Examining the use of a reflection framework to guide teachers' video analysis of their science teaching practice

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Abstract

This multiple case study examined four elementary teachers' use of a reflection framework for analyzing video of their science teaching practice. Open coding was used to analyze the data. Cross-case comparison was used to compare each participant's case and identify similarities and differences. The introduction of a reflection framework supported the participants in developing more detailed explanations of their science teaching practice but did not engage them in critically examining their science teaching. While the participants were able to engage in the reflective cycle, they did not always thoroughly address the framework prompts. Findings illustrate the need for frameworks and additional coaching to support teachers' reflective practice and the revision of this framework and similar ones.

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Introduction

The teaching experience is shaped by the knowledge and beliefs that teachers bring to their practice (Barnes, 1992; Desforges, 2003). Since knowledge about education is bound in specific contexts (Carr & Kemmis, 1986), teachers need to understand that their beliefs and experiences of teaching directly impact their construction of knowledge about teaching and learning. Teachers can only make sense of new teaching experiences and information by interpreting them using their own previous knowledge, beliefs, and experiences (Dewey, 1938; Barnes, 1992; Weiss & Weiss, 2001). "The beliefs that students of teaching hold play a pivotal role in the interpretation and construction of professional knowledge" (Bryan & Abell, 1999, p. 122). The use of reflective activities in professional development experiences help in-service teachers make their beliefs more explicit and allow them to address inconsistencies between their beliefs about teaching and their actual teaching practice. Their experience and reflection on those activities will help teachers "become cognizant of their beliefs about teaching and learning" (Bryan & Abell, 1999, p. 136), a crucial step in teachers' development of knowledge.

Using Reflection

Reflection can be a systematic and purposeful methodology for examining ones' own teaching practice. The process of reflection requires teachers to identify an issue of practice, frame that issue of practice using their beliefs and previous experiences, develop solutions and

implement solutions for solving issues of practice, and reframe the issue based on new evidence that arises during their examination (Schön, 1987). Through self awareness, "the ability to see oneself as object" (Fendler, 2003, p. 17), teachers become aware of their own beliefs and knowledge about teaching and learning and the environment they create in their classroom. When teachers' familiar routines produce unexpected results or they begin to question their teaching practice or view their teaching differently (Schön, 1987), "a state of perplexity" (Dewey, 1910, p. 9) occurs. As teachers examine this perplexing event, they become aware of multiple factors that impact their teaching practice. Teachers may use this new information to revisit and refine their beliefs and knowledge about a problem in their teaching. Reflection is an exercise of skills in analyzing evidence and finding solutions for complex problems in one's teaching practice (Calderhead, 1989; Dewey, 1910; Schön, 1987). This process allows teachers to gain a deeper understanding of their teaching practice and knowledge and beliefs about teaching and learning.

Using Tools for Reflection

In order to systematically reflect on their teaching using evidence, teachers may use tools for collecting, storing, and examining evidence of their teaching practice. Teacher education programs routinely integrate tools such as cases, videotape reflections, and portfolios to help teachers gain a better understanding of their knowledge and practice (Abell & Bryan, 1997 Abell, Cennamo, Anderson, Bryan, Campbell, & Hug, 1996; Bowers, Kenehan, Sale, & Doerr, 2000; Delandshere & Arens, 2003). Many professional development experiences also integrate these tools to help science teachers reflect on their teaching practice in addition to helping them develop a better understanding of school curriculum or science content. These types of tools support teachers in participating in reflection-on-action (Schön, 1987), where teachers take time to step outside their teaching situation and critically examine issues of practice. Even though teacher education and professional development efforts align with the use of these tools and evidence for the improvement of practice, they are usually isolated from one another and/or used unsystematically (Recesso, Hannafin, Wang, Deaton, Shepard, & Rich, 2009). This may result in teachers not being able to thoroughly or critically examine issues in their teaching practice. Further, evidence from teacher practice cannot be critically assessed in the same manner as research evidence since much of teachers' practice is not documented (Hammersley, 2004). Teachers need opportunities to systematically collect evidence of their teaching, examine their teaching practices, and organize their knowledge. Professional development facilitators "must use methods and tools to intentionally support the iterative and reflective aspects of knowledge building" (Land & Zembal-Saul, 2003, p. 65).

