noted that her lack of familiarity with the TSM attributes made assessment difficult. Furthermore, she indicated that the evidence available to her in VAT did not allow her to identify and examine all of the attributes. Finally, she noted that it was difficult to use both the TSM attributes and Assessment Focus during Analysis 3, which was due to her perception that her Assessment Focus did not tightly align with any of the TSM attributes.

Mariska

Conceptions of Formative Assessment

From the beginning of this study, it was apparent that Mariska did not have a clear conception of formative assessment. When describing self-assessment and reflection, she noted, "self-assessment and reflection are both looking back at something that you did [in the classroom] and seeing what you could do to make it better" (Mariska, Initial Interview). She firmly perceived that both processes led to the outcome of improved teaching. However, beyond a general sense that formative assessment would lead to better teaching, Mariska was neither able to articulate how either process should be conducted nor could she describe how solutions for changing her teaching were developed.

As she discussed self-assessment and reflection, Mariska made use of a similar strategy for conducting the two processes. She used a series of questions as the primary approach to examine her teaching so that she could become "more aware of something that" (Mariska, Initial Interview) occurred in her classroom. For example, when assessing a test, she would ask herself,

"[Was it] a fair test? [Did I] cover everything? Did [I] review enough?" (Mariska, Initial Interview). However, beyond the inclusion of a series of yes and no questions for identifying problematic issues, Mariska did not mention questions or prompts that required her to interpret and explain what happened in this classroom. Mariska also had several misconceptions about the two processes, particularly in regards to size, scope, and what could be assessed.

On the surface, it appeared that Mariska perceived self-assessment and reflection as identical processes. However, after further probing, she identified differences between the two, which helped identify the misconceptions she held about the two processes. Those differences were primarily related to the size and scope of the issue being examined. That is, she indicated that self-assessment allowed her to look at her teaching with a "narrow view on a particular event" (Mariska, Initial Interview). Because self-assessment allowed her to examine small, specific events in her teaching, Mariska perceived that it allowed her to assess a wide range of issues in her teaching before, during, and after lesson delivery. Conversely, she stated that reflection was "broad field" and examined "the whole day" (Mariska, Initial Interview). Subsequently, she noted that reflection could only be conducted post hoc and focused on broad, global issues of practice.

Another misconception that Mariska held about formative assessment was not apparent until after the completion of VAT Analysis 1. In the post-analysis interview, she described her rationale for selecting a particular lesson in VAT for analysis. She stated, "this [video] is the only lecture that does not include a lab" (Mariska, Analysis 1, Clip 6226). Mariska's comment implied that formative assessment examined only teacher-centered activities. That is, she did not find value in assessing her facilitation of classroom activities (e.g., science labs) unless it contained a "lecture" component.

In general, Mariska had an incomplete understanding of formative assessment. While she viewed self-assessment and reflection as processes that would allow her to improve her teaching, she was not able to identify how they should be conducted. Beyond the identification of issues of practice, Mariska could not conceptualize formative assessment as a systematic process for interpreting classroom events in order to make sense of issues after their identification. Thus, through her participation in this study, Mariska would have to develop and refine strategies for assessing her teaching. In the following sections, the processes she used and the foci of her analyses are discussed.

Processes and Foci for Self-Assessment

As Mariska began this study, it was evident that she did not have a well-defined conception of self-assessment. Therefore, she would have to develop her own approach for assessing her teaching practices. In the following sections, how she made use of video evidence, how she focused her assessments, the depth of her written assessments, and the issues she examined are discussed in detail.

Using Video Evidence in VAT

Mariska's approach to using video evidence in VAT evolved throughout this study. For Analysis 1, she was neither able to clearly articulate how she approached observing her lesson in VAT or how she selected clips to be analyzed. This lack of clarity seemed to result from her focus on learning to use the technology versus creating an approach for making use of her video evidence. However, she did mention that she watched her lesson on global warming multiple times. She also noted that she only created clips when she saw herself lecturing. Thus, the only segments of her lesson in VAT that she closely observed were those that contained teacher-centered events.

For Analysis 2, Mariska selected the same lesson that she used during Analysis 1. However, unlike the other participants, Mariska's approach in using video evidence of her teaching became less systematic than her first analysis, which included multiple observations of her lesson. This change was principally due to Mariska's belief that she was already aware of everything that occurred during the lesson. Because of that belief, she noted that the process of associating a TSM attribute with a classroom event was a simple process. She stated, "Because I was familiar with this [lesson], I did not have to watch it through" (Mariska, Post-Analysis 2 Interview). Therefore, Mariska did not allow issues of practice to emerge from the video evidence. Instead, she simply pre-selected events that she could connect to a TSM attribute. Subsequently, her use of video evidence was not based on a systematic observation of the video evidence.

To complete Analysis 3, Mariska once again made use of the same lesson that she observed during Analyses 1 and 2. However, the inclusion of an Assessment Focus, which was an issue that she identified as needing analysis, changed the way in which she made use of video evidence. Even though she was familiar with the lesson, Mariska "watched the whole ninety minutes instead of picking parts" (Mariska, Post-Analysis 3 Interview) before trying to create any clips. That is, like Laura and WIlliam, Mariska observed her lesson in VAT multiple times. Not until a second pass through the video did she create clips "that were around my [Assessment] Focus" (Mariska, Post-Analysis 3 Interview). Thus, Mariska adopted a more systematic approach in using the video evidence as she carefully observed her lesson so that she could identify clips to be assessed.

Overall, Mariska's use of video evidence was inconsistent. During Analyses 1 and 3, she observed her lesson multiple times before creating clips in VAT. Her second analysis was her

least systematic approach in using video evidence. During that analysis, she did not carefully observe her lesson in VAT because of she had already observed the lesson during Analysis 1. By her third analysis, Mariska once again changed how she made use of video evidence by adopting a more systematic approach. During that analysis, she observed her lesson multiple times and carefully selected clips that associated with her Assessment Focus. However, despite the changes in the way in which she used video evidence, Mariska struggled to assess her teaching throughout all three of her VAT Analyses. In the sections below, the challenges she faced in focusing on specific issues and the lack of depth in her written assessments are examined.

Ability to Focus on Specific Issues

Mariska had difficulty in focusing on specific issues during her written assessments for multiple reasons. First and foremost, Mariska's written assessments demonstrated that she had difficulty identifying a well-defined issue of practice to analyze. Second, as she developed her written assessments, Mariska was commonly distracted by surface level distractions. The dilemmas she faced throughout her three analyses are briefly discussed below.

During Analysis 1, distractions were especially prevalent. For example, in one written assessment, Mariska appeared to be examining how she helped make content relevant to her students. She wrote

> I am .. using concepts [the students] can relate to ... for example, makeup with SPF, sunglasses, etc. It is interesting to see if my examples are relevant to the students' lives. Mostly to see if they can relate to the examples...and what other examples I can provide [the] next time around. (Mariska, Analysis 1, Clip 6226)

However, instead of focusing on how providing relevant examples helped students better understand the content, she became distracted by her selection of words. Subsequently, the

distraction caused her to change the direction of her written assessment. She wrote, “I want to improve my usage of "weasel" words. Weasel words are the following: VERY, EXTREMELY, GOOD, NICE, and LIKE [emphasis in original]. It makes you sound silly and not educated” (Mariska, Analysis 1, Clip 6226). This type of analysis, being distracted by her own classroom mannerisms and switching foci, was common throughout the entirety of Mariska’s first analysis.

Upon examination of Mariska’s Analysis 2, it was evident that she had a lack of knowledge about self-assessment. That is, the clips she created were not an assessment of teaching practices. Instead, she created a collection of clips that demonstrated that she could find events in her teaching that were related to the TSM attributes. As noted in the previous section, Mariska a) did not closely observe the lesson she used for Analysis 2 and b) stated that her primary goal was to successfully associate a TSM attribute to a clip. Thus, from the beginning of Analysis 2, Mariska’s goal was not to assess issues of practice from her lesson. For example, in one of her written assessments, she wrote, “This clip is directly related to my interaction with students .. (my rapport)” (Mariska, Analysis 2, Clip 8252), which demonstrated that she could find a connection between one of the TSM attributes (i.e. building rapport with students) and her lesson in VAT. However, she quickly changed directions and wrote about the benefits of using relevant articles and posited that a change in teaching strategies would be beneficial for the learning activity, which was unrelated to building rapport. She wrote, “[This] clip [is a] great example [of] how you can add articles that relate to your home state to your lecture. [Next time] I would have [students] read the article out loud.” (Mariska, Analysis 2, Clip 8252). This pattern of associating a TSM attribute to her lesson, but not making a connection between an actual issue of practice and a TSM attribute, was problematic throughout her entire second analysis.

Mariska's third analysis was her most successful attempt in consistently addressing a single issue in her written assessments. As noted in the section above, the manner in which she observed her lesson in VAT and approached Analysis 3 was much more purposeful. This change was evident in her written assessments, which indicated that she carefully selected clips that were associated with her Assessment Focus. While she sometimes lost direction as she responded to the Analysis Framework prompts, Mariska was able to continually return to her Assessment Focus. Thus, the Assessment Focus supported Mariska's self-assessment and allowed her to remain focused on one issue more consistently.

In summary, Mariska's written assessments demonstrated that she did not have a strong conceptual understanding of self-assessment. One of the primary dilemmas that Mariska faced in completing her analyses was actually identifying an issue of practice to assess, which was especially prevalent during Analyses 1 and 2. During Analysis 3 and after struggling to identify issues and remain focused on them during her first two analyses, the inclusion of the Assessment Focus relieved Mariska's need to identify an issue of practice. Subsequently, she was able to more consistently examine an issue within her written assessments. Mariska's inability to focus on specific issues resulted in a lack of depth in her analyses, which is discussed in the following section.

Depth of Analysis

In all of her analyses, Mariska's written assessments lacked depth. That is, she did not interpret the video evidence in order to make sense of what occurred in her classroom. Multiple factors contributed to this dilemma. First, based on her conceptions of formative assessment, it was evident that she did not have a clear conception of the purpose of self-assessment. Another issue that impacted her analyses was her approach in using video evidence. Not until Analysis 3

did she carefully observe her video evidence, which indicated that her first two analyses were done without systematically making use of her lesson in VAT. Furthermore, Mariska's written assessments also indicated that watching her teaching was distracting. Specifically, during Analysis 1, she was unable to move past her own classroom mannerisms. In that analysis, she was more concerned about the phrases that she used and her movements in the classroom than she was in examining teaching and learning.

Another factor that inhibited the assessment of her teaching was the frequency in which she changed foci. As she moved from issue to issue in her analyses, she spent very little, if any, time interpreting the video evidence. Instead, she only shared her beliefs about teaching and a description of the events within each clip rather than deconstructing the video evidence in order to explain what was occurring and why. Subsequently, she was not able to develop substantive solutions that would lead to change in practice. Furthermore, when she did pose a solution, it was often not based on the evidence. In fact, her conclusions often contradicted statements that she made within each written assessment. For example, as Mariska analyzed her facilitation of note-giving during Analysis 3, she stated, "I feel like I went too in-depth with my notes and my students were not paying attention" (Mariska, Analysis 3, Clip 8645). In her statement, Mariska recognized that the manner in which she approached and presented the content was too advanced for her students. However, she contradicted herself by noting, "I am satisfied with this clip. I think that I provided [good] examples and … I would like to replicate this [in my teaching]" (Mariska, Analysis 3, Clip 8645).

The final factor that prevented Mariska from being able to assess her teaching was due to the Analysis Frameworks. For Analysis 2, it was evident that Mariska did not use the TSM attributes to help her identify issues of practice in her lesson. Instead, she was only interested in

locating an example that represented one of the attributes. Thus, her second analysis contained almost no assessment of her teaching. After she completed her final analysis, another dilemma was made evident. While the Assessment Focus did help Mariska focus on a specific issue, her written assessments were very inconsistent. However, after examining her written assessments more closely, they data indicated that she did not understand or make differentiations between the Analysis Framework prompts. That is, she frequently did not respond to the prompts that asked her to provide an explanation or those that required her to identify what she could have done differently. For those questions, she would often write, for example, "See question 4," which indicated that she either a) did not differentiate between prompts that asked her to describe versus those that asked her to explain or b) did not understand the prompts.

In summary, several factors contributed to the lack of depth in Mariska's written assessments. Due to the approaches she adopted in observing the evidence and using the support mechanisms provided in the Analysis Frameworks, Mariska neither reasoned with or interpreted her teaching in VAT. Subsequently, she was unable to move beyond providing only narratives of clip events and her beliefs about teaching, which meant that she was able to make inferences from the evidence and develop solutions to address issues of practice.

Foci of VAT Analyses

Mariska, as noted above, had difficulty focusing on specific issues during her analyses. Furthermore, regardless of whether or not she switched foci in her written assessments, it was difficult to understand what was being assessed. Unlike the other participants in this study who also often had difficulty focusing on specific issues, they were able to provide enough depth to identify what they were trying to assess. However, Mariska very rarely moved beyond providing a description of what occurred in the clip. Furthermore, her written assessments were redundant

in that she chose to make use of the same lesson for all three VAT analyses. Another difference between Mariska and the other participants was the areas of teaching and learning that were assessed. Most of the other participants examined multiple facets of teaching and learning. However, while she occasionally shared her beliefs about meeting students' needs or issues related to student learning, almost all of the issues that she examined dealt with her facilitation of the lesson. Thus, the only pedagogical theme that Mariska examined was related to the act of teaching, which may be attributable to what she considered to be teaching – teacher-centered, or teacher-driven, segments of a lesson.

During all three of her analyses, Mariska focused on several issues related to the act of teaching. Due to her interest, she exclusively examined lesson facilitation and technical aspects of teaching. For lesson facilitation, she chose to focus on both the delivery of content (i.e. the lecture) and the delivery of a quiz in all three VAT Analyses. She also discussed her own content knowledge, interacting with students, and the use of specific teaching strategies. Finally, she also focused on technical components, in particular, classroom management, in all three of her VAT Analyses.

Summary of Processes and Foci for Self-Assessment

Overall, Mariska had difficulty assessing her teaching in all three analyses. In her written assessments, she primarily examined only teacher-centered aspects of her teaching. The data also indicated that she had difficulty focusing on specific issues within the written assessments of all three of her analyses. Furthermore, despite the inclusion of additional support mechanisms, she was unable to systematically examine well-defined issues of practice. Subsequently, she was unable to interpret her teaching, which limited her ability to understand what was occurring in her classroom. However, one area in which Mariska grew during this study was her approach to

using video evidence. After being provided with an Assessment Focus, she more carefully observed her lesson in VAT and purposefully created clips. Thus, the data indicated that only some of the interventions provided in this study gave Mariska the levels of support necessary for assessing one's own teaching.

Enablers and Constraints for Formative Assessment

This section discusses the situations, tools, and resources that impacted Mariska's ability to assess her teaching. The enablers and constraints to formative assessment that she identified are discussed below.

Enablers for Formative Assessment

Throughout her participation in this study, Mariska identified several enables for self-assessment. They included a) external support, b) VAT, and c) the Analysis Frameworks. Each is discussed in more detail below.

External support. Mariska, like all the other participants, noted that her mentor teacher was supportive in the assessment of her teaching practices. However, she also indicated that her mentor teacher sometimes inhibited assessment, which will be discussed in the constraints section below. Mariska identified multiple instances where her mentor teacher supported assessment. For instance, in describing an assessment experience she had with her mentor, Mariska commented that her mentor teacher asked her, "[W]e spent a really long time doing this [activity]. How can [you] shorten this up?" (Mariska, Initial Interview). Mariska indicated that she frequently encountered this type of broad support throughout her student teaching experience. However, as Mariska described the type of feedback and support that she received, it became apparent that formative assessment was not being modeled effectively. For example, she described an experience where she sought guidance in shortening a lesson's length. She stated, "I

really spent too long talking about the frogs. And [my mentor teacher] was like, 'Well just talk about one frog instead of five different frogs'" (Mariska, Initial Interview). While Mariska commented that she greatly valued her mentor teacher's input because of her many years of classroom experience, Mariska was unable to identify specific instances where her mentor teacher helped her assess a very specific issue. Instead, they focused on very broad issues with little depth or analysis. Furthermore, Mariska was most often provided with a solution rather than working through and analyzing issues in her teaching.

Unlike the other participants, Mariska did not feel that her science teacher education program provided her with knowledge of or meaningful experiences with self-assessment, which is discussed in the constraints section below. Mariska also indicated that her university supervisor, who also supervised Erica, provided little support and guidance concerning formative assessment. She stated, "His point was to come and tell me how he felt, if I was improving, or what I could have done better" (Mariska, Initial Interview). Thus, Erica perceived that she was let down by her teacher education program.

The person that aided Mariska the most in the examination of her teaching practices was, surprisingly, her boyfriend, whom she frequently mentioned. She noted that her boyfriend, who had no teaching experience and had "no knowledge of science" (Mariska, Initial Interview), frequently supported her by a) allowing her to practice science lessons on him and b) providing constructive criticism and ideas for her lessons. She stated

> I would talk to my boyfriend and I would [describe] what happened in class. This was the objective of the class and this is how the class went today. I would talk about this is what I had in mind, this is what I wanted to do, but this is really what happened. … He would … tell me that maybe this happened because of [this reason or that reason]. If I

couldn't [sic] realize something on my own, he would step in and [provide support]. (Mariska, Initial Interview)

Thus, Mariska's boyfriend provided the support she perceived was missing from her mentor teacher and teacher education program. Furthermore, he became someone she found to be instrumental in both the development and analysis of her teaching.