In order to support reflection, professional development facilitators and teachers need to identify and use tools for documenting and reflecting on their knowledge. Scaffolds are one tool that are often employed by professional development facilitators and teacher educators. Scaffolds provide teachers with sets of prompts to guide them through the process of reflecting. They can be in the form of verbal conversations, written frameworks, or computer-based frameworks. Scaffolds are designed, like the practice of reflection, to acknowledge learner's prior knowledge (Lipscomb, Swanson, & West, 2004). Verbal scaffolds can be used in conversations by tutors or supervisors to support teachers as they construct explanations (Chi, 1996). Written frameworks may also support teachers' development of explanations. Griffin (2003) developed a written

framework to guide teachers' through reflecting on their practice. Her framework focused on helping teachers, "(a) use the language of their profession; (b) connect theory to practice as they explain their practice; (c) connect their practice to the standards of their profession; and (d) describe how their reflection/analysis would affect their actions in the classroom and school community" (Griffin, 2003, p. 208). Her study showed that the framework may increase pre-service teachers' awareness of the multiple variables that impact the teaching and learning in their classroom. Other written frameworks are often integrated into computer- based systems that are used by teachers for reflection of or assessment on their teaching (Land & Zembal-Saul, 2003; Zembal-Saul, Munford, Crawford, Friedrichsen, & Land, 2001). Land and Zembal-Saul's (2003) study discussed how computer-based scaffolds helped preservice teachers gather evidence on their science learning and reflect on their experience. Their study showed "evidence of increasing sophistication in explanations" (Land & Zembal-Saul, 2003, p. 70). The researchers found that the scaffolds their research participants used stimulated "learners to become more precise in their explanations, to offer justification, and to connect evidence with claims" (Land & Zembal-Saul, 2003, p. 70). This process of developing evidence-based explanations is crucial to both successful practices of reflection and science teaching.

Videotape, such as videotaped lessons or cases, is another tool that allows teachers to engage in reflection by observing, examining, and evaluating their teaching (Abell et al., 1996; Davies, 2000; Ratcliffe et al., 2003). The use of audio and visual components during reflection help to better capture the rich context of the classroom (Abell et al., 1996; Kurz, Llama, & Savenye, 2005; Tippins, Nichols, & Dana, 1999). Teachers can reflect on their practice away from classroom distractions to examine the complexities of the classroom. By stepping out of the classroom experience and looking at their teaching from another view, teachers are able to identify factors in their classroom they may not have seen during their teaching episode. To support the use of video, there are many video analysis programs that allow individuals to watch, clip, and comment on video, such as the Video Annotation and Summarization Tool (VAST) (http://www.professional-vision.org/) developed at Northwestern University (Sherin & van Es, 2005; van Es & Sherin, 2002), Digital Interactive Video Exploration & Reflection (DIVER) (http://diver.stanford.edu/home.html) developed by the Stanford Center for Innovations and Learning (Pea, Mills, Rosen, Dauber, Effelsberg, & Hoffert, 2004), and Video Analysis Tool (VAT) (http://evirx.com) developed at the University of Georgia's Learning and Performance Support Laboratory and owned by Evirx (Bryan & Recesso, 2006; Recesso & Zepeda, 2008). This study will employ the use of VAT to support teachers' use of a framework for analyzing video of their science teaching. VAT is an Internet-based tool designed to support and record evidence of deep learning outcomes for preservice teachers and teacher educators (Recesso et al., 2009).