VAT. After using VAT, Mariska strongly indicated that the tool supported teacher self-assessment. She noted that VAT was beneficial because she "got to see what [I was] actually doing" (Mariska, Post-Analysis 1 Interview). Furthermore, she commented that VAT allowed her to examine and concentrate on specific aspects of her teaching that she perceived as important. While not evident in her written assessments, interview data indicated that VAT helped her conduct an in-depth analysis of her teaching because it allowed her to "see the whole picture and all the little components of [her science lesson]" (Mariska, Post-Analysis 1 Interview). Mariska also identified the importance of being able to watch her teaching from a different perspective in VAT. That is, VAT allowed her to watch herself teach from the students' perspective. The final benefit of VAT that she identified was the ability to watch the same lesson multiple times, which allowed her to fully understand what was occurring in her teaching.

Analysis Frameworks. Mariska perceived that all three components of the Analysis Frameworks, the prompts, TSM attributes, and Assessment Focus, supported the assessment of her teaching. However, her perception of the utility of those support mechanisms contradicted the data from her written assessments. When discussing the Analysis Framework prompts, she indicated that they forced her to carefully observe and analyze her teaching and required her to "go in-depth … and explain what [was] going on [in the clip being assessed]" (Mariska, Post-

Analysis 2 Interview). Yet, her written assessments contradicted her stated perception in that she frequently did not respond to all of the prompts in her written assessments.

Mariska also noted that the TSM attributes were beneficial because they provided specific aspects of her teaching to examine that meant that she "did not have to sit down and think about the attributes [herself]" (Mariska, Post-Analysis 3). She perceived that the TSM attributes made it easier to assess her teaching because they reduced the cognitive load required during self-assessment. However, her Analysis 2 written assessments indicated that the TSM attributes inhibited the assessment of her teaching.

Finally, Mariska noted that the Assessment Focus supported self-assessment and was the most helpful component of the Analysis Frameworks. She stated

> Having a Focus made it a lot easier because, when you are picking clips, you have to make sure it really had to do with your Focus. You could not just pick any clip. It was interesting because [the Assessment Focus] narrowed it down to … the problem. (Mariska, Post-Analysis 3 Interview)

Mariska's statement conveyed her perception that the Assessment Focus allowed her to better concentrate on a specific issue, which was a persistent problem during her first two analyses. By not having to concentrate her efforts on finding issues to examine, it appeared that the Assessment Focus provided direction and made it easier for Mariska to identify clips for in VAT. Mariska also perceived that the Assessment Focus helped her be more in depth in the analysis of her teaching because it helped filter out extraneous events from the lesson being analyzed. She noted

> I thought [Analysis 3] was more in depth than first or second [analysis]. Only because I had a focus [was I] able to … shut [out] everything else that was going [on]. So I said,

> ”My focus is about how I present my notes to the class. What I can do to make those notes better?” Everything else that was going on in the classroom I ignored except for the fact that here [are] my notes on the overhead. (Mariska, Post-Analysis 3 Interview)

Mariska’s statement indicated that the Assessment Focus allowed her to ignore the noise and distraction from events and issues not related to her focus, which was a problem in Analyses 1 and 2. Subsequently, that focus enabled her to explicitly examine a self-identified, specific issue of concern in her teaching. However, as noted previously, the data contradicted Mariska’s perceptions of the interventions’ utility. That is, the data indicated that the interventions aid her in being more systematic in her use of video evidence of her teaching, but had little, if any, impact on the depth of her analyses.

Summary of enablers for formative assessment. Mariska was able to identify several enablers for formative assessment. Like the other participants, she noted that external support, VAT, and the Analysis Frameworks helped support the assessment of her teaching. However, Mariska was unique in that she did not include her teacher education program and mentor as external support providers. Instead, Mariska noted that her boyfriend was her primary external resource. With VAT, Mariska noted that the tool was beneficial because it allowed her to view and review actual events from her classroom. That is, she did not have to solely rely on recollection of teaching events. Finally, Mariska noted that the Analysis Framework prompts, the TSM attributes, and Assessment Focus helped her assess her teaching. She indicated that each component gave her direction and guidance, allowing her to be more detailed in her written assessments. However, as noted in the previous sections, those support mechanisms did not appear to have the impact that she perceived.

Constraints for Formative Assessment

In addition to the enablers for self-assessment that Mariska identified, she also noted several constraints that inhibited self-assessment. They included a) time and experience, b) the lack of external support, c) VAT and d) the Analysis Frameworks. Each of these constraints is discussed below.

Time and experience. The first inhibitor of self-assessment that Mariska noted was the lack of time that teachers have to examine their own teaching. She noted that, in addition to the preparation and delivery of instruction, teachers also had to contend with school and state policies and other non-teaching responsibilities. Those additional responsibilities coupled with teaching duties made it difficult for her to envision when she would be able to stop and assess her teaching. Subsequently, Mariska indicated that she did not foresee assessment being a practical activity to do each day.

Another limitation that Mariska identified was her lack of teaching experience. Specifically, she noted that self-assessment was difficult because she "[had] no experience. This [was] the first time that I was out in the regular classroom everyday and so I [did not] really have anything to compare [my teaching] to" (Mariska, Post-Analysis 1 Interview). Like William, she perceived that in order to meaningfully assess her teaching she needed experiences to which she could compare her teaching.

Lack of external support. One of Mariska's primary concerns with self-assessment was her belief that she did not receive the external support and guidance that would have prepared her to effectively assess her teaching. She mentioned that her teacher education program as a whole did not meet her needs as preservice teacher. Specifically, she noted that the reflection course in

which she was enrolled did not provide her with the knowledge and opportunities needed to understand how to analyze and assess her teaching. She stated

> [We have not reflected on] how you are teaching or how you are improving. It hasn't [sic] been brought up … [in my reflection] course. [Instead, it is all] based on a reading. They are not my reflections. They are journals. So, you are reading an article and you explain how you feel about the article by bringing up previous experiences. (Mariska, Initial Interview)

Mariska's experience with reflection was reading journal articles and discussing the teaching within the article. She did not find value in reading journal articles, which implied that the journal articles were not relevant to her needs as a preservice teacher. Because of her limited teaching experience and lack of experience in analyzing her teaching, Mariska did not make connections between the literature and her teaching. Thus, she was disappointed in the course and was disappointed in her experiences with her teacher education program as a whole.

Even though Mariska pointed out that her mentor teacher did provide some support for assessment, she indicated that her mentor's support could have been more extensive. She indicated that her mentor teacher did not perceive reflection or self-assessment to be valuable processes for professional growth in teaching. She commented

> My mentor teacher has been teaching for thirty years so she … really wasn't [sic] that much into reflection. She felt like, "I have been teaching here for 30 years. I lived in this community. This is what I think is going to happen. I know most these kids parents because I taught them." She had a different view and I don't [sic] think she did reflection. … We would talk if a lesson went really bad. We would talk about it. If [the lesson]

went really well, we would talk about it and she would keep it for the next year. But that [was] pretty much it. (Mariska, Initial Interview)

Mariska's comments illustrated that her mentor teacher did not model or support formative assessment to the degree in which she desired. Because her mentor teacher had many years of experience, Mariska perceived that her mentor neither assessed her teaching nor valued the analysis of one's own teaching. Because of that belief, Mariska perceived that she was unable to approach her mentor for support. Furthermore, Mariska's observation of and experience with her mentor teacher reified her belief that experience was the only means for becoming a better teacher.

VAT. While Mariska found VAT to be an enabler of self-assessment, she also indicated that it constrained the analysis of her teaching as well. Her concern was principally due to technical difficulties. For instance, she commented, "I would save [the clip] and forget to submit [it]" (Mariska, Post-Analysis 1 Interview). Because of issues such as that, she had to recreate some of her written assessments. Another problem that Mariska identified was based on the technical limitation of using a single camera and microphone to capture teaching and learning in a K-12 classroom. Specifically, she noted that the location of the camera and the layout of the classroom video in VAT did not allow her to see everything that was taking place in the classroom.

Mariska also noted that she would like to be able to make use of additional resources, or evidence, in her analyses. She stated that it would be beneficial "if you could [upload] your lesson plan [into VAT] … and put the clip where you covered [a specific] objective" (Mariska, Post-Analysis 1 Interview). That is, Mariska wanted to be able to make connections between the video in VAT and other forms of evidence (e.g., lesson plans). She perceived that being able to

use multiple forms of evidence would allow her to demonstrate or identify when she did or did not meet a lesson objective. However, Mariska's example of including additional forms of evidence did not necessarily represent self-assessment. Instead, she wanted to use her lesson plans in a fashion similar to the way she used the TSM attributes during Analysis 2. That is, she wanted to use VAT as an evaluative tool that would allow her to simply show, or check-off, that a standard or objective was met in her teaching.

Analysis Frameworks. The final constraint to formative assessment that Mariska noted was the Analysis Frameworks. Her primary concern with the Analysis Frameworks centered on the prompts. She commented, "I would [have asked] a question [like], 'do you think your students are listening? Do you feel like your classroom is an active classroom?'" (Mariska, Post-Analysis 1 Interview). Similarly, she stated, "I think it would be interesting if you could ask a question about if you fulfilled the [state standard]. 'Do you feel like today's lecture fulfilled [state] standards that you had on your lesson plan?'" (Mariska, Post-Analysis 2 Interview). In both statements, Mariska noted her desire to have unique questions that addressed her own concerns and needs. That is, Mariska wanted a personalized set of prompts that either addressed issues of her teaching practice that she perceived were important or that were specifically designed issue being assessed. Thus, the primary reason she reported constraints by the Analysis Frameworks was that the guiding questions were too generic for her personal needs and goals.

Summary of constraints for formative assessment. Mariska noted that time and experience had a major impact on formative assessment. Specifically, she noted that time constraints made assessment a difficult task to fit in her professional life. She also implied that she would have difficulty learning a lot about her teaching from assessment because it required her to be able to compare and contrast her previous teaching experiences, which she did not possess. Uniquely,

Mariska noted that a lack of external support inhibited formative assessment. She perceived that her teacher education program did not prepare her to assess her teaching adequately. Also, Mariska stated that she was uncomfortable approaching her mentor teacher about assessment because Mariska perceived that her mentor valued teaching experience over formative assessment. Thus, Mariska, like William, indicated that experience in the classroom would provide the knowledge necessary to be an effective practitioner. Finally, Mariska noted that both VAT and the Analysis Frameworks constrained self-assessment. With VAT she encountered technical difficulties and the evidence available to her did not allow her to see everything that occurred in her classroom. Concerning the Analysis Frameworks, her primary concern was related to the prompts. That is, she wanted prompts tailored specifically for her interests and concerns.

CHAPTER 5

CROSS-CASE ANALYSIS

This chapter compares the individual cases of William, Erica, Laura, and Mariska. The research questions presented in Chapter 3 are addressed according to themes and situations that emerged from the data analysis. The chapter is organized by the same format used for the individual cases in Chapter 4. Thus, this chapter discusses how the participants conceptualized formative assessment, the processes they developed to assess their teaching in VAT, the commonalities of their assessments, and the constraints and enablers of formative assessment.

Conceptions of Formative Assessment

To better understand the participants, it was important to understand how they viewed formative assessment (i.e. self-assessment and reflection) before they conducted their VAT Analyses. From the study's beginning, it was evident that the participants did not have a well-defined understanding of formative assessment, which is a common attribute among preservice teachers (LaBoskey, 1993). Furthermore, the literature suggests that preservice teachers' understanding of formative assessment is often difficult to grasp because there is no one view of reflection or self-assessment and it is often presented to them very differently (Calderhead, 1989; Richert, 1992; Ziechner & Liston, 1996). As they discussed self-assessment and reflection, there was one commonly held understanding among the participants – the two processes led to better teaching. However, beyond the notion of improvement, the participants' beliefs about the two

processes diverged. Specifically, the two processes differed in two areas: formality and specificity.

Formality

As they discussed self-assessment and reflection, all four participants identified self-assessment as being a formal process. That is, they perceived self-assessment to be a process that required them to rigorously examine their teaching. Furthermore, they stated that self-assessment would lead to change in their teaching practices. Conversely, they perceived reflection to be an informal, personal process that they equated to "thinking" (Erica, Initial Interview; Laura, Initial Interview), which paralleled Boud's (2006) findings of how reflection is often perceived. Subsequently, three of the four participants expressed that engaging in reflection did not lead to change in practice. Instead, reflection only allowed them to understand what was going on their classroom. The participants' divergent views on the outcome of the two processes may be attributable to their perspective on the specificity of the issue being assessed.

Specificity

Another difference the participants identified between self-assessment and reflection was based on the specificity of the issue being explored. More specifically, they had differing opinions about the size and scope of the issue that could be examined. All participants, except Erica, noted that self-assessment required them to examine specific issues of their teaching that provided a "narrow view on a particular event" (Mariska, Initial Interview). Furthermore, they all indicated that self-assessment examined individual instances of an issue. For example, William noted that self-assessment should be done "day-to-day" (William, Initial Interview). However, when sharing their understanding of reflection, they noted that reflective practice examined global issues of practice that allowed them to see the "bigger picture" (Laura, Initial Interview).

Due to the examination of global issues, they noted that reflection examined broad, global issues that spanned larger periods of time (e.g., an entire week of classes or unit).

Overall, the participants' understanding of formative assessment was not well developed and they did not view formative assessment an iterative process that would allow them to systematically examine their own teaching. Subsequently, they neither knew what to assess nor did they have knowledge of a process for conducting an assessment of their own teaching. Thus, to conduct their analyses, the participants would have to develop their own strategies for assessing their teaching with VAT and the Analysis Frameworks. Furthermore, they would have to develop strategies for making use of the support mechanisms to make sense of and interpret their teaching practices, which is discussed in the following section that examines the processes they used as well as what they examined in their three VAT analyses.

Processes and Foci for Self-Assessment

For each of their VAT analyses, the participants adapted to the inclusion of additional support mechanisms. Subsequently, their approaches to assessment evolved throughout the study. In the sections below, themes that emerged from the participants' VAT analyses are discussed.

Systematic Use of Teaching Evidence

As noted in Chapter 3, the participants chose three of their lessons to be videotaped and conducted three analyses using those lessons in VAT. For each analysis, they were provided with support mechanisms to help conduct their assessments (see Table 1). Through their use of those support mechanisms, the manner in which they made use of video evidence evolved. The commonalities of their three VAT analyses are discussed in this section.

During Analysis 1, the participants selected the lesson of their choice to analyze and were provided with Analysis Framework 1 to guide their analysis. This framework allowed them to assess any issue of their choosing. The participants used two basic approaches for using video evidence for Analysis 1. The first approach was through the pre-selection of issues to examine, which William and Laura employed. From this approach, they identified what they wanted to examine ""before [watching] the video" (William, Initial Interview). Instead of allowing issues to emerge from observations of their lessons in VAT, their pre-selection resulted in the selection of broad, technical components of teaching (e.g., lesson introductions, transitions). The second approach for using video evidence during Analysis 1 was employed by Mariska and Erica. They did not pre-select aspects of their teaching to examine, but created clips when they "saw something .. interesting" (Erica, Initial Interview) in the lesson. Yet, neither Mariska nor Erica was able to clearly articulate what made an event interesting. Furthermore, the approach they applied was also not systematic. Similar to the rationale that William and Laura used for creating clips, Mariska and Erica also focused on common components of a lesson or created clips of known problems in their teaching (e.g., off-task discussions). Thus, neither of the two approaches for using video evidence during Analysis 1 employed systematic observation of their lesson in VAT.

For Analysis 2, the participants were provided with the TSM attributes to support their use of the Analysis Framework. Again, the participants were allowed to select any of their three lessons to assess. However, unlike Analysis 1, the participants were asked to a) create a clip after identifying an issue of practice in their lesson and b) associate the clip with one of the TSM attributes. Based on the approaches they described after completing Analysis 2, three of the participants' use of video evidence, William, Erica, and Laura, became more systematic.

Conversely, Mariska's use of evidence digressed during Analysis 2. Because she chose to make use of the same lesson that she analyzed during Analysis 1, she noted that she did not need to observe her entire lesson again. Even though Mariska, unlike the other participants, did not closely observe her lesson in VAT, all four participants used video evidence in a similar manner. The participants did not focus on identifying issues of practice to assess. Instead, they focused on demonstrating that they could find clips associated with one of the TSM attributes. They participants were determined to demonstrate that they could find as many of the TSM attributes as possible (see Table 3) and pointed out that focusing on only one or two of the attributes was not a good use of time. For example, William noted, "[T]here is no point in [assessing] six [clips] of the same topic" (William, Post-Analysis 2 Interview).

Table 3

Participants' Use of TSM Attributes for Analysis 2

TSM Attribute	William	Erica	Laura	Mariska
1.1 – Content knowledge in teaching area	1	1	1	1
1.2 – Resources and content area knowledge	1	1		3
1.3 – Curriculum aligned per state and national standards		1		
2.1 – Respect for and rapport with students	1	1	1	1
2.2 – Accommodation of individual student needs	1	1	2	1
3.1 – Classroom management		1	2	
3.2 – Individual differences in the classroom	1			

For their final analysis, the participants were provided with another support mechanism, an Assessment Focus. The Assessment Focus, which was unique for each participant, was an issue of practice the participants identified immediately after the delivery of one of their lessons. The inclusion of the Assessment Focus clearly changed the way in which the participants used video evidence. Mariska highlighted this difference by noting, "You have to make sure [the clip was related to] your [Assessment] Focus. You just could not just pick any clip" (Mariska, Post-Analysis 3 Interview). Additionally, the participants did not focus their efforts on merely making an association between a clip and a TSM attribute (see Table 4). Instead, they carefully observed their lesson in VAT to find clips relevant to their Assessment Focus. In fact, three of the participants watched their lesson in its entirety before creating any clips. Erica, the only participant who did not watch her lesson unabridged, watched each segment of her clipped video multiple times. Even with Erica's approach, all the participants used video evidence in a similar manner in that they purposefully observed their lesson. Laura summarized this approach by stating, "[I watched my lesson] one time through before I picked out any clips. Then I [went] back and watch it again, specifically looking for my [Assessment] focus" (Laura, Post-Analysis 3 Interview). For Analysis 3, the participants were more systematic in how they used video evidence to identify clips for assessment.