The purpose of this paper is to examine elementary teachers use of a reflection framework, which was based on Griffin's (2003) Critical Incidents Framework, to analyze video of their science teaching practice. Specifically, this study focused on how the teachers used the framework to guide their analysis of their science teaching videos and development of reflective writings in the VAT. To examine how they used the framework, the following research questions guided this study:

- How did the introduction of the reflection framework influence teachers' reflective practice?

- How did teachers use the reflection framework to examine their teaching practice?

Research Methodology

Context

This study was set within a year-long professional development experience on environmental science that consisted of a two-week summer workshop and follow-up support in the form of academic year meetings and coaching. The professional development experience encouraged participants to engage in reflective practice and provided them with tools and opportunities for reflecting on their practice. In the summer, the participants engaged in one week of content lessons and one week of practice in teaching environmental science to summer camp students and reflecting on their science teaching to those students. In the follow-up support, the teachers reflected on their lesson facilitation in their science classes and attended two afterschool meetings to discuss science content and their reflections on their science teaching practice. The participants used journal entries, video of their science teaching, the Video Analysis Tool (VAT), and a reflection framework (Table 1) to reflect on their science teaching practice as per the professional development experience guidelines. (author, submitted). The reflection framework was developed using modified Critical Incidents Framework prompts (Griffin, 2003) and introduced after the summer workshop. By developing journal entries and using the reflection framework to analyze video of their science teaching in VAT, the teachers reflected on their science lessons and developed reflective writings.

Role of Researcher

The author of this study was also one of the facilitators for the professional development experience that served as the context for this study. As a facilitator, she provided the teachers with science content support, technical support for using VAT, and feedback on their VAT analyses. In the summer workshop, the facilitators focused on science content and pedagogy, reflective practice, and using VAT. The follow-up support focused on the use of VAT and reflection. During the academic year, the author conducted three interviews with each participant, videotaped three of their science lessons, provided feedback on the participants' VAT analyses of their science lessons, provided any other necessary support via email, phone, or individual face-to-face meetings, and co-facilitated two afterschool meetings.

Table 1
Reflection framework

Reflecting on Your Lesson
1. Watch your video. Identify events or issues that attract your attention.
a. Clip those events or issues in VAT
b. Describe the events/issues that you see. (What was interesting? surprising? frustrating? etc.)
2. Pick one of the events/issues you would like to examine more closely.
a. After your description of the event/issue (see 1a), discuss any emotions that were evoked when you saw that event/issue. (How do you feel about that event/issue?)
3. Develop an explanation of the event/issue.
a. Why do you think this event/issue happened?

b. What does this mean to your teaching or your students' learning?

4. Develop your understanding of this issue.
   a. What do you know about your event or issue?
   b. What do you know about that particular topic?
5. How does this issue relate to your teaching as a whole? (Is it an issue of teaching? science content? the elementary curriculum? etc.)
   a. What specific standards relate to this event or issue? (Does this event/issue relate to a teaching standard? state content standard? etc.)
6. Revisit your beliefs statement in the Blog.
   a. What beliefs do you have about this event/issue?
   b. Do any of your beliefs, which were stated in your Blog, relate to this event/issue? If so, which ones?
   c. Does this event/issue contradict or support any of your beliefs about teaching and learning? If so, which ones?
7. What actions can you take to further examine this event/issue? For example: What can you do to find out why a successful strategy worked? What can you do to find out why a strategy didn't work? What steps can you take to solve this issue?

Participants

Through purposeful and convenience sampling (Patton, 2002), four participants were selected due to their completion of the professional development experience, willingness to participate in the study, and use of the professional development tools for reflection. The four participants in this study were Sarah, Betty, Brenda, and Patricia. Sarah was a third grade teacher of European American descent with 37 years of teaching experience. Betty was a kindergarten teacher of European American descent with 10 years of teaching experience. Brenda, a K-5 gifted teacher of European and Native American descent, had 29 years of teaching experiences and Patricia, a K-5 science teacher of European American descent, had 17 years of teaching experience.

Data collection and analysis

Data collected were (a) four journal entries where the teachers discussed their teaching philosophy, a video analysis they created in VAT, and issues that arose in their recent science lessons, (b) two or four video analyses in VAT of participants science teaching during a summer science camp (i.e. Summer VAT analyses), (c) three video analyses of their science teaching during the academic year (i.e. Academic Year VAT analyses), (d) three revised versions of each aforementioned video analyses developed after feedback from research (i.e. academic year VAT analysis refinements), (e) two VAT analysis presentations to their peers, one presentation of their VAT analyses during the summer and one during the academic year, and (f) interviews conducted after each video analysis. While the participants' reflective writings developed in VAT (i.e. Summer and Academic Year VAT analyses and Academic Year VAT Analysis refinements) are used to discuss themes in the findings section of this paper, the other forms of data (i.e. journal entries, interviews, and VAT analysis presentations) were collected to clarify or elaborate on statements that were provided by the participants in their reflective writing. Multiple forms of data were used for triangulation. Data were collected in two phases: summer phase and academic year phase (See Figure 1). During the summer phase, the researcher collected

participants' summer VAT analyses (two or three depending on how many the teachers created), journal entries, and audio of participants' presenting their VAT analyses to their peers at the end of the summer workshop. During the academic year phase, the researcher collected participants' other journal entries, academic year VAT analyses, academic year VAT analysis refinements, and audio of participants' presenting their VAT analyses to their peers at the end of academic year. Journal entries were used to prompt teachers to discuss their philosophy of science teaching and examine their beliefs and understanding about science teaching and learning. The science teaching video used in VAT and focus of each video analysis was chosen by the participants and analyzed at their own school or personal computer. Each video analysis took place outside of normal classroom distractions as teachers participated in reflection-on-action (Schön, 1987) to analyze their teaching practice,

A multiple case study approach (Yin, 2003) was used to examine elementary teachers' reflections and allow "for in-depth study and comparison" (Patton, 2002, p. 447). The object of each case study was an individual elementary teacher participating in a professional development experience about environmental science. Open coding was used to identify themes (Cortazzi, 2001; Polkinghorne, 1995) in all sources of data. The themes were categorized and organized according to the research questions. Each category was defined and revisited to attend to external heterogeneity and internal homogeneity (Patton, 2002). Cases were organized according to the research questions and related categories and themes. Cross-case analysis was used to examine similarities and differences among cases (Patton, 2002).

Findings

The findings for this study represent the cross-case analysis conducted for the four participants' cases. The findings are organized into two sections that correspond with the research questions below:

- How did the introduction of the reflection framework influence teachers' reflective practice?
- How did teachers use the reflection framework to examine their teaching practice?

How did the introduction of the reflection framework influence teachers' reflective practice?

After the participants were introduced to the reflection framework, the nature of their written reflections in VAT changed in three main ways. First, the participants changed the focus of their VAT analyses from only narrating events in their video to narrating and explaining their science teaching practice. Second, the framework supported the participants in developing lengthier and more detailed VAT analyses. Third, the participants began to participate in the reflective cycle of naming, framing, and reframing a problem of practice (Schön,1987). The following sections detail these three changes in the participants' reflective practice.

Change in focus. When developing their summer reflective writings (i.e. VAT analyses), the participants were not encouraged to use a framework in analyzing their video in VAT. Instead of focusing on their use of the framework, the professional development facilitator focused on the participants' understanding of reflection and how to use VAT for analyzing their science teaching videos. No specific system or guidelines for actually developing reflective writings, other than technical concerns with use the VAT system were provided to participants. The participants, however, were encouraged to critically examine video of their science teaching practice to look for and solve issues of practice. Even though they were encouraged to reflect on

their science teaching, the teachers basically used their development of VAT Analyses in the summer to "get use to using the system" (Betty, Journal Entry 1).