Table 4

Participants' Use of TSM Attributes for Analysis 3

TSM Attribute	William	Erica	Laura	Mariska
1.1 – Content knowledge in teaching area	4		1	1
1.2 – Resources and content area knowledge				5
1.3 – Curriculum aligned per state and national standards				
2.1 – Respect for and rapport with students	2	5	4	
2.2 – Accommodation of individual student needs				
3.1 – Classroom management			1	
3.2 – Individual differences in the classroom				
None (participant individually identified)		1		

Overall, the participants' use of video evidence evolved through their three analyses. By Analysis 3, all participants systematically observed their lesson to create clips in VAT. Their Analysis 1 efforts demonstrated that they struggled without specific tools for helping them approach video evidence. The participants' Analysis 2 demonstrated that the TSM attributes were valuable in that it resulted in participants carefully and purposefully selected clips that represented one of the attributes. For Analysis 3, the Assessment Focus was a valuable tool that reiterated an issue of practice that the participants previously identified. Altogether, the inclusion of those two support mechanisms had little impact on the participants' ability to systematically assess their teaching. As they used the TSM attributes, the participants were more interested in creating a clip that represented one of the attributes than they were in assessing an issue of

practice. Similarly, the Assessment Focus, excluding one participant, Erica, did not provide the necessary support for them to interpret the evidence in order to make sense of what was occurring in their classroom. As discussed in the following sections, the participants encountered multiple challenges in assessing their own teaching – difficulty in focusing on one issue and a lack of depth in their analyses. Those dilemmas are discussed in the following sections.

Inability to Focus on Specific Issues

During their three VAT analyses, all of the participants, with the exception of Erica, had difficulty focusing on a single issue of practice in their written assessments. Two of the participants, Laura and Mariska, struggled with this dilemma in all three of their analyses. The way in which this challenge emerged was unique for each participant. William, for example, did not have difficulty focusing on one issue during his first two analyses. During his third analysis, which provided him with a specific issue to analyze, he was unable to consistently focus on his Assessment Focus. His difficulty resulted from the manner in which he approached assessment. In Analysis 1, William focused his efforts on demonstrating that his lesson contained all the elements of a proper lesson (e.g., lesson introduction, transitions, etc.). In his second analysis, he challenged himself to demonstrate that he could create a clip associated with all of the TSM attributes. Through this approach, he avoided assessing issues of practice. When he was provided with an Assessment Focus, he was still unable to focus on that issue. That is, he would become distracted by what was occurring in the video.

Laura, like Mariska, had difficulty throughout her three analyses. Laura would become distracted by events not related to the issue she identified as being the focus of her written assessments. However, Laura, unlike William and Mariska, was able to refocus her written assessments on the issue she originally identified as the focus of assessment. Mariska's dilemma

was that she would try to describe and explain everything that was occurring, which was attributable to her tendency to focus on surface issues. Specifically, she would be easily distracted by her classroom mannerisms and her word selection.

When examining Erica's assessments it was clear that she was able to avoid the dilemma of switching between issues throughout her written assessments. During her first two analyses, she used an approach similar to William. That is, during Analysis 1, she simply pointed out known issues or identified common components of a typical lesson (e.g., lesson introduction). During Analysis 2, she challenged herself to identify as many TSM attributes as possible. However, during Analysis 3, Erica was the only participant able to use her Assessment Focus consistently. During that analysis, she was able to use the Assessment Focus as the one and only issue she analyzed in each written assessment.

In summary, the participants struggled to focus on a specific issue of in their written assessments. It was evident that the participants had difficulty identifying an issue of practice to examine. Furthermore, their written assessments indicated that the support mechanisms provided to the participants had little impact on the participants' abilities to identify and focus on one, well-defined issue in their written assessments. The Analysis Framework prompts, TSM attributes, and Assessment Focus did not influence their ability to focus on one issue or move beyond the non-related distractions in the video evidence. Subsequently, but not unexpectedly, the participants were unable to deeply assess their teaching, which is discussed in more detail in the section below.

Lack of Depth in Analysis

As a collective, the participants' written assessments lacked depth. That is, they did not interpret the video evidence in order to explain why problematic issues were occurring in their

lessons. Subsequently, the participants were not able to frame and reframe issues of practice. There were several factors that contributed to their inability to deeply analyze their teaching.

First, it was evident that they did not have a clear conception of self-assessment and had little experience assessing their own teaching. Second, their inability to focus on one issue of practice was a significant constraint because it prevented them from being able to examine a single, well-defined issue of practice. Third, the manner in which they used the provided support mechanisms, especially the TSM attributes, inhibited their written assessments. In fact, the TSM attributes appeared to impede the participants' assessment of issues because they were more concerned with being able to associate a clip with an attribute than they were on identifying an issue of practice. Rich and Hannafin (2008b) identified a similar dilemma in which preservice teachers indicated that they were constrained "by the need to associate [their] teaching with an [attribute]" (p. 1434). Similarly, other studies also indicated that preservice teacher may often become focused on using pedagogical terms to show evidence that they understand the terms and can identify where they are in their teaching (Abell, Bryan, & Anderson, 1998; Bell & Freyberg, 1985). In Analysis 2, the participants demonstrated that tendency, as they were more concerned with showing evidence that they met multiple TSM attributes rather than developing in-depth self-assessments of their teaching practice (see Table 3).

Lastly, the participants had difficulty responding to the Analysis Framework prompts. Specifically, they did not, or were unable, to differentiate between prompts that asked them to provide a description and those that asked them to provide an explanation. As they treated the two prompts equally, it made it difficult for them to provide any interpretation or sense-making of the video evidence, which was also an issue that inservice science teachers had trouble

overcoming as they assessed their teaching with VAT and a reflection framework (Deaton, 2007).

Because of the factors identified above, the participants' written assessments often provided only a narrative or description of clips' events. When additional information or comments were provided, the participants often shared their beliefs about teaching. For example, a typical written assessment resembled the following excerpt.

> [This clips shows] me keeping the students on track and working which is a part of classroom management. … I believe [that] in this aspect of classroom management, I do a very good job. I am able to keep the students on task once they have began [sic] an activity. … In this clip, the students are all at their desk and working on a worksheet [about] Darwin and the evidence for his theory. The whole time the students are [working,] I make a point to stay up and walk around the room. … This is important to my teaching because as a classroom teacher I do not feel like you should ever sit down. Also, you must be able to keep the students on task or nothing will ever be accomplished. … I do not think teachers should ever sit down. (Laura, Analysis 2, VAT Clip 8453).

In her written assessment, Laura created a clip to examine classroom management. She was able to make an association between the classroom management TSM attribute and the clip, but she did not identify an issue to assess. Instead, she only demonstrated that she could find a clip related to one of the TSM attributes. Furthermore, her written assessment only included a narrative of the clips events and shared her beliefs about how teachers should manage the classroom. Written assessments similar to Laura's were common among the participants. That is, they would focus on a very broad, global aspect of teaching (e.g., classroom management) and

would not actually identify an issue to examine. Because of this tendency, they were unable to develop solutions to address the problem due to the fact that they did not identify issues to be examined. This type of low-level analysis was developed by all of the participants during Analysis 1 and 2. However, during Analysis 3, there were exceptions.

During their third analysis, Laura and Erica demonstrated that when provided with appropriate levels of support, specifically the Assessment Focus, they were able to interpret and make sense of video evidence in order to develop solutions. As highlighted in Chapter 4, Erica was able to deeply assess her teaching throughout Analysis 3 as she examined similar teaching events related to her Assessment Focus from multiple perspectives, which allowed her to gain new insights into her teaching and develop solutions for changing her practice. Even though Laura struggled to assess a single issue during Analysis 3, her written assessments demonstrated that the inclusion of the Assessment Focus significantly impacted the way she assessed a particular event of her teaching practice. Initially, after teaching one of her lessons that was made available in VAT, Laura noted that she wanted to focus on being "more [time] efficient [because the lesson] went a little bit longer than I wanted it to" (Laura, Post-Lesson 3 Interview). Laura noted that she wanted to focus on that issue (i.e. being time efficient) because she was running out of time to close the lesson, which was a constant problem during her student teaching. In Analysis 1, Laura analyzed one of her clips in the following manner. She wrote

> I chose this event because it is something I do almost every day at the beginning of the period that I feel is important. In this clip, I am going around the room to each student's desk and checking their homework from the night before. This is critical to my teaching because this is a time when I actually have some kind of contact between every student in the room which I believe is crucial to my teaching. … I am satisfied with this event

> because it has allowed me to get to know my students better as individuals even though it is only a couple of seconds a day. … This is definitely something I want to replicate [and] … is something I am doing well because it does not waste a lot of time and is an efficient way to check homework and interact with every student all at once. (Laura, Analysis 1, VAT Clip 6346)

In her written VAT analysis, Laura identified that visiting her students' desk was a good use of classroom time and viewed this approach as an effective strategy for building rapport with her students. However, when Laura revisited this same segment of her lesson during Analysis 3 with her self-defined Assessment Focus, she was forced to confront her own analysis of this teaching practice. Subsequently, she analyzed and interpreted the same event much differently. She stated

> I chose this clip to represent the attribute because I feel like spending a little bit of time with each student allows me to establish [rapport] … In this clip I am moving around the room to each students desk and checking their homework. It is related to my focus because I do not see this as being very time efficient and it does not help me in keeping the students on-task. I am dissatisfied with this clip .. because I do not believe it makes me more efficient. I should improve [this strategy] because I think it is still a good idea to have contact with each student during the day, but maybe I could find a better way to do that. Well, I am kind of torn because I really liked doing this everyday because it gave me a chance to talk to each student and this is a huge part of my teacher beliefs, but it is not very time efficient. I could have just had the students turn in their homework. Or I could have had the students working on some introductory activity while I did this. (Laura, Analysis 3, VAT Clip 8789).

Laura's written assessment in VAT illustrated how the Assessment Focus, a personally relevant issue of practice, influenced her interpretation of the classroom event. Originally, Laura thought her review of student homework was a good use of class time. However, Laura's use of the Assessment Focus generated a new perspective on building rapport and the subsequent loss of teaching and learning time. In her written assessment, Laura confronted her teaching beliefs and expressed concern over losing the ability to connect with her students. However, she realized that she needed to make use of time more efficiently and proposed some simple solutions for addressing her dilemma.

Foci of Analyses

As noted in the previous sections, the participants encountered several difficulties when assessing their teaching. However, when they were able to identify an issue of practice to examine, they focused on very similar issues. Subsequently, their written assessments could be categorized as focusing on one of three pedagogical themes: acts of teaching, addressing the needs of students, and factors related to learning. These themes, which are discussed below in detail, recapitulate three of the pedagogical domains (i.e. teaching, children, and learning) discussed by Alexander (2004).

Acts of teaching. The participants most often focused on issues directly related to acts of teaching. Those written assessments focused on teacher-centered aspects of the teaching; that is, they focused on either their delivery of instruction or technical components of their teaching. For instance, most clips from this pedagogical theme examined issues such as classroom management, delivering lectures, and lesson transitions. Furthermore, written assessments that analyzed acts of teaching most often included only a narrative of the clips events. For example, during Analysis 2, Mariska developed a written assessment on her lecture. She wrote, "[In this

clip,] I am giving .. a brief history of the [increased use of] fossil fuels. ... I incorporate a brief history about a scientific issue and talk about the changes both in views and evidence" (Mariska, Analysis 2, Clip 8230). In fact, almost all of Mariska's written assessments were based on acts of teaching because she only associated teaching with lecturing, which she specified was the only aspect of teaching that warranted assessment.

Addressing the needs of students. Addressing students' needs was another commonly examined pedagogical theme. Like written assessments associated with acts of learning, written assessments that examined students' needs often lacked depth and insight. In written assessments from this category, the participants concentrated on sharing their beliefs about why it is important to accommodate students' needs and account for individual differences. One issue that was frequently mentioned was the importance of creating a comfortable learning environment. For example, Laura expressed her goal of creating a "friendly [classroom] environment" (Laura, Analysis 1, Clip 7977) to ensure that her students were comfortable responding to questions whether or not they knew the correct answer.

Factors related to learning. Written assessments that provided the most insight and interpretation of video evidence dealt with issues that directly impacted student learning. In these clips, two of the participants were able to frame a problem and identify the impact of the issue being explored. While not always able to develop a solution to the problem being explored, clips associated with student learning frequently taught the participants something new about their teaching. Erica's Analysis 3, which had the most depth of all the participants' analyses, exclusively explored student learning. For example, in an Analysis 3 written assessment, Erica was able to recognize that she was "not communicating with [her class] in a way that benefit[ed] all of the students" (Erica, Analysis 3, Clip 8808). From that observation, she was able to

recognize that her questioning strategy was impairing student participation, which also prevented her from being able to gauge her students' understanding of the content.

Summary of Processes and Foci for Self-Assessment

The participants' ability to assess their teaching using VAT and the Analysis Frameworks varied throughout this study. They demonstrated that they were able to develop systematic processes for using video evidence to analyze their teaching. Yet, as a collective, they struggled to systematically assess issues of practice, which was influenced by several factors, including: a tendency to switch foci and provide little more than a narrative of classroom events, and a sharing of their teacher beliefs as they responded to the Analysis Framework prompts. Subsequently, how they approached and implemented self-assessment aligned with the common-sense/pedagogical thinking continuum described by LaBoskey (1993). That is, LaBoskey posited that preservice teachers trended towards either common-sense thinking or pedagogical thinking when they engaged in formative assessment. She noted that common-sense thinkers were preservice teachers who had a self-oriented view when assessing their teaching practice that also have a tendency to perceive that personal experience (i.e. learn by doing) is the exclusive means for developing knowledge of teaching. On the other side of the continuum, pedagogical thinkers, or "alert novices" (p. 24), have a student-centered orientation when they assess their teaching and have a broader, long-term view and are open to learning. From their written assessments it was clear where the participants in this study fell along the continuum. Furthermore, their written assessments indicated that the use of VAT and the provided support mechanisms (i.e. prompts, TSM attributes, and Assessment Focus) were not strong enough for them to consistently be pedagogical thinkers, if at all.

William and Mariska's written assessments demonstrated that they could be categorized as common-sense thinkers. That is, they a) almost exclusively focused on teacher-centered practices in their written assessments, b) had strongly held beliefs that teaching experience was the primary means for them to become better teachers, and c) wanted quick and easy solutions for improving their teaching. Subsequently, it was clear that William and Mariska needed additional support to encourage them to move towards pedagogical thinking, which would require them to interpret and make sense of teaching evidence. However, LaBoskey (1993) noted that "common-sense thinking of many preservice teachers is difficult to change" (p. 24). To overcome that challenge, it may be necessary to develop unique support mechanisms for preservice teachers like William and Mariska to help them systematically assess their teaching.

Conversely, Laura and, especially, Erica's written assessments demonstrated that they were more toward the alert novices end of the continuum. That is, they perceived that formative assessment that did not lead to drastic changes in teaching. Instead, as Laura noted, it is a process that allows one to "make small steps [for] improvement" (Laura, Initial Interview). Additionally, they would most often frame their analysis on student-centered issues. Overall, while not evident in all, or even most of their written assessments, Laura and Erica were able to interpret video evidence and develop knowledge of their teaching and develop solutions for changing their teaching. They both demonstrated evidence of movement toward being alert novices, however, because of their struggles, particularly during Analyses 1 and 2, the data suggested that they needed additional support as they assessed their teaching in VAT.

Overall, these findings have larger implications for preservice teachers use of tools such as VAT and the Analysis Frameworks for formative assessment. Specifically, additional, or refined, support mechanisms should be provided to encourage pedagogical thinking by

preservice teachers as they assess their own teaching. Furthermore, identifying the needs and tendencies of preservice teachers according to where they fall along the common-sense/pedagogical thinking continuum would allow those support mechanisms to be tailored to their needs, which may allow them to more deeply assess and interpret evidence of their teaching practices.

Enablers and Constraints of Formative Assessment

In the following section, the enablers and constraints for formative assessment that the participants identified are discussed. Based on the data, two factors were identified as enablers for self-assessment: external resources and tools. The constraints they identified included time and experience, the lack of knowledge about formative assessment, the type of available evidence, and the need for support.

Enablers for Formative Assessment

External resources. All four participants noted that the primary means for supporting the analysis of their own teaching was through external resources. Excluding Mariska, the participants indicated that support came from three sources: their teacher education program, mentor teachers, and university supervisors. They noted that their teacher education program was an assessment enabler in that it provided them with multiple opportunities to assess and examine their own teaching practices. Those experiences primarily centered on the use of reflection journals, the examination of others' teaching experiences, and group discourse. Of those three approaches, group discourse was the most widely used strategy for examining teaching. For instance, Erica noted that in her science teacher education course, she and her peers would often read an article and "then we talk[ed] about he we can use [it] or how [it] applie[d] to my own teaching" (Erica, Initial Interview). The participants in this study specified that that those types

of activities allowed them to examine their own experiences as well as the experiences of other, which they indicated would further their development of teaching knowledge.

University supervisors also played a role in supporting the preservice teachers' self-assessment practices. However, the data indicated that the participants had very different experiences with their university supervisor. Laura and William found their university supervisor, whom they shared, to be extremely beneficial when it came to formative assessment. Conversely, Erica and Mariska, who shared a different university supervisor, did not. For instance, Laura noted that her university supervisor provided her with a sheet that allowed her to assess her teaching, She stated, "[I would] rate myself [and identify whether] I was good or satisfactory or needs improvements. I thought that was really helpful because I actually sat down and thought about it" (Laura, Initial Interview). Laura and William both indicated that their university supervisor helped with the assessment of teaching practice through the use of an evaluation instrument that allowed them to rate their performance on various aspects of teaching (e.g., classroom management and student assessment). As noted above, Erica and Mariska stated that their university supervisor did not promote or support formative assessment. Erica, in describing the types of formative experiences provided by her university supervisor provided, succinctly stated, "None that I can think of" (Erica, Initial Interview).

Overall, whether through coursework or by providing university supervisors, three of the four participants indicated that their teacher education program was a key factor for promoting formative assessment. However, the experiences they described also pointed highlighted the inconsistencies in university supervision in that the participants received very different experiences based on whom they received as a supervisor. Subsequently, they were mixed on whether or not university supervisors were formative assessment enablers.

Outside of Mariska, the external support the participants found to be most supportive of formative assessment was provided by their mentor teachers. Mariska reported that her mentor teacher provided little, if any, encouragement and support for formative assessment. For the other participants, the data indicated that the mentor teachers supported and provided the participants' with several opportunities to assess their teaching practices. For example, Erica stated

> I think this semester was good [in] helping me learn to self-assess because I always had my mentor teacher to talk to. She would bring up stuff and say, "How do you think this went? What do you think happened with this?" She would encourage me [examine my teaching] after every class period, not just at the end of the day or the end of the week. (Erica, Initial Interview)

Statements such as Erica's were common. The participants often indicated that their mentor teachers continually emphasized the need to assess and refine their teaching. Furthermore, their reliance on their mentors for formative assessment demonstrated the need for mentors to carefully model and scaffold formative assessment, which as discussed in the constraints section, was not often modeled as a systematic process.

Tools that enable self-assessment. By participating in this study, the participants were able to work with a several tools (i.e. VAT and the Analysis Frameworks) to assist in the assessment of their teaching practices. Each of the participants indicated that these tools enhanced and supported the assessment of their teaching practices. In addition to being able to quickly and easily review their lessons, they noted that one of VAT's primary benefits was that it allowed them to examine their teaching from a different perspective. Erica stated, "[VAT] gives

me a fresh perspective on [my teaching]" (Erica, Post-Analysis 3). Laura's initial reaction to VAT was analogous to Erica's. She stated

> You get to see it from a completely different perspective … when I was teaching the lesson I was thinking, "Oh, this is going really good [sic]", but then you look back at the video and you notice maybe I did not do so well and this kid wasn't [sic] really paying attention. You are able to look at in a lit more detail and from a third person perspective. You can look at yourself as well as the kids. (Laura, Post-Analysis 1)

These statements indicated that the participants perceived that VAT supported formative assessment because they were able to see their teaching from a different perspective. Furthermore, this new perspective allowed them to identify or become cognizant of aspects of their teaching they had forgotten or not noticed at all during the delivery of their teaching. Both of these findings mirrored results from other VAT studies (see, for example, Deaton, 2007; Rich & Hannafin, 2008b; Shepherd & Hannafin, 2008).

Another set of tools that the preservice teachers' identified as being self-assessment enablers were the Analysis Frameworks, which included the Analysis Framework prompts, TSM attributes, and Assessment Focus. Specifically, the prompts were beneficial because they forced the participants to think about what was occurring in their lesson. They also indicated that the TSM attributes were beneficial in that they prompted to examine areas of their teaching they would have otherwise not considered. Laura and William summarized this view by stating that the TSM attributes"[gave] you specific things to look at" (Laura, Post-Analysis 2 Interview) that "[we] would not have necessarily looked at on my own" (William, Post-Analysis 3 Interview). Overall, the participants reported that the TSM attributes strengthened their assessments and allowed them to assess aspects of teaching practice that were important to examine. However,

even though they found the TSM attributes to be extremely beneficial, their written assessments demonstrated that at times, particularly during Analysis 2, the attributes were a deterrent to assessment. That is, they often tended to focus solely on making an association between a segment of their lesson and an attribute, which prevented them from examining an issue of practice that was associated with one of the attributes.

Of all the support mechanisms, the Assessment Focus appeared to be the most beneficial in that it was an personally relevant, emergent issue of practice the participants' identified as warranting assessment immediately after teaching their lessons. Furthermore, the Assessment Focus allowed them to focus on that issue during the entirety of Analysis 3 instead of having to search for issues, which they struggled with a great deal during their first two analyses. Subsequently, all of the participants stated that Analysis 3 was their most beneficial assessment because they could focus on a single aspect of their teaching practice. For instance, Erica stated, "I found that it was easier to focus my attention [during Analysis 3] because I was looking for one particular thing … so it kind of narrowed my analysis" (Erica, Post-Analysis 3 Interview). Mariska also noted that the Assessment Focus provided her with a more meaningful experience with self-assessment. She noted that the Assessment Focus "narrowed [my self-assessment] down to … the problem, this is how [I] handled this problem … and how [I] would do it differently". (Mariska, Post-Analysis 3 Interview). Erica and Mariska's statements, as well as similar statements from their other participants, illustrated that the participants perceived the Assessment Focus to be an enabler for conducting self-assessment. However, while the Assessment Focus did help them address a single issue during Analysis 3, it alone still did not provide the support necessary for the participants to interpret and make sense of their teaching.

Constraints for Formative Assessment

Time and experience. All of the participants noted that meaningful self-assessment requires a significant amount of time. Because of that concern, they pointed out that teachers should be provided with more time during the teaching day in order for self-assessment to be practiced. William's comment on self-assessment, "[self-assessment] is kind of tedious and long to do" (William, Post-Analysis 1, line 76), was a concern that was also mirrored by the other participants. Two of the participants, William and Mariska, were also adamant that their lack of teaching experience was a major limitation. Finally, a lack of experience with self-assessment was, understandably, a constraint. William's statement, "… I had no idea of what I was doing" (William, Post-Analysis 2 Interview) reflected a common sentiment among the participants in regards to their knowledge of assessing their own teaching. Finally, the participants' noted that self-assessment was further complicated by the actual complexity of teaching. That is, they recognized the difficulty in making sense of their teaching due to complex nature of teaching and learning.

Lack of knowledge about formative assessment. As noted in the first section of this chapter, the participants universally agreed that that the purpose of formative assessment was to improve their own teaching. However, the participants did not have a well-defined understanding of approaches or processes for assessing their teaching, which was made evident in their analyses. Similar to their lack of experiences with teaching, the participants also had a lack of experiences with assessing their teaching practices. While not vocalized by the participants, it was evident from their written assessments and interviews that their lack of knowledge about formative assessment influenced their ability to analyze and interpret evidence of their teaching.

Subsequently, the participants, for the most part, had difficulty explaining why they encountered problems in their teaching and developing solutions to address those challenges.

Available evidence for formative assessment. The participants identified that the a) capture of evidence and b) available forms of evidence in VAT constrained their self-assessment. Based on their written assessments and responses to interview questions, the participants recognized that additional video evidence or the inclusion of additional forms of evidence are critical in supporting the assessment of their own teaching practices. The concerns they had towards the capture of evidence were primarily based on what they perceived to be technical limitations. They reported that the limitation prevented them from closely examining several events that would have been beneficial to their analyses. For example, Laura noted

> If the camera followed me around the room and watched me check with each student, that would be important. I would be able to look at each individual interaction in that instance. By doing [that], I could see if I reacted the same with of the students or if there was a difference with some. (Laura, Analysis 1, VAT Clip 6346)

William expressed a similar concern. He noted, "I am trying to assess [the students] and ask them questions on my own, but you cannot hear too well because the camera is so far away" (William, Analysis 3, VAT Clip 8818). William and Laura's statements were common statements among the participants that highlighted their desire to more closely examine classroom events that were not captured in the video evidence.

They also noted that the video evidence available to them prohibited them from identifying some of the TSM attributes in their analyses. For example, Laura noted

> I think it was kind of hard to see individual differences in the classroom. I do not think it would be hard over like a longer period of time, but what I looked at was more out loud

discussion and then they did some class work at their desk. So it was hard to really pick out individual student needs looking at that. (Laura, Post-Analysis 2 Interview)

Laura's statement demonstrated the difficulty she had in the identification of some of the TSM attributes. Her statement also identified that additional evidence is needed in order to examine a wider range of issues to be examined at a narrow, well-defined level.

Even though the participants largely attributed the issues described above as being a technical limitation of the captured evidence, their concerns can be attributed to two issues. First, the limitation of the video evidence can be partly attributed to the video capture. Because the researcher captured all of the video with a single camera and microphone, not every event or interaction could be captured due to the size and complexity of high-school classrooms. However, video and audio recording technologies capable of capturing the types of evidence described by the participants (e.g., student to student interactions and teacher to individual student interactions) are available.

Secondly, the participants' comments are directly related to the relevance of evidence (Schum, 1994). For instance, Laura recognized that one of the TSM attributes (i.e. individual differences in the classroom) was not going to be found in the evidence that was available to her. Similarly, William wanted to watch and examine individual student interactions that were not captured in the evidence. In both of those examples, the available evidence did not allow them to analyze or explain those events or issues related to a specific TSM attribute. Those concerns existed because the available evidence was not relevant to the issue or events they wanted to examine. Because of the issue associated with the relevance and the areas of teaching practice that should be examined, additional video evidence and/or additional forms of evidence (e.g.,

lesson plans, student artifacts, etc.) would be needed in order to allow the participants to assess additional areas of their teaching practice.

The need for more support. Each of the participants indicated that they viewed support, whether it was from mentor teachers, university supervisors, or from VAT and the Analysis Frameworks, as an enabler for self-assessment. While all of the participants noted that the Analysis Frameworks provided support for self-assessment, two of the participants, William and Mariska, also wanted specific directions about how to conduct the self-assessment. For example, William wanted more "guideline[s] that makes sure that a certain amount of information for each question [is answered]. Make it a minimum of four or five sentences for each question" (William, Post-Analysis Interview 1). Furthermore, he wanted "a question in there like, 'How did you prepare this with your mentor teacher? How do you prepare this lesson with a mentor teacher?" (William, Post-Analysis 2).

Three of the four participants also wanted help choosing what they considered to be "important" events in their teaching. For example, Laura stated that her self-assessment would be better if an expert, or experienced teacher, "had watched [her lesson in VAT] ahead of time and picked out some points that they thought [should be analyzed]" (Laura, Post-Analysis 2 Interview). William also noted that for one of his analyses, issues noted as important by an authority figure or mentor may more readily be internalized as an attribute to focus on. Like Laura and William, Mariska realized the need for support from experienced teachers or mentors. She mentioned that "sometimes it is nicer [to have issues of practice identified by] someone" other than herself (Mariska, Initial Interview). Her desire for outside support to help her examine her teaching resulted in her asking individuals outside of education to discuss her lessons with

her. As she saw it, the participation of others and their opinions will help her develop "more of a critical standpoint" (Mariska, Initial Interview).

William, Laura, and Mariska identified the need for additional resources to support their examination of their practice. Both William and Mariska noted the need for more support through a more personalized framework. Specifically, William wanted the Analysis Framework questions that provided individualized support directly related to his interests and context. All of the participants identified the significance of having experienced teachers share their experiences and interpretations of their science lessons.

In summary, the Analysis 3 written assessments developed by the participants demonstrated their use of a more systematic approach to self-assessment. While they noted several constraints to self-assessment, the addition of support mechanisms such as the TSM attributes and Assessment Focus enabled the participants to identify and analyze fine-grained attributes of their teaching practices. The inclusion of those support mechanisms also required the participants to more explicitly use the video evidence in VAT to select issues for self-assessment. In the following chapter, the implications of these findings and ideas for future research are presented.

Summary of Cross-Case Analysis

In this study, preservice teachers used VAT and Analysis Frameworks to assess their teaching practices. As they began the study, it was clear that the participants did not have a strong conceptual understanding of formative assessment. Furthermore, the types of experiences they had with formative assessment, whether through their teacher education program or with their mentor teachers, had little impact on their understanding of assessment. Subsequently, that

lack of understanding as well as their lack of meaningful experiences with assessment was evident in their VAT analyses.

During this experience, the participants were able to gain experience in assessing their own teaching. As LaBoskey (1993) noted, the goal of formative assessment experiences for novices is not so much in learning from their assessment, but in learning to examine and assess one's own practices. Through the use of VAT, they were afforded the opportunity to examine their teaching from a different perspective and explore many different issues related to their teaching. However, the participants' abilities to assess single, well-defined issues and interpret evidence of their teaching varied a great deal, which resulted from many factors. First, the participants had trouble focusing on specific issues as they constantly switched foci throughout their assessments. Second, their use and interpretation of Analysis Framework prompts prevented them from being able to provide depth in their analyses. However, their use of the provided support mechanisms enabled them to garner insights for better understanding how they used VAT and the Analysis Frameworks to assess their teaching.

As they discussed the benefits of the VAT and Analysis Frameworks, the participants' identified that VAT was an extremely beneficial tool that allowed them to see what actually occurred in their classrooms. Specifically, they noted that VAT allowed them to observe evidence of their teaching as opposed to relying on their own recollection of classroom events. Also, they greatly appreciated the TSM attributes and Assessment Focus. Based on their written assessments and their interview responses, the inclusion of those support mechanisms helped the participants systematically make use of video evidence in VAT in that they were much more observant of their teaching in VAT. Furthermore, while they still had difficulty as group in focusing on specific issues throughout their Analyses 2 and 3 written assessments, the

participants perceived that the TSM attributes and Assessment Focus provided them with greatly needed support in beginning to assess and identify issues of practice in their teaching. In fact, for two of the participants, Erica and Laura, the Assessment Focus had a tremendous impact on their ability to deeply examine and interpret evidence of their teaching. Based on these findings, the results of this study provide several implications and ideas for future research, which are discussed in the following chapter.

CHAPTER 6

CONCLUSION AND IMPLICATIONS

Prior studies have indicated that using video annotation tools have enhanced teachers' assessment of their teaching practices (Beardsely, Cogan-Drew, & Olivero, 2007; Bryan & Recesso, 2006; Deaton, 2007; Rich & Hannafin, 2008a; 2008b; in press; Shepherd & Hannafin, 2008; van Es & Sherin, 2002). To add to this body of research, this study was designed to examine several factors related to preservice teachers use of video analysis tools to formatively assess their teaching. Specifically, this study investigated a) preservice teachers' conceptions of formative assessment, b) the processes they developed to assess video evidence of their teaching with the Video Analysis Tool (VAT) and Analysis Frameworks, c) the issues they examined, and d) the constraints and enablers of preservice teacher formative assessment. The research questions that guided this study were:

- To what extent do evidence-informed methods and tools influence preservice teachers identifying and describing specific attributes of practice?
    - How do preservice teachers assess their own teaching? What do they look at and what processes do they apply?
    - To what extent do preservice teachers rely on intuition or evidence to define a need for change?

- What situations, tools, or resources enable or constrain evidence-informed approaches to preservice teachers' assessment of fine-grained attributes of practice?

For this study, data were collected in the form of post-lesson interviews, VAT analyses, and post-analysis interviews. Through open coding and constant comparison, themes were identified within and across participants. After completing the analysis, four individual cases were developed as well as a cross-case analysis.

The experiences of William, Erica, Laura, and Mariska provided several insights into preservice teachers' understanding and use of formative assessment. Through their participation in the study, four preservice teachers were afforded the opportunity to conduct three assessments of their teaching using VAT and the Analysis Frameworks. VAT allowed them to revisit and analyze evidence of their teaching rather than solely rely on their recollection of classroom events. The participants made use of three Analysis Frameworks that were designed to provide support during their analyses. For the first analysis, Analysis Framework 1 contained a set of prompts and questions that allowed them to choose the issues or aspects of the lesson that warranted assessment. Analysis Framework 2, which was used during their second analysis, consisted of the prompts and the Teacher Success Model (TSM) attributes. For Analysis 2, the participants were asked to use the TSM attributes to help them identify issues of practice that should be assessed. During their final analysis, the participants made use of Analysis Framework 3 that included the prompts, the TSM attributes, and an Assessment Focus. The Assessment Focus was an issue the participants identified as needing assessment immediately after the delivery of one of their videotaped lessons. For Analysis 3, all of the participants' written assessments were asked analyze and interpret events that only associated with their Assessment

Focus. In the following sections, a summary of the study's findings, the implications of those findings, how this study contributes to the literature, and ideas for future research are presented.

Summary of Findings

Conceptions of Formative Assessment

As noted in the literature, preservice teachers often have an ill-defined understanding of formative assessment (Boud, 2006; Boud & Walker, 1998; Calderhead, 1989; LaBoskey, 1993). Other studies have identified that preservice teachers' ill-formed conceptions often result from teacher education programs presenting preservice teachers with multiple definitions and strategies for assessing their teaching (Calderhead, 1989; Richert, 1992; Ziechner & Liston, 1996). The data indicated that both of those issues were true for the preservice teachers in this study. That is, they had misconceptions about formative assessment and had been presented with very different definitions, strategies, and levels of support for assessment. However, this study also provided insight into the misconceptions that the preservice teachers held.

While the participants pointed out that both reflection and self-assessment improved their teaching, they did not have a strong understanding of either formative process. In fact, their perceptions of the two processes were quite different. Those misconceptions could be categorized around two main themes: formality and specificity. They perceived reflection to be an informal process that often produced no change in their teaching practices. Instead of identifying reflection as a systematic process, they equated it to thinking, which Boud (2006) has identified as well. Conversely, they perceived self-assessment as a formal process that did lead to a change in teaching practices. However, the participants did not know how to operationalize, or conduct, either process. In regards to specificity, the participants, again, had different conceptions of the size and the scope of the issues that could be examined through reflection and

self-assessment. As they identified the types of issues that could be analyzed through reflection, they perceived that reflection was for the analysis of global issues of practice (e.g., classroom management) that occurred over long durations of time (e.g., a week or an entire unit). For self-assessment, they identified that it required them to regularly examine specific issues of practice that arise during practice.

Because of these conceptions and their inexperience with assessment of their own teaching, the participants had to develop their own processes for assessing their teaching during this study. The data suggested that, after completing their three analyses, the participants had difficulty assessing their teaching even when afforded the opportunity to use VAT and the Analysis Frameworks. However, the data also indicated that they progressed in some areas of assessment.

Processes and Foci for Self-Assessment

One of the goals of this study was to better understand how preservice teachers make use of video evidence when assessing their teaching. Sherin and van Es (2005) identified that providing preservice teachers with multiple opportunities to examine video evidence of their teaching helped them "*learn to notice* what is happening in their classrooms" (p. 491, emphasis in original). Their finding, as well as the results from other studies that used VAT (Deaton, 2007; Rich & Hannafin, 2008a; Shepherd & Hannafin, 2008), implies that preservice teachers become more selective and purposeful in their use of video evidence through multiple experiences. However, little has been reported on how preservice teachers approach and observe video evidence as they assess their teaching. This study found that the manner in which participants approached and made use of video evidence became more systematic as they progressed. During Analysis 1, the participants chose the issues and events to be assessed on their own. The data

demonstrated that the participants most often selected what they wanted to assess before observing their lesson in VAT. By using that strategy, the preservice teachers employed a non-systematic approach for using video evidence in that they did not allow issues or events to emerge from their lesson observations in VAT.

However, by Analysis 2, the data indicated that the participants adopted a more systematic approach for observing their lesson in VAT. That is, the inclusion of the TSM attributes required them to carefully and purposefully observe their lesson in order to choose clips for assessment. When using the Assessment Focus for Analysis 3, the participants were, again, systematic in their use of evidence. During that analysis, they carefully observed their lesson to allow issues and events associated with their Assessment Focus to emerge from the video evidence. Thus, the data indicated that the Analysis Frameworks for the final two analyses had an impact on the way participants observed evidence of their teaching. Yet, even though the participants were more systematic in their use of video evidence during those analyses, the participants, as a whole, struggled to systematically assess specific issues of practice in their VAT analyses.

Research has shown that identifying issues or events to assess is particularly challenging because of the complexity of classroom environments (Sherin & van Es, 2005; van Es & Sherin, 2002). In this study, the participants examined several aspects of their teaching using VAT and the Analysis Frameworks, which were designed to assist the participants' by helping them identify and assess issues of practice. This data indicated that VAT and the Analyses Frameworks did not consistently provide the level of support needed to identify an individual issue of practice to assess within the participants' written assessments, which was related to several factors. First, three of the four participants had difficulty focusing on one issue of

practice in their written assessments. That is, they would switch between foci within their written assessments. Second, in many of their other written assessments, the participants either selected a very broad topic (e.g., classroom management) to examine or did not clearly select an issue to be assessed. Finally, extraneous events distracted several of the participants in their written assessment, which caused them to switch their attention to events not related to the issue identified as being the written assessment's focus.

Another area in which the participants had difficulty was related to the depth of their analyses. From the data, it was evident that the participants found it difficult to provide an insightful, in-depth analysis of the issue being examined in their written assessments. Similarly, Abell, Bryan, and Anderson (1998) observed that preservice teachers' reflections often lacked depth and detail in their examination of an issue. In this study, the participants' lack of depth was related to multiple factors. First and foremost, the participants' written assessments and interview responses made evident their lack of understanding about formative assessment. Another common problem, as noted above, was that the participants often changed the focus of their analysis within their written assessments. In those written assessments, the participants would most commonly narrate and describe clip events or share their beliefs about teaching, which provided no insight about the issue being examined. However, the Assessment Focus, which was used during their final analysis, did have an impact on the depth of two of the participants' analyses.

For two of the participants, William and Mariska, the Assessment Focus' inclusion had no impact on their ability to deeply assess their teaching. That is, it did not provide the type support needed to help them assess issues with depth and insight. In fact, William had more difficulty focusing on one issue after being provided with the Assessment Focus. However, for

Erica and Laura, the data indicated that the Assessment Focus helped them assess their teaching with depth. In their third analyses, they were able to use the issue identified in their Assessment Focus to find instances in their lessons where that issue was problematic. In their written assessments, they were able to interpret and explain classroom events and develop solutions for changing their teaching.

As noted earlier, VAT enabled the participants to examine several aspects of their teaching with VAT. As a whole, they focused on three pedagogical themes: acts of teaching, addressing the needs of students, and factors related to learning. Those themes corresponded with themes that corresponded with three of the pedagogical domains identified by Anderson (2004): teaching, children, and learning. The most commonly examined theme was acts of teaching. In those written assessments, the participants examined teacher-centered aspects of their teaching (e.g., lesson introductions, delivering instructions, etc.). The data also indicated that the participants were very interested in developing comfortable, inviting classroom environments. Lastly, but least frequently, the participants developed written assessments that focused on student learning. Erica and Laura represented the only participants who examined student learning in more than one written assessment. The data indicated that written assessments that focused on student learning contained the most depth and insight.

Enablers and Constraints for Formative Assessment

The participants identified several factors that supported or prohibited formative assessment for preservice teachers. The most common, but expected (LaBoskey, 1995), constraints identified by the participants were time and experience. Like the teachers who used VAT to analyze their teaching in other studies (Deaton, 2007; Shepherd & Hannafin, 2008), the participants in this study communally noted that assessment of one's own teaching requires a

substantial amount of time. They also perceived that assessment is difficult to conduct because they did not have the amount of classroom experience necessary for comparing and contrasting the problems they encountered in their student teaching. Outside of those two constraints, all of the other factors they identified were labeled as both an enabler and a constraint.

External support was a factor the preservice teachers in this study identified as being an enabler and constraint. Outside of Mariska, the other three participants strongly indicated that the support provided by their teacher education program, university supervisor, and mentor teacher had a significant impact in their understanding of and approach to assessment. However, they also indicated that additional support for formative assessment should have been provided and was needed throughout their experience as preservice teachers. Furthermore, the data indicated that they received differing methods for approaching and conducting assessment, which, as noted above, was problematic and led to ill-formed, often confused, conceptions of and approaches for conducting formative assessment.

They also identified VAT as both a constraint and enabler for formative assessment. As in other studies (e.g., Deaton, 2007; Recesso & Bryan, 2006; Rich & Hannafin, 2008a, 2008b; Shepherd & Hannafin, 2008), the participants perceived VAT as valuable tool that allowed for meaningful assessment because it provided them with opportunities to examine their teaching from a different perspective. It also allowed the participants to assess their teaching outside of daily classroom distractions. When accessing the video evidence in this setting, preservice teachers "do not have to rely only on their memory of what occurred" (Sherin & van Es, 2005, p. 478) in the classroom. With VAT, they were able to use the tool to observe the actual events, interactions, successes, and failures that occurred in their classrooms. Outside of minor technical issues (e.g., failing to save text comments and having to maneuver through their lesson), there

was only one issue they identified as being a significant constraint – not being able to see and hear everything in VAT, which is a concern that mirrored the findings of other studies in which inservice teachers (Deaton, 2007) and preservice teachers (Rich & Hannafin, 2008a, 2008b; Shepherd & Hannafin, 2008) used VAT to assess their teaching. This concern was related to two factors. First, the participants wanted to increase the amount of and type of available evidence (e.g., lesson plans and student work samples). However, as has been shown in preservice teachers' formative assessment experiences with electronic portfolios, additional evidence may hinder or further complicate assessment (Borko, Michalec, Timmons, & Siddle, 1997; Delandshere & Petrosky, 2004). Second, the participants wanted to examine issues outside of the scope of the available evidence, which meant they perceived the evidence to have low relevance (Schum, 1994). That is, the participants wanted to examine events and aspects of their teaching that were not observable in the video evidence available to them.

The Analysis Frameworks were the final factor labeled as both an enabler and a constraint. The preservice teachers in this study valued all three support mechanisms that comprised the Analysis Frameworks (i.e. the prompts, TSM attributes, and Assessment Focus). While not evident in their written assessments, they perceived that the prompts provided them with the types of support necessary for thoroughly examining issues of practice. In particular, the participants greatly appreciated the Assessment Focus because it allowed them to examine an issue that they felt was important and focus on one issue, which was especially important because it relieved them from having to search for issues of practice to examine in VAT. Rich and Hannafin (2008b) observed a similar phenomenon with preservice teachers using VAT to assess their teaching. Similarly, they found that preservice teachers preferred being given a specific issue to examine in the analysis of their teaching. However, in their study, the preservice

teachers were provided with an issue to focus on by their mentor teachers. These findings suggest that providing preservice teachers with a specific issue to examine, whether self-generated or provided by an external resource, is a powerful mechanism for supporting assessment.

As noted above, the participants also identified several concerns that they had with the Analysis Frameworks. First, multiple participants indicated that the prompts were too general. That is, they wanted customized prompts that addressed their specific needs and concerns. The data also indicated that the participants did not make distinctions between the prompts. In particular, they often equated prompts that asked them to describe the issue or event being assessed with those that asked them to explain why an issue occurred. Deaton's (2007) study with inservice teachers and Rich and Hannafin's (2008a) study with preservice teachers observed a similar phenomenon. These findings imply that teachers may ignore or disregard the guidance provided by prompts designed to guide their assessments.

The participants noted that they valued the TSM attributes because they allowed the participants to focus on meaningful aspects of their teaching. However, the interview data and written assessments also indicated that the TSM attributes were, at times, a constraint. Specifically, they noted that some of the TSM attributes could not be found in the lessons they observed in VAT, which, again, is related to the relevance (Schum, 1994) of available evidence. The data also indicated that the participants did not use the TSM attributes as intended, which was especially true in the participants' second analyses. During that analysis, the data demonstrated that the participants, unexpectedly, focused their efforts on making an association between a clip and a TSM attribute as opposed to identifying and assessing an issue of practice. Thus, the data suggested that the TSM attributes, when used as the primary means for identifying

clips to be assessed, inhibited preservice teacher assessment. While the participants' use of the TSM attributes in this study was unexpected, Rich and Hannafin (2008b) experienced a similar application of the attributes by both preservice teachers and their mentor teachers. Other studies (Abell, Bryan, & Anderson, 1998; Bell & Freyberg, 1985) have suggested that preservice teachers often will focus their assessment efforts on simply showing that they can identify and demonstrate pedagogical terms in their teaching, which might explain the participants' use of the TSM attributes in this study.

Overall, the Analysis Frameworks provided mixed results in terms of their utility. That is, the Analysis Frameworks neither provided the support necessary for helping the participants identify well-defined issues of practice to examine nor did they help them consistently interpret evidence of their teaching with depth in their written assessments. However, the data suggests that the inclusion of the TSM attributes and Assessment Focus proved to be beneficial in helping them to use evidence of their teaching more systematically and purposefully.

Implications For Practice

For decades researchers have advocated the use of formative assessment for preservice teachers' development of knowledge and understanding of their profession (Artzt, 1999; Barber, 1990; Bryan, 2003; Bryan & Abell, 1999; Dewey, 1933; Hoover & Carroll, 1987; Ross & Bruce, 2007; Schön, 1983; 1987; Zembal-Saul et al., 2002). This view is further reflected by national teaching standards (NRC, 1996) and accreditation agencies (National Council for Accreditation of Teacher Education, 2008) that emphasize the value and importance of self-assessment and reflective practice and their impact on teacher development. This study supported those views by allowing preservice teachers to assess their teaching multiple times through the use of VAT and the Analysis Frameworks.

This study's findings generated several implications. First, the preservice teachers in this study had varying conceptions of formative assessment and had very different experiences with formative assessment in their student teaching experience. Thus, as LaBoskey (1995) noted, it is important that teacher education programs that promote formative assessment provide preservice teachers with a consistent definition of, approach for, and experiences with formative assessment.

This study also found that through the use of VAT and the Analysis Frameworks, preservice teachers demonstrated that they were able to systematically make use of evidence of their teaching (i.e. digitized video of their teaching). As additional support mechanisms were introduced to support the Analysis Frameworks, the preservice teachers refined their approach to assessment and became more systematic in their use of evidence, especially with the Assessment Focus. This implies that preservice teachers' assessment of their teaching is enhanced when they are provided with a specific issue to examine.

The participants' use of the Assessment Focus demonstrated the importance of allowing preservice teachers to examine events or issues of practice they perceived as needing to be assessed. Therefore, it is important for teacher educators to encourage preservice teachers to identify those issues immediately after a lesson's delivery. This can be accomplished through journaling, note-taking, or discourse. Allowing preservice teachers to identify the issues or events that they perceive as needing assessment produces two key benefits. First, it develops a mind-set for preservice teachers to continually identify issues that should be assessed, which may also help the preservice teacher better remember the issue. Second, it would allow teacher educators to better understand the needs and concerns of the preservice teacher and would also enable them to help preservice teachers refine the issue to be examined.

This study used VAT and the Analysis Frameworks in lieu of external support (e.g., mentor teachers, peers, and university faculty). While the Analysis Frameworks helped the participants more systematically observe evidence of their teaching, those same support mechanisms did not provide the support necessary for deeply examining their teaching. Thus, the participants' analyses indicated that, for the most part, external support is needed to support preservice teachers' assessment of their teaching. For that reason, it is important that teacher education programs, even when using tools such as VAT, provide preservice teachers with additional support through modeling and coaching, which aligns with the findings of other research (see Basile, Olson, & Nathenson-Mejia, 2003; Schön, 1987). However, two of the participants demonstrated that, at times, they were able to deeply examine and interpret evidence of their teaching on their own, which occurred during their final VAT analysis. Thus, those findings imply that some preservice teachers may be able to systematically interpret evidence of their teaching after being provided with multiple opportunities and experiences with assessment. Hence, teacher educators should provide preservice teachers with multiple opportunities to assess their teaching throughout their teacher education program.

Finally, this study indicated that tools such as VAT and the Analysis Frameworks are valuable instruments for supporting preservice teachers' assessment of their teaching. VAT allows preservice teachers to assess their teaching from a different perspective. Furthermore, VAT allows preservice teachers to analyze evidence of their teaching as opposed to their recollections of classroom events. VAT is also flexible enough that it allows for multi-layered frameworks, such as the Analysis Frameworks in this study, to be used for assessment. However, the findings of this study suggest that the tool can be further refined to enhance preservice

teachers' assessment of their teaching. For example, allowing preservice teachers to upload additional forms of evidence (e.g., lesson plans) may be beneficial to preservice teacher self-assessment because making available only one form of evidence "may provide a limited field of vision" (Shepherd & Hannafin, 2008, p. 35). That is, video evidence does not allow preservice teachers to observe all of the verbal and non-verbal interactions that occur in a classroom environment. However, as noted above, the addition of multiple forms of evidence must be done cautiously as it increases the complexity of the assessment process.

Contributions to the Literature

This study contributes to teacher education and education in several ways. There have been several studies that have examined preservice teachers use of formative assessment through both reflection (Artzt, 1999; Bryan, 2003; Bryan & Abell, 1999; Land & Zembal-Saul, 2003; Zembal-Saul et al., 2002) and self-assessment (Hoover & Carrol, 1987; Ross & Bruce, 2007). To support formative assessment, several technologies have been used. First, electronic performance support systems (EPSSs) have been designed to increase teachers' efficiency and performance for completing tasks such as generating reports (Moore & Orey, 2001) and designing lesson plans (Wild 2000; Wild & Kilpatrick, 1995). However, those types of systems do not often provide preservice teachers with the type of support necessary for systematically assessing teaching practices. To meet that goal, researchers have developed several video annotation tools that scaffold and structure the formative assessment process (Sherin & van Es, 2002; Recesso et al., 2009; Recesso & Zepeda, 2008; van Es & Sherin, 2005).

This study used VAT to support preservice teacher formative assessment. VAT has been examined in the context of inservice teacher reflection with a Reflection Framework (Deaton, 2007), preservice teacher reflection in electronic portfolios (Shepherd & Hannafin, 2008), and

preservice teacher use of VAT and the Evidence-Based Decision Support (EBDS) methodology self-inquiry (Rich & Hannafin, 2008a; 2008b; in press). This study was unique in that it first examined preservice teachers conceptions of and experiences with formative assessment prior to this study and then allowed them to use VAT and the Analysis Frameworks multiple times to develop their own processes for assessing their teaching.

This study found that the preservice teachers in this study had an ill-defined conception of formative assessments. The study also found that preservice teachers were able to develop systematic processes for making use of evidence of their teaching. However, the preservice teachers struggled to deeply examine and interpret evidence of their teaching. For the most part, that challenge prevented them from being able to develop a) explanations of what was occurring in their classrooms and b) solutions for changing their teaching practice. However, the data indicated that when provided with additional support mechanisms such as the Assessment Focus, some preservice teachers are capable of interpreting evidence of their teaching, which allowed them to confront the issues they face in their classrooms. Upon this finding, a closer examination of the data found a result that correlated with LaBoskey's (1993) continuum of reflective thinkers. She noted that the two extremes of formative thinking went from common-sense thinkers to pedagogical thinkers. Common-sense thinkers, she posited, tended to focus on teacher-centric practices only and believed that their teaching would only be improved through additional teaching experience. Conversely, pedagogical thinkers most often focused on student-centered issues in their assessments and continually looked to improve. The data from this study found that the two preservice teachers who primarily focused on teacher-centered aspects of their teaching were unable to interpret evidence of their teaching and develop solutions for change. Conversely, the preservice teachers who began to examine student-centered aspects of their

teaching during their final analysis were able to interpret video evidence and develop solutions. The findings described here and above have generated several ideas for future research, which are discussed in the following section.

Ideas for Future Research

The findings in this study indicate that when afforded the opportunity to make use of educational technologies for assessing their teaching, preservice teachers are capable of strengthening their ability to assess their teaching on their own. However, their growth was primarily in the development of a more systematic approach for using evidence than it was for interpreting evidence of their teaching. This study's findings indicate the need to further refine the analysis frameworks to support preservice teachers' use of VAT. Specifically, the data indicated that when used alone, the TSM attributes hindered preservice teachers' assessment of their teaching. This concern implies that the TSM attributes should be used carefully and should not be used until an issue of practice for assessment has been first selected.

Additionally, the participants did not always answer framework questions fully. Particularly, they either did not respond to explanation-oriented questions or simply offered descriptions regarding what was occurring in the video evidence. Thus, the results from this study indicate that preservice teachers should be provided with either additional prompts or training on the purpose and use of the analysis frameworks. Further research is needed to explore this issue. Additionally, because the analysis framework questions were tightly coupled with the use of VAT, further study of the frameworks would also yield knowledge regarding preservice teachers use of VAT.

One of the primary wishes the participants in this study expressed was to have support from experts. That is, they noted their desire to have input from their mentor teacher, university

supervisor, or peers. VAT is capable of providing multiple users (e.g., experts and peers) with access to preservice teachers' video evidence and created clips. Thus, future studies could examine means through which experts could provide additional coaching or prompting to support preservice teacher self-assessment with VAT. However, as noted in the previous section, some of the participants, those who were pedagogical thinkers (LaBoskey, 1993), were able to interpret and develop solutions for change through the use of VAT and the Analysis Frameworks. Future research with VAT could explore support mechanisms that may support the movement of preservice teachers who are primarily common-sense thinkers towards a more pedagogical thinking orientation could be examined.

Another basic tenet of the formative assessment is the use of evidence to support the analysis of one's own practice. Currently, VAT allows preservice teachers to make use of evidence through embedded frameworks and digital video. Participants in this study were encouraged to make use of other forms of evidence (e.g., lesson plans and teaching materials) during their analyses, but they did not make use of that evidence. Thus, users of VAT should be able to integrate and upload other forms of evidence into VAT that are associated with the lesson or lessons available to them in the system. Future studies could then examine how preservice teachers make use of that evidence and how it can be used to inform their analyses.

As noted in the literature and based on the findings of this study, it is clear that self-assessment is a challenging and complex task. Moreover, self-assessment examines teaching, which is and of itself, a complex and challenging process. However, this study demonstrated that when provided with training, time, and the opportunity to engage in the analysis of their own practices. Furthermore, this study indicated that preservice teachers are capable of engaging in that process and laying the foundation for becoming critical examiners of their own teaching.

This notion demonstrates significant implications not only for preservice teachers, but also all of teacher education. William, Erica, Laura, and Mariska demonstrated growth in their understanding of self-assessment and their ability to focus on specific aspects of their teaching while analyzing their practices with VAT. While more research is needed, the results from this study give promise to the use of assessment techniques using technology like VAT.

REFERENCES

Aamodt, A., & Plaza, E. (1994). Case-based reasoning: Foundational issues, methodological variations, and system approaches. *Artificial Intelligence Communications, 7*(1), 39-59.

Abd-El-Khalick, F., & BouJaoude, S. (1997). An exploratory study of the knowledge base for science teaching. *Journal of Research in Science Teaching, 34 (7)*, 673-699.

Alexander, R. (2004). Still no pedagogy? Principle, pragmatism, and compliance in primary education. *Cambridge Journal of Education, 34*(1), 7-33.

American Association for the Advancement of Science. (1993). *Benchmark for Science Literacy*. New York: Oxford University Press.

Abell, S. K., Bryan, L. A., & Anderson, M. A. (1998). Investigating preservice elementary science teacher reflective thinking using integrated media case-based instruction in elementary science teacher preparation. *Science Teacher Education, 9*(3), 491-510.

Abell, S.K., Cennamo, K.S., Anderson, M.A., Bryan, L.A., Campbell, L.M., & Hug, J.W. (1996). Integrated media classroom cases in elementary science teacher education. *The Journal of Computers in Mathematics and Science*, *15*(1-2), 137-51.

Abell, S. K., & Roth, M. (1992). Constraints to teaching elementary science: A case study of a science enthusiast student teacher. *Science Teacher Education, 76*(6), 581-595.

Anderson, R. D., & Mitchener, C. P. (1994). Research on science teacher education. In D. L. Gabel (Ed.), *Handbook of Research on Science Teaching and Learning* (pp. 3-44). New York: MacMillon Publishing Company.

Arnold, L., Willoughby, T., & Calkins, E. (1985). Self-evaluation in undergraduate medical education: A longitudinal perspective. *Journal of Medical Education*, *60*, 21-28.

Artzt, A. F. (1999). A structure to enable preservice teachers of mathematics to reflect on their teaching. *Journal of Mathematics Teacher Education, 2*, 143-166.

Barber, L. W. (1990). Self-assessment. In J. Millman & L. Darling-Hammond (Eds.), *The New Handbook of Teahcer Evaluation: Assessing Elementary and Secondary School Teachers* (pp. 216-228). Newbury Park, CA: Sage Publications.

Barnes, D. (1992). The significance of teachers' frames for teaching. In T. Russell & H. Munby (Eds.), *Teachers and teaching: From classroom to reflection* (pp. 9-32). New York: Falmer Press.

Barrows, H.S., & Tamblyn, R.M. (1980). *Problem-based learning: An approach to medical education*. New York: Springer.

Basile, C., Olson, F., & Nathenson-Mejia, S. (2003). Problem-based learning: Reflective coaching for teacher educators. *Reflective Practice, 4*(3), 291-302.

Bastiaens, T. J. (1999). Assessing an electronic performance support system for the analysis of jobs and tasks. *International Journal of Training and Development, 3*(1), 54-61.

Beardsley, L., Cogan-Drew, D., & Olivero, F. (2007). Videopaper: Bridging research and practice for pre-service and experienced teachers. In R. Goldman, R. Pea, B. Barron, & S. Derry (Eds.), *Video research in the learning sciences* (pp. 479-493). Mahwah, NJ: Lawrence Erlbaum.

Beck, R. J., Livne, N. L., & Bear, S. L. (2005). Teachers' self-assessment of the effects of formative and summative electronic portfolios on professional development. *European Journal of Teacher Education, 28*(3), 221-244.

Bell, B., & Freyberg, P. (1985). Language in the science classroom. In R. Osborne & P. Freyberg (Eds.), *Learning in science: The implications of children's science* (pp. 29-40). Portsmouth, NH: Heinemann Pulishers.

Berrill, D., & Whalen, C. (2003). "Where are the children?" Personal integrity and reflective teaching portfolios. *Teaching and Teacher Education, 23*(6), 868-884.

Bishop, J.B. (1971). Another look at counselor, client, and supervisor ratings of counselor effectiveness. *Counselor Education and Supervision*, *10*, 319-323.

Borko, H., Micbalec, P.,Timmons, M., & Siddle, J. (1997). Student teaching portfolios: A tool for promoting reflective practice. *Journal of Teacher Education*, *48*, 345-357.

Boud D. (1995). *Enhancing learning through self-assessment*. Philadelphia: Kogan Page.

Boud, D. (2006). *Relocating reflection in the context of practice: rehabilitation or rejection?* Keynote address` at the Professional Lifelong Learning: Beyond Reflective Practice, Leeds, England.

Boud, D., & Tyree, A. (1979). Self and peer assessment in professional education: a preliminary study in law. *Journal of the Society of Public Teachers of Law*, *15*(1), 65-74.

Boud, D., & Walker, D. (1998). Promoting reflection in professional courses: The challenge of context. *Studies in Higher Education*, *23*(2), 191-206.

Bryan, L. A. (2003). Nestedness of beliefs: Examining a prospective elementary teacher's belief system about science teaching an learning. *Journal of Research in Science Teaching, 40*(9), 835-868.

Bryan, L. A., & Abell, S. K. (1999). Development of professional knowledge in learning to teach elementary science. *Journal of Research in Science Teaching, 36*(2), 121-139.

Bryan, L., & Recesso, A. (2006). Promoting reflection with a web-based video analysis tool. *Journal of Computing in Teacher Education*, *23*(1), 31-39.

Calderhead, J. (1989). Reflective teaching and teaching education. *Teaching and Teacher Education, 51*(1), 43-51.

Campbell, D. T. (1975). Assessing the impact of planned social change. In G. Lyons (Ed.), *Social research and public policies: The Dartmouth/OECD Conference* (pp. 3-45). Hanover, NH: Dartmouth College, The Public Affairs Center.

Carr, W. & Kemmis, S. (1986). *Becoming critical: education, knowledge, and action research.* London: The Falmer Press.

Cochran, K. F., DeRuiter, J. A., & King, R. A. (1993). Pedagogical content knowledge: An integrative model for teacher preparation. *Journal of Teacher Education, 44*(4), 263-272.

Cope, P., & Stephen, C. (2001). A role for practising teachers in initial teacher education. *Teaching and Teacher Education, 17*(8), 913-924.

Darling-Hammond, L., & Snyder, J. (2000). Authentic assessment of teaching in context. *Teaching and Teacher Education, 16*, 523-545.

Day, C., & Pennington, A., (1993). Conceptualising professional development planning: A multidimensional model. *Journal of Education for Teaching*, *19*(2), 251-260.

Deaton, B., Recesso, A., & Hannafin, M. J. (2005). *Evidence-Based Inquiry: A Methodology for the Continual Improvement of Teaching Practices*. Paper presented at Society for Information Technology and Teacher Education annual meeting, Phoenix, AZ.

Deaton, C. (2007). *Examining evidence-based explanations in in-service science teachers' reflections*. Unpublished doctoral dissertation, University of Georgia.

Delandshere, G., & Arens, S. A. (2003). Examining the quality of the evidence in preservice teacher portfolios. *Journal of Teacher Education, 54*(1), 57-73.

Delandshere, G., & Petrosky, A. (2004). Political rationales and ideological stances of the standards-based reform of teacher education in the United States. *Teaching and Teacher Education,* 1-15

Dewey, J. (1933). *How we think*. Boston: D.C. Heath and Co., Publishers.

Dewey, J. (1938). *Experience in education*. New York: MacMillon.

Duchastel, P., & Lang, J. (1995). Performance support systems for learning. *Journal of Educational Technology Systems, 24*(1), 55-65.

Floden, R. E., & Klinzing, H. G. (1990). What can research on teacher thinking contribute to teacher preparation? A second opinion. *Educational Researcher*, *19*(5), 15-20.

Gery, G. (1995). Attributes and behavior of performance-centered systems. *Performance Improvement Quarterly, 8*(1), 47-93.

Gess-Newsome, J., & Lederman, N. G. (1993). Preservice biology teachers' knowledge structures as a function of professional teacher education: A year-long assessment. *Science Teacher Education, 77*(1), 25-45.

Goodlad, J. (1984). *A place called school*. New York: McGraw-Hill Book Company.

Griffin, M. (2003). Using critical incidents to promote and assess reflective thinking in preservice teachers. *Reflective Practice, 4*(2), 207-220.

Grimmett, P. P., & MacKinnon, A. M. (1992). Craft knowledge and the education of teachers. In G. Grant (Ed.), *Review of Research in Education* (18 ed., pp. 385-456). Washington, D.C.: American Educational Research Association.

Grossman, P. L., Wilson, S. M., & Shulman, L. S. (1989). Teachers of substance: Subject matter knowledge for teaching. In M. C. Reynolds (Ed.), *Knowledge Base for the Beginning Teacher* (pp. 23-36). New York: Pergamon Press.

Haidar, A. H. (1997). Prospective chemistry teachers' conceptions of the conversation of matter and related concepts. *Journal of Research in Science Teaching*, *34*, 181 – 197.

Hannafin, M. J., Hill, J., & McCarthy, J. (2000). Designing resource-based learning and performance support systems. In D. A. Wiley (Ed.), *The Instructional Use of Learning Objects* (pp. 99-129). Bloomington, IN: Association for Educational Communications & Technology.

Hill, J. R., Hannafin, M. J., & Recesso, A. (2007). Creating a patchwork quilt for teaching and learning: The use of learning objects in teacher education. In P. Northrup (Ed.), *Learning objects for instruction: Design and evaluation* (pp. 261-280). Hershey, PA: Idea Group.

Hoffman, R., & Geller, M. (1981). A comparison of self-evaluations and classroom teacher evaluations for aides in a pre-student teaching field experience program, *Teacher Educator*, *17*(2),16-21.

Hoover, N.L., & Carroll, R.G. (1987). Self-assessment of classroom instruction: An effective approach to inservice education. *Teaching and Teacher Education, 3*(3), 179-191.

Hoover, N. L., & O'Shea, L. J. (1987). *The influence of a criterion checklist on supervisors' and interns' conceptions of teaching*. Paper presented at the Annual Meeting of the American Educational Research Association, Washington, D.C.

Houston, W. R. (1988). Reflecting on reflection in teacher education. In H. C. Waxman, H. J. Frieberg, J. C. Vaughan & M. Weil (Eds.), *Images of Reflection in Teacher Education*. Reston, VA: Association of Teacher Educators.

Jonassen, D. H., & Hernandez-Serrano, J. (2002). Case-based reasoning and instructional design: Using stories to support problem solving. *Educational Technology Research and Development, 50*(2), 65-77.

Kolodner, J. L. (1992). An introduction to case-based reasoning. *Artificial Intelligence Review, 6*(1), 3-34.

Kolodner, J. L. (1993). *Case-based reasoning*. San Mateo, CA: Morgan Kaufmann Publishers, Inc.

Kolodner, J. L. (1997). Educational implications of Analogy: A view from case-based reasoning. *American Psychologist, 52*(1), 57-66.

Kubota, C. (1997). Preparation and professional development of k-12 science teachers in the United States. *Peabody Journal of Education*, *72*(1), 129-149.

LaBoskey, V. K. (1993). A conceptual framework for reflection in preservice teacher education. In J. Calderhead & P. Gates (Eds.), *Conceptualizing Reflection in Teacher Development* (pp. 23-38). Bristol, PA: The Falmer Press.

Land, S., & Zembal-Saul, C. (2003). Scaffolding reflection and articulation of scientific explanations in a data-rich, project-based learning environment: An investigation of Progress Portfolio. *Educational Technology Research and Development, 51*(4), 65-84.

Lortie, D. (1975). *Schoolteacher: A sociological study*. Chicago: University of Chicago Press.

Loucks-Horsley, S., Love, N., Stiles, K., Mundry, S., Hewson, P. (2003). *Designing professional development for teachers of science and mathematics* (2nd Ed.). Thousand Oaks, California: Corwin Press, Inc.

Luft, J. (2001). Changing inquiry practices and beliefs: the impact of an inquiry-based professional development programme on beginning and experienced secondary science teachers. *International Journal of Science Education*, *23*(5), 517-534.

McCray, R. A., DeHaan, R. L., & Schuck, J. A. (Eds.). (2003). *Improving undergraduate instruction in science, technology, engineering, and mathematics*. Washington, D.C.: The National Academy Press.

Mellado, V. (1998). The classroom practice of preservice teachers and their conceptions of teaching and learning science. *Science Teacher Education, 82*(2), 197-214.

Mellado, V., Blanco, L. J., & Ruiz, C. (1998). A framework for learning to teach science in initial primary teacher education. *Journal of Science Teacher Education, 9*(3), 195-219.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass Publishers.

Moore, J. L., & Orey, M. A. (2001). The implementation of an electronic performance support system for teachers: An examination of usage, performance, and attitudes. *Performance Improvement Quarterly, 14*(1), 26-56.

Morine-Dershimer, G. & Kent, T. (1999). Source of teachers' pedagogical knowledge. In J. Gess-Newsome & N. G. Lederman (Eds.), *Examining Pedagogical Content Knowledge* (pp. 21 - 50). Hingham, MA: Kluwer Academic Publishers.

Mu, X., & Koohang, A. (2006). Video learning object application system: Beyond the static reusability. *Issues in Informing Science and Information Technology, 3*, 411-422.

National Commission on Excellence in Education. (1983). A nation at risk: The imperative for educational reform. Retrieved July 11, 2008 from http://www.ed.gov/pubs/NatAtRisk/risk.html.

National Research Council. (1996). *National Science Education Standards*. Washington, D.C.: National Academy Press.

National Science Teachers Association. (2003). Standards for science teacher preparation [Electronic Version]. Retrieved September 28, 2006, from www.nsta.org/pdfs/NSTAstandards2003.pdf

Nichols, S. L., & Berliner, D. (2005). The inevitable corruption of indicators and educators through high-stakes testing [Electronic Version]. Retrieved June 13, 2008, from http://www.asu.edu/educ/epsl/EPRU/documents/EPSL-0503-101-EPRU.pdf

Nichols, S. L., & Koballa, T. (2006). Framing issues of elementary science teacher education: Critical conversations. In K. Appleton (Ed.), *Elementary Science Teacher Education: International Perspectives on Science Teacher Education*. Mahwah, NJ: Lawrence Erlbaum Associates and the Association for Science Teacher Education.

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback. *Studies in Higher Education, 31*(2), 199-218.

Osborne, M. D. (1998). Teacher as knower and learner: Reflections on situated knowledge in science teaching. *Journal of Research in Science Teaching, 35*(4), 427-439.

Ostrander, L.R. (1996). Multiple judges of teacher effectiveness: Comparing teacher self-assessments with the perceptions of principals, students, and parents. Paper presented at the annual meeting of the American Educational Research Association, New York, NY, April 1996.

Patton, M. (1987). *How to use qualitative methods in evaluation*. Newbury Park, CA: Sage Publications.

Patton, M. (2002). *Qualitative research and evaluation methods* (3rd Ed.). Thousand Oaks, CA: Sage Publications.

Pea, R., & Hay, K. (2002). Report to the National Science Foundation: Center for Innovative Learning Technologies (CILT) *workshop on digital video inquiry in learning and education*. Stanford, CA: Stanford University.

Pea, R., & Lemke, J. (2007). Sharing and reporting video work. In S. J. Derry (Ed.). *Guidelines for Video Research in Education: Recommendations from an Expert Panel* (pp. 33-46). Prepared for the National Science Foundation, Interagency Education Research Initiative, and the Data Research and Development Center. Arlington, VA: National Science Foundation. (Downloadable from: http://drdc.uchicago.edu/what/video-research-guidelines.pdf)

Pea, R., Mills, M., Rosen, J., Dauber, K., Effelsberg, W., & Hoffert, E. (2004). The DIVER project: Interactive digital video repurposing. *Multimedia, IEEE, 11*(1), 54-61.

Recesso, A., & Hannafin, M. (2003). *Evidence-based technology enhanced alternative curriculum in higher education (ETEACH)*. Project # P342A030009. Proposal funded by the U.S. Department of Education's Preparing Tomorrow's Teachers to use Technology (PT3) program office. Washington, D.C.: U.S. Department of Education.

Recesso, A., Hannafin, M. J., Wang, F., Deaton, B. E., Shepherd, C., & Rich, P. (2009). Direct evidence and the continuous evolution of teacher practice. In P. Adamy & N. Milman (Eds.), *Evaluating Electronic Portfolios in Teacher Education*. Greenwich, CT: Information Age Publishing, Inc.

Recesso, A., & Zepeda, S. (2008). Evidential reasoning and decision support in assessment of teacher practice. In T. Kowalski & T. J. Lasley (Eds.), *Handbook of Data-Based Decision Making in Education* (pp. 363-381). New York: Routledge.

Reiser, R. A. (2001). A history of instructional design and technology: Part II: A history of instructional design. *Educational Technology Research and Development, 49*(2), 57-67.

Rennert-Ariev, P. (2005). A theoretical model for the authentic assessment of teaching. *Practical Assessment, Research, & Evaluation, 10*(2), 1-11.

Rich, P., & Hannafin, M. (2008a). Capturing and assessing evidence of student teacher inquiry: A case study. *Teaching and Teacher Education*, *24*, 1426-1440.

Rich, P. J., & Hannafin, M. J. (2008b). Decisions and reasons: Examining pre-service teacher decision-making through video self-analysis. *Journal of Computing in Higher Education, 20*(1), 62-94.

Rich, P., & Hannafin, M. (2009b). Video annotation tools: Technologies to scaffold, structure, and transform teacher reflection. *Journal of Teacher Education*, *60*(1), 52-67.

Rich, P., & Hannafin, M.J**.** (in press). Making instructional decisions visible: The use of video evidence to assess preservice teachers' practice. *Journal of Computing in Higher Education.*

Richert, A. E. (1992). The content of student teachers' reflections within different structures for facilitating the reflective process. In T. Russell & H. Munby (Eds.), *Teachers and teaching: From classroom to reflection* (pp. 171-191). Bristol, PA: The Falmer Press.

Rosebery, A., & Puttick, G. (1998). Teacher professional development as situated sense-making: A case study in science education. *Science Education*, *82*, 649-677.

Ross, J.A., & Bruce, C.D. (2007). Teacher self-assessment: A mechanism for facilitating professional growth. *Teaching and Teacher Education*, *23*, 146-159.

Russell, T., & Martin. (2007). Learning to teach science. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of Research on Science Education* (pp. 1151-1177). Mahwah, NJ: Routledge.

Russell, T., & Munby, H. (1991). Reframing: The role of experience in developing teachers' professional knowledge. In D. A. Schön (Ed.), *The reflective turn: Case studies in and on educational practice* (pp. 164-187). New York: Teachers College Press.

Russell, T., Munby. H., Spafford, C., & Johnston, P. (1988). Learning the professional knowledge of teaching: Metaphors, puzzles, and the theory-practice relationship. In P. Grimmett & G. Erickson (Eds.), *Reflection in Teacher Education* (pp. 67-90). New York: Teachers College Press.

Schank, R. C. (1990). *Tell me a story: Narrative and intelligence*. Evanston, IL: Northwestern University Press.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. New York: Basic Books.

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions.* San Francisco: Jossey-Bass.

Schum, D. A. (1994). *The evidential foundations of probabilistic reasoning*. New York: John Wiley and Sons.

Sherin, M. G., & van Es, E. A. (2005). Using video to support teachers' ability to notice classroom interactions. *Journal of Technology and Teacher Education, 13*, 475-491.

Sherry, L., & Wilson, B. (1996). Supporting human performance across disciplines: A converging of roles and tools. *Performance Improvement Quarterly, 9*(4), 19-36.

Shepherd, C., & Hannafin, M. J. (2008). Examining preservice teacher inquiry through video-based, formative assessment portfolios. *Journal of Computing in Teacher Education, 25*(1), 63-69.

Shepherd, C., & Hannafin, M.J**.** (in press). Beyond recollection: Re-examining preservice teacher practices using structured evidence, analysis, and reflection. *Journal of Technology in Teacher Education*.

Shulman, L. S. (1986a). Paradigms and research programs in the study of teaching. In M. C. Wittrock (Ed.), *Handbook of Research on Teaching* (3 ed., pp. 3-36). New York: MacMillon Publishing Company.

Shulman, L. S. (1986b). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22.

Smith, D. C., & Neale, D. C. (1989). The construction of subject matter knowledge in primary science teaching. *Teaching and Teacher Education, 5*(1), 1-20.

Smith, K., & Tillema, H. (2001). Long-term influences of portfolios on professional development. *Scandanavian Journal of Educational Resarch, 45*(2), 183-203.

Spillane, J. P., Halverson, R., & Diamond, J. B. (2001). Investigating school leadership practice: A distributed perspective. *Educational Researcher, 30*(3), 23-28.

Stake, R. (1995). *The art of case study research*. Thousand Oaks, California: Sage Publications.

Strauss, A. & Corbin, J. (1990). *Basics of qualitative Research: Grounded theory procedures and techniques* (2nd ed.). Newbury Park, CA: Sage.

Stuart, M., Goldstein, H., & Snope, E. (1980). Self-evaluation by residents of family practice. *Journal of Family Practice*, *10*, 639-642.

Tabachnick, B. R., & Zeichner, K. M. (1984). The impact of the student teaching experience on the development of teacher perspectives. *Journal of Teacher Education, 35*(6), 28-36.

Thorén, I., Kellner, E., Gullberg, A., & Attorps, I. (2005). Developing transformative pedagogical content knowledge in science and mathematics teacher education [Electronic Version]. Retrieved October 13, 2008, from www.hig.se/pdf/n-inst/Slutrapport0501F3.pdf

Towler, L., & Broadfoot, P. (1992). Self-assessment in the primary school. *Educational Review*, *44*(2), 137–151.

U.S. Department of Education. (2001). The No Child Left Behind Act of 2001: Executive Summary. Retrieved July 8, 2008 from http://www.ed.gov/nclb/landing.jhtml?src=ln.

Van Driel, J. H., De Jong, O., & Verloop, N. (2002). The development of preservice chemistry teachers' pedagogical content knowledge. *Science Teacher Education, 86*, 572-590.

van Es, E. A., & Sherin, M. G. (2002). Learning to notice: Scaffolding new teachers' interpretations of classroom interactions. *Journal of Technology and Teacher Education, 10*(4), 571-596.

Van Riper, B.W. (1982) Facilitating systematic self-assessment: a role for teachers in contemporary appraisal. *Education, 103*, 1.

Van Zee, E. H., & Roberts, D. (2001). Using pedagogical inquiries as a basis for learning to teach: Prospective teachers' reflections upon positive science learning experiences. *Science Teacher Education, 85*, 733-757.

Wang, F. K., Moore, J. L., Wedman, J., & Shyu, C. R. (2003). Developing a case-based reasoning knowledge repository to support a learning community - An example from the technology integration community. *Educational Technology Research and Development, 51*(3), 45-62.

Ward, J. R., & McCotter, S. S. (2004). Reflection as a visible outcome for preservice teachers. *Teaching and Teacher Education, 20*, 243-257.

Ward, M., Gruppen, L., & Regher, G. (2002). Measuring self-assessment: Current state of the art. *Advances in Health Science Education*, *7*, 63-80.

Wild, M. (2000). Designing and evaluating an educaitonal performance support system. *British Journal of Educational Technology, 31*(1), 5-20.

Wild, M., & Kirkpatrick, D. (1995). *University students working with performance support systems (PSSs) to learn complex tasks.* Retrieved January 12, 2005, from http://www.ascilite.org.au/conferences/melbourne95/smtu/papers/wild.pdf

Wilhelm, L., Puckett, K., Beisser, K., Merideth, E., Sivakumaran, T., & Wishart, W. (2006). Lessons learned from the implementation of electronic portfolios at three universities. *Tech Trends, 50*(4), 62-71.

Wilson, S. M. (1995). Performance-based assessment of teachers. In S. W. Soled (Ed.), *Assessment, Testing, and Evaluation in Teacher Education*. Norwood, NJ: Ablex Publishing Company.

Yerrick, R. K., & Hoving, T. J. (2003). One foot on the dock and one foot on the boat: Differences among preservice science teachers' interpretations of field-based science methods in culturally diverse contexts. *Science Teacher Education, 87*(3), 390-418.

Yin, R. (2003). *Case study research: Design and methods (3rd Edition)*. Thousand Oaks, CA: Sage.

Yorke, M. (2003). Formative assessment in higher education: Moves towards theory and the enhancement of pedagogic practice. *Higher Education*, *45*, p 477-501

Zeichner, K. M., & Liston, D. P. (1996). *Reflective teaching: An introduction*. Mahwah, NJ: Lawrence Erlbaum Associates.

Zembal-Saul, C., Krajcik, J., & Blumenfeld, P. (2002). Elementary student teachers' science content representations. *Journal of Research in Science Teaching, 39*(6), 443-463.

Zuckerman, J. T. (1999). Student science teachers constructing practical knowledge from inservice science supervisors' stories. *Journal of Science Teacher Education, 10*(3), 235-245.

APPENDIX A

ANALYSIS 1 FRAMEWORK

Analysis 1 Framework

Analysis 1:

Using the Video Analysis Tool (VAT), create clips to examine your teaching. For each clip that you create, answer the following questions in detail. Please be as thorough as possible.

1. Explain why you chose this event.
2. Describe in detail what is going on in this clip.
3. Explain why that event is important to your teaching.
4. Explain why it would be important for you to examine that event.
5. Explain why you are satisfied/dissatisfied with this event.
6. Explain why this is something you would want to improve (or replicate).
7. Explain if this is problematic or something you are doing well.

APPENDIX B

ANALYSIS 2 FRAMEWORK

Analysis 2 Framework

For each clip, complete the following questions or prompts as thoroughly as possible:

1. Domain and Attribute:
2. Explain why this clip represents the attribute you chose:
3. Describe in detail what is occurring in the clip:
4. Explain why this clip is important to your teaching:
5. Explain why you are satisfied or dissatisfied with the clip:
6. Explain why this is something you would want to improve (or replicate) and describe how it impacts your beliefs about teaching?
7. What could you do have done differently in this clip? Explain.

APPENDIX C

TEACHER SUCCESS MODEL (TSM) ATTRIBUTES

TSM Attributes Provided to Preservice Teachers

Domain 1: Content & Curriculum: Teachers demonstrate a strong knowledge of content area(s) appropriate for their certification levels.

Attribute	**Basic**	**Proficient**	**Advanced**	**Exemplary**
1.1: Content knowledge in teaching area.	• Lesson content accurate and organized for own teaching needs. • Implements content adhering to plan; keen to complete the day's lessons. • Needs regular support and direction from field supervisors, mentor and colleagues to plan and teach content.	• Lesson content accurate and organized for self and students' needs. • Implements content successfully using thoughtfully planned activities; incorporates feedback about teaching and learning of content into lessons. • Recognizes strengths and shortcomings in teaching of content and in students' understanding; attempts alternative approaches. • Seeks occasional support with content from others in response to self or students' needs. • Is knowledgeable of content and seeks opportunities for professional growth.	• Lesson content accurate, organized and adapted to address individual student needs. • Implements diverse activities to teach content to the needs of each child. • Develops innovative activities with content; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or student needs. • Is knowledgeable and confident of content; seeks opportunities for professional growth; assists peers informally with content knowledge.	• Implements diverse activities to teach and learn content to educate each child and facilitate professional growth of peers. • Deep understanding of content and professional practice; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or student needs; excellence in planning content. • Is knowledgeable and confident of content; seeks opportunities for professional growth; supports peer efforts to develop content knowledge

Domain 1: Content & Curriculum: Teachers demonstrate a strong knowledge of content area(s) appropriate for their certification levels.

Attribute	Basic	Proficient	Advanced	Exemplary
1.2: Resources and content area knowledge.	• Plans and organizes content-appropriate teaching and learning materials/aids to address own needs. • Uses content-relevant materials/teaching aids as detailed in lesson as per plan. • Needs routine direction and support from supervisor, mentor and colleagues to plan and select and use content-relevant materials/ teaching aids in teaching	• Plans and organizes content-appropriate teaching and learning materials/aids to address own and student needs • Uses content-relevant materials/teaching aids as detailed in lesson per plan; incorporates feedback about content resources for teaching and learning into lesson plans. • Recognizes strengths and limitations in own use of content resources; has increased awareness of alternative approaches. • Seeks occasional support with materials from others in response to own or students' needs. • Is knowledgeable of content-relevant materials and seeks opportunities for professional growth.	• Plans and organizes appropriate resource material for individual students' needs. • Implements and adapts content-relevant materials to address individual learning needs. • Develops innovative content resources; takes risks and develops innovative materials/teaching aids; modifies use dynamically based on emergent opportunities or needs. • Confident and independent in creating and use of materials; keen to learn for professional growth; assists peers informally with content-relevant materials.	• Plans and organizes appropriate resource material for individual students' needs. • Implements diverse content-relevant materials to educate the whole child and facilitate professional growth of peer teachers. • Deep understanding of materials/teaching aids and professional practice; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or student needs; excellence in creating and use of materials. • Is independent and confident in creating and use of materials; seeks opportunities for professional growth; supports peer efforts to develop content-relevant materials.

Domain 1: Content & Curriculum: Teachers demonstrate a strong knowledge of content area(s) appropriate for their certification levels.

Attribute	Basic	Proficient	Advanced	Exemplary
1.3: Curriculum aligned per state and national content area standards.	• Accurate and organized curriculum for own teaching needs. • Implements curriculum adhering to plan as per standards; keen to complete the day's lessons. • Needs regular support and direction from field supervisors, mentor and colleagues to plan and implement curriculum.	• Accurate and organized curriculum for self and students' needs. • Implements curriculum successfully through thoughtful lesson plan and choice as per standards; incorporates feedback about curriculum into lessons. • Recognizes strengths and shortcomings in the curriculum for teaching and students' understanding; attempts alternative approaches. • Seeks occasional support with curriculum from others in response to self or students' needs. • Is knowledgeable of curriculum and seeks opportunities for professional growth.	• Accurate and organized curriculum and adapted to address individual student needs. . • Implements a holistic curriculum to address individual needs. • Develops holistic curriculum; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities for needs. • Is knowledgeable and confident of curriculum; seeks opportunities for professional growth; assists peers informally with curriculum.	• Curriculum accurate and organized and adapted to address individual students' needs. • Implements a holistic curriculum to address individual needs of each child and facilitate professional growth of peers. • Deep understanding of curriculum and professional practice; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or student needs; excellence in curriculum development and implementation. • Is knowledgeable and confident of curriculum; seeks opportunities for professional growth; supports peer efforts to develop curriculum.

Domain 2: Knowledge of Students & Their Learning: Teachers support the intellectual, social, physical, and personal development of all students.

Attribute	Basic	Proficient	Advanced	Exemplary
2.1: Respect for and rapport with students	• Plans and organizes for positive communication and interaction with and among students for own teaching needs. • Communicates and implements interactions adhering to plan; keen to complete the day's lessons. • Needs regular support and direction from field supervisors, mentor and colleagues to plan and teach reciprocal positive interactions.	• Plans and organizes for positive communication and interaction with and among students for self and students' needs. • Communicates and implements positive interactions successfully through thoughtful plan; incorporates feedback about positive communication into practice. • Recognizes strengths and shortcomings of interaction that impact self and students' development; attempts alternative approaches, implements innovative approaches. • Seeks occasional support from others for positive communication in response to self or students' needs. • Is knowledgeable of communication and seeks opportunities for professional growth.	• Plans and organizes for positive communication and interaction with and among students; adapted to individual students' needs. • Communicates and implements diverse activities for positive communication to address each child's needs. • Develops positive communication; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or needs. • Is knowledgeable and confident in the use of positive communication; seeks opportunities for professional growth; assists peers informally to develop positive communication.	• Plans and organizes for positive communication and interaction with and among students; adapted to individual students' needs. • Implements diverse activities for positive communication to address each child's needs; facilitate professional growth of peers. • Deep understanding of positive communication and professional practice; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or student needs; excellence in positive communication. • Is knowledgeable and confident of positive communication; seeks opportunities for professional growth; supports peer efforts to develop curriculum.

Domain 2: Knowledge of Students & Their Learning: Teachers support the intellectual, social, physical, and personal development of all students.

Attribute	Basic	Proficient	Advanced	Exemplary
2.2: Accommodation of individual student needs.	• Plans and organizes differentiated learning for own purposes. • Implements differentiated learning adhering to plan; keen to complete the day's lessons. • Needs regular support and direction from field supervisors, mentor and colleagues to plan and implement differentiated learning.	• Plans and organizes differentiated learning for self and students' needs. • Implements differentiated learning successfully through thoughtful plan and choice of opportunities; incorporates feedback about differentiated learning into lessons. • Recognizes strengths and shortcomings in use of differentiated learning that impact self and students' development; attempts alternative approaches, • Seeking occasional support with differentiated learning from others in response to self or students' needs. • Is knowledgeable of differentiated learning; seeks opportunities for professional growth.	• Plans and organizes differentiated learning and adapts to address individual student needs. • Implements diverse activities for differentiated learning to the needs of each child. • Develops innovative activities for differentiated learning; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or needs. • Is knowledgeable and confident of differentiated learning; seeks opportunities for professional growth; assists peers informally with differentiated learning	• Plans and organizes for differentiated learning and adapts to address individual students' needs. • Implements diverse activities for differentiated learning to the needs of each child and facilitate professional growth of peers. • Deep understanding of differentiated learning and professional practice; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or student needs; excellence in differentiated learning. • Is knowledgeable and confident of differentiated learning; seeks opportunities for professional growth; supports peer efforts to develop understanding of differentiated learning.

Domain 3: Learning Environments: Teachers create learning environments that encourage positive social interaction, active engagement in learning, and self-motivation.

Attribute	**Basic**	**Proficient**	**Advanced**	**Exemplary**
3.1: Classroom management.	• Plans and organizes class norms and classroom arrangement for own purposes. • Implements adhering to plan; keen to complete the day's lessons. • Needs regular support and direction from field supervisors, mentor and peers to plan and implement class norms, seating and classroom.	• Plans and organizes class norms and classroom arrangement for self and students' needs. • Implements successfully through thoughtfully plan; incorporates feedback on class norms and classroom arrangement. • Recognizes strengths and shortcomings of class norms and classroom arrangement; attempts alternative approaches. • Seeks occasional support with class norms and classroom arrangement from others in response to self or students' needs • Is knowledgeable of class norms and classroom arrangement; seeks opportunities for professional growth.	• Plans and organizes class norms and classroom arrangement; adapts to address individual student needs. • Implements diverse activities to manage the whole class and to the needs of each child. • Develops effective class norms and classroom arrangement; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or needs. • Is knowledgeable and confident of class norms and classroom arrangement; seeks opportunities for professional growth; assists peers informally with class norms and classroom arrangement. .	• Plans and organizes class norms and classroom arrangement; adapts to address individual students' needs. • Implements diverse activities to manage the class; facilitate professional growth of peers. • Deep understanding of effective classroom management and professional practice; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or student needs. • Is knowledgeable and confident of managing classrooms; seeks opportunities for professional growth; supports peer efforts to develop classroom management techniques and strategies.

Domain 3: Learning Environments: Teachers create learning environments that encourage positive social interaction, active engagement in learning, and self-motivation.

Attribute	Basic	Proficient	Advanced	Exemplary
3.2: Individual differences in classroom	• Accurate and organized plan to respect each child's uniqueness; adapted for own teaching purpose. • Implements activities that respect each child's uniqueness adhering to plan; keen to complete the day's lessons. • Needs regular support and direction from field supervisors, mentor and peers to plan and teach with respect for each child's uniqueness.	• Accurate and organized plan to respect each child's uniqueness adapted to address self and students' needs. • Implements activities that respects each child's uniqueness successfully through thoughtful plan and choice of opportunities; incorporates feedback into lessons. • Recognizes strengths and shortcomings of respecting individual uniqueness that impact classroom/learning environment; attempts alternative approaches. • Seeks occasional support from others to incorporate individual uniqueness in class in response to self or students' needs. • Is knowledgeable of individual uniqueness; seeks opportunities for professional growth.	• Accurate and organized plan to respect each child's uniqueness and adapted to address individual students' needs. • Implements diverse activities that respects uniqueness and educates each child and the whole class. • Develops innovative activities that respects each child's uniqueness; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or needs. • Confident and independent in catering to individual uniqueness; keen to learn for professional growth • Is knowledgeable and confident of respecting each child; seeks opportunities for professional growth; assists peers informally to develop opportunities to respect each child's uniqueness.	• Accurate and organized plan to respect each child's uniqueness; adapted to address self and students' needs. • Implements diverse activities that respects uniqueness of each child and the whole class and facilitate professional growth of peers. • Deep understanding of individual differences and professional practice; takes risks and develops innovative approaches; modifies approaches dynamically based on emergent opportunities or student needs • Is knowledgeable and confident of respecting individual uniqueness; seeks opportunities for professional growth; supports peer efforts to develop techniques and strategies to respect individual uniqueness.

APPENDIX D

ANALYSIS 3 FRAMEWORK

Analysis 3 Framework

For each clip, complete the following questions or prompts as thoroughly as possible:

1. Domain and Attribute
2. Explain why this clip represents the attribute you chose.
3. Describe in detail what is occurring in the clip.
4. Describe and explain how that clip is related to your focus.
5. Explain why you are satisfied or dissatisfied with the clip.
6. Explain if this clip represents something you should improve or replicate.
7. How does this clip impact your beliefs about teaching?
8. What could you have done differently in this clip?

APPENDIX E

ASSESSMENT FOCI FOR ANALYSIS 3

Analysis 3 Assessment Foci for Each Participant

William's Assessment Focus

> I would want to focus on how well my students understood what I taught them today … I wish there was a way to figure out today how well they knew because it seemed like some were getting confused. So that is one thing that I would like to tweak is maybe make sure I assess them before they leave today instead of like tomorrow or something and clarify it. (William, 3/20/2006)

Laura's Assessment Focus

> … Just being more specific so I can be more time efficient. They can be more time efficient as well would be one thing that I would focus on … Just making them aware of that again so they are always on task. (Laura, Post-Lesson Interview, 3/22/2006)

Erica's Assessment Focus

> I would focus on getting all the students to answer questions. Getting them all involved in participating. I noticed that one or two of the students is volunteering and every answer and asking all the questions. Where there are others are laying their head down and would not know what is going on if I asked them a question. I need to get everyone involved. (Erica, Post-Lesson Interview, 3/22/2006)

Mariska's Assessment Focus

> I think I could have done better on my notes. I don't [sic] think my notes were [good]. They were kind of complicated … I was reading from [the notes] and I think that was a little complicated. I should have given [the students] more time to think about [the questions and topic]. (Mariska, Post-Lesson Interview 3, 3/9/2006)

APPENDIX F

POST-LESSON INTERVIEW PROTOCOL

Post-Lesson Interview Protocol

1. What were the goals or objectives of today's lesson?
2. After teaching the lesson, what are your initial thoughts?
3. What worked well with today's lesson?
4. What did not work well with today's lesson?
5. What were the strengths of your lesson today?
6. What were the weaknesses of your lesson today?
7. If you could change something about today's lesson, what would it be?
8. If you were to analyze your teaching today, what would be one specific part of your teaching you would want to focus on?

APPENDIX G

INITIAL INTERVIEW PROTOCOL

Initial Interview Protocol

1. What are your beliefs about science teaching? (1a – 1e are modified from L. Bryan. (2004). Science teacher beliefs. From the course "Reflection on Science Teaching" taught at the University of Georgia.)
    a. Why should students learn science?
    b. How do students gain understanding of scientific concepts?
    c. The role of the teacher?
    d. The role of the student?
    e. What is your vision of yourself as a science teacher?
2. What is self-assessment?
    a. What is the goal of self-assessment?
3. How do you self-assess your own teaching practices?
4. What is reflection?
    a. What is the goal of reflection?
5. How do you reflect on your own teaching practices?
6. What are the differences between reflection and self-assessment?
7. What do you gain from reflection? Self-assessment?
    a. What do you take away from reflection/self-assessment?
8. Tell me about a specific experience/situation you reflected on?
    a. assessed?
    b. Can you think of another?
9. How do you focus your reflections/self-assessments?

10. How do you ensure, or motivate yourself, to conduct reflection/self-assessment?

11. What prevents/inhibits you from conducting reflection/self-assessment?

12. How are reflection/assessment encouraged by your teacher education program?

    a. University supervisor?

    b. Mentor teacher?

    c. How do they support/encourage you to reflect/assess?

13. What is evidence of teaching practice?

14. What a) evidence, b) tools, or c) resources do you use to examine your own teaching?

15. Can you think of any other questions I should have asked you?

APPENDIX H

POST-ANALYSIS 1 INTERVIEW PROTOCOL

Post-Analysis 1 Interview Protocol

0. Describe what was most challenging about examining your own teaching.
1. Describe what you learned about your own teaching from watching the video.
2. Describe any changes you could have made or will make when analyzing your video.
3. How in-depth do you think you examined your teaching practices with VAT?
4. How did VAT help you look at your teaching more in-depth?
5. Describes your uses of VAT. (alt. what VAT helped you do)
6. What would help you look at you teaching more in-depth when using the VAT?
7. Describe the difficulties you had using the VAT system.
8. Describe what was good about the VAT system.

APPENDIX I

POST-ANALYSIS 2 INTERVIEW PROTOCOL

Post-Analysis 2 Interview Protocol

1. Describe how you analyzed your teaching in your second analysis.
2. Describe what you learned about your own teaching from watching the video when using the GTSM attributes.
3. Describe the process of how you created clips using the GTSM attributes.
    a. What did you focus on in your self-assessment? Why?
    b. Explain how you identified specific parts of your teaching practice to examine?
4. Describe what was most challenging about examining your own teaching using the GTSM attributes
5. Describe the difficulties you had with the GTSM attributes.
6. Describe what you liked about the GTSM attributes.
7. How in-depth do you think you examined your teaching practices with the GTSM attributes?
8. How did the GTSM attributes help you look at your teaching more in-depth?
9. What would help you examine your teaching more in-depth when using the GTSM attributes?
10. Describe how using the GTSM attributes different than your first reflection.
11. Describe any changes you could have made or will make when analyzing your video.
12. Is there anything we've talked about that you feel like you need to elaborate on? Are there any questions you think I should have asked?

APPENDIX J

POST-ANALYSIS 3 INTERVIEW PROTOCOL

Post-Analysis 3 Interview Protocol

1. Describe how you analyzed your teaching for your third analysis.
2. Describe the process of how you created clips for your third analysis.
    a. How did you examine/identify specific parts of your teaching practice?
3. Summarize your third analysis.
4. Describe what you focused on during your third analysis.
5. Describe what was different about doing an analysis using a focus.
6. Explain the difference between your previous analyses and your third analysis.
7. Describe how the GTSM attributes assisted or prohibited your analysis around a focus.
8. Describe any difficulties you had with the GTSM attributes when examining a specific issue, your focus.
9. Describe what you learned about your own teaching from watching the video when having a focus for your analysis.
10. Describe how in-depth you examined your teaching.
    a. What could have made your analysis more in-depth?
11. Let's look at the GTSM attributes:
    a. What attributes did you find confusing? Why?
    b. What attributes did you have difficulty seeing in your video? Why?
    c. What attributes did you see most often? Why?
    d. Explain how the lens helped or prohibited your analysis of your teaching.
    e. Explain how you would change the GTSM lens.
12. Looking at VAT:

a. What do you like about the system?

b. What would you change in the system?

c. How does VAT enable or prohibit the examination of your teaching practices? (What does VAT do for you as you examine your teaching?)

13. How did your work over the last month help you examine your teaching?

    a. What knowledge about your own teaching do you believe you have gained?

    b. Had you not used VAT, how would you have analyzed your teaching?

14. What does self-assessment mean to you now?

    a. Describe from beginning to end the process of how you would conduct self-assessment in the future.

15. Describe what evidence of teaching practice means to you?

16. For your three analyses, describe how you used evidence to examine your teaching?

17. Describe how you plan to assess or reflect on your teaching when you become a full-time teacher.

18. Is there anything we've talked about that you feel like you need to further elaborate? Are there any questions you think I should have asked?

APPENDIX K

DATA EXCERPT FROM A WRITTEN ASSESSMENT IN VAT

Laura Written Assessment Excerpt from Analysis 1

Clip Id	Start	End	Comments
6347	05 :18	06:17	**1. Explain why you chose this event.** I feel this is an area of my teaching that I have really improved on so that is why I chose this event. **2. Describe in detail what is going on in this clip.** In this clip I am giving an introduction to what we will be doing for the day plus I am reviewing over what we have been doing for the past two days. **3. Explain why that event is critical to your teaching.** This is a critical part of my teaching because it allows the students to start thinking along the lines of what they are learning and sets them up for the lesson of the day. It helps the kids to be able to scaffold their learning as well. **4. Explain why it would be important for you to examine that event.** It would be important for me to examine this event because it is crucial to my class and if I can find ways to improve the event then it will only improve the learning in my classroom. Not only the learning of the students but my learning as well. **5. Explain why you are satisfied/dissatisfied with this event.** I am satisfied with this event because in the beginning of my student teaching I would have stayed behind the desk and not moved around a whole lot. At this point I feel like I have really improved on my voice level and moving around the room and being close to the students while I am talking. This has enabled me to get the students attention better and move right into the new lesson for the day. **6. Explain why this is something you would want to improve (or replicate).** I believe this is something I would want to improve on because it still seems a little boring at times and I think I can always make things better. **7. Explain if this is problematic or something you are doing well.** At this point in my student teaching I believe this is something I am doing well especially when I think back to how it was at the beginning of my student teaching. However, I still believe I can make more improvements.

APPENDIX L

DATA CODING EXCERPT

Coding Excerpt from William

Source	Excerpt	Initial Code	Sub-Code	Theme/Notes
LI-1, 123-125	P: Reflection would be just looking to see how I have done in the past. Not necessarily assessing to see what you can change but just more looking on what you have done and discussing about it.	Reflection	Defining reflection	Lack of Understanding about Reflective Process
LI-1, 129-132	P: Maybe see how you can change next time so that you can better yourself in the future. So when you reflect on what you did or how this weeks you can see how you change or tweak that assignment to fix it next time to make it a little but better.	Reflection	Purpose of reflection	General View that Reflection "Improves" Practice
LI-1, 138	P: And reflection is more looking at the week as a whole.	Reflection	Span of Reflection	Reflection for Large Spans of Time
LI-1, 157-160	P: Her and I would pretty much talk every Friday and at the end of every day. How well I did that week or what I need to work on for next week. Then on Friday we would plan for the next week. We were able to make our assessments for the next week and kind of plan out what we were going to reflect on.	Reflection	Reflection w/ mentor	Lack of Modeling for Reflective Process Not enough Support from Mentor to Learn Reflective Process
LI-1, 164-170	P: I can remember when we were planning out for the cell activity. We were trying to figure out a great way to assess the students and see how we could figure out how well they understood the working of the cells. Just how it was like a factory and we decided on having [the students] make a little cell model. We were not sure if we wanted them to make posters or cell models or reports or whatever. We finally ended up deciding that and it came out to be a very good choice on our part to have them to do the cell models. They understood what was going on.	Reflection	Reflection w/ mentor	Lack of Modeling for Reflective Process Not enough Support/Knowledge to Understand this is not Reflective Practice

Source	Excerpt	Initial Code	Sub-Code	Theme/Notes
LI-2, 6-7	P: Reflection is more like I said just looking at your own teaching kind of like as a whole like a whole semester or what not.	Reflection	Defining Reflection	Reflection for Large Spans of Time
LI-2, 17-21	P: I never could see a lot of things that I am doing well and a lot of things that I am not doing well in my classroom so it is a really good opportunity for me to see my teaching and certain things that I do throughout the day. Just … go back and hopefully change for better or not change something because I am doing them well.	Reflection	Justification for Reflection	Reflection for Examining Teaching
LI-2, 91-97	P: I would start probably with you know you have to write down or have in your mind what happens that day. A lot of people like to write down what they did or certain things that stuck in their mind that they need to change or what not. I believe that just realizing that these certain events are taking place is like the first part of the reflection. Then when you do the reflection just thinking about it on your own or talking with people trying to see what you can do personally and kind of fix that. Then the last part is applying what you know and what you learn will act that behavior or whatever you are trying to fix.	Reflection	Process of Reflection	Lack of Understanding about Reflective Process Lack of well-defined process
LI-2, 110-119	P: Well a lot of it is pretty obvious when the students ask you a question in class and you don't know the answer it is a pretty good time to reflect. 'Why don't I know this answer?' Is it a really good question or I don't know enough about the information. Pretty much the times for reflection would be pretty obvious. … When you are having problems or not necessarily a problem or if you did something really well in class and you want to reflect on that. Reflection on that say, "Well, I will have to do that next year'.	Reflection	Identifying Issues to Reflect on	Reflection as "Easy" Process Lack of systematic process for identifying issues