In addition to learning to reflect using a new tool, VAT, the participants were also teaching in a new way (i.e. co-planning and co-teaching a science lesson with a peer). As indicated in one of Betty's journal entries, "I am seeing that I am not moving around as much as I should. I usually do in my regular class – I guess since there are more teachers I am staying put more."(Betty, Journal Entry 1), the participants were altering their normal teaching strategies and approaches to co-teach a lesson with another participant. Some of them were even "echoing [their partner]" (Sarah, Summer VAT Analysis presentation) and mimicking their teaching approach in order to support the co-taught lessons. Even though they co-taught lessons with a peer, the participants were instructed to create as many individual summer VAT analyses as they wanted on their science teaching videos.

For each participant, there were four videotaped lessons recorded and uploaded into VAT by the professional development facilitators. Betty used VAT to develop four summer VAT analyses three different lessons. Sarah developed three summer VAT analyses using three different lessons. Patricia developed three summer VAT analyses on two different lessons while Brenda developed two summer VAT analyses on two different lessons. The participants used their reflective writings in VAT to (a) narrate their science lessons and (b) justify their use of specific teaching strategies. The participants mainly used their VAT analyses as a platform for narrating segments of their videotaped lesson. For instance, Sarah often developed statements such as "monitors student progress[.] provides individual assistance[.] relates to prior learning." (Sarah, Summer VAT Reflection) in her VAT analyses as she narrated events in her classroom. Brenda and the others often created a focus (i.e. issue of teaching) before watching their video. Then, they would examine the video and look for instance of that teaching issue. When discussing an instance where she focused on providing clear instructions to students, Brenda stated, "I could see examples of showing the students how to do a leaf rubbing, where to put the leaf rubbing and bark rubbing on the Adopt-a-Tree form. There was evidence of explaining which materials to take outside for the Adopt-a-Tree activity" (Brenda, Journal Entry 2). She used her VAT analysis to record her observation of this evidence. Even though Brenda and the other participants were able to identify evidence related to an issue in their teaching practice, they did not always examine it thoroughly or develop explanations about their teaching using this evidence. In addition to narrating video events, the participants also justified the use of certain teaching strategies that they identified in their teaching video. They would state why they used certain strategies using their beliefs about teaching and not necessarily evidence from their teaching. In one of her VAT analyses, Sarah noted that she was "monitoring closely as [the students] work leads to success and eliminates unnecessary errors. If the children get the first examples correct then the other choices will really be a matter of matching like items"(Sarah, Summer VAT Analysis). Sarah and the other participants, made a point of identify some of the strategies that they used and why they used them.

With the introduction of the framework during the academic year, the participants changed the way they developed their reflective writings. As in the summer, the professional development facilitators videotaped and uploaded videos of the participants' science lessons as well. The participants were asked to select at least three science lessons to be videotaped and

uploaded. Then, they were asked to examine each videotaped lesson using the reflection framework to guide them as they analyzed their video in VAT. The participants were also encouraged to continually revisit and reflect on any other video they had access to (i.e. summer videotaped science lessons) or have reflected on in the past. All four participants developed a reflective writing for each video from the academic year lesson. None of the participants reexamined a videotaped lesson from the summer or created an additional VAT analysis for any of the academic year videos.

One change in their reflective writings was their development of explanations. The participants switched from mainly narrating events to explaining their teaching practice. By responding to the framework prompts while analyzing their videos during the academic year, the participants were encouraged to explain why they think the issue or focus they were examining occurred, what they knew about the issue, and how it influenced their teaching. These prompts, along with the other ones, supported participants in going beyond just identifying related practices to examining why certain events occurred in the classroom. An excerpt from Brenda's Academic Year VAT Analysis 2 (see Table 2) illustrated how the framework prompts and questions supported her in going beyond just identifying how an event related to the focus of her reflection to a more thorough discussion of how it related to her teaching, what she knew about the topic, and how it related to her beliefs about teaching. While the other participants still narrated events from their video, they, like Brenda, also used their VAT analyses to identify evidence of their practice to inform their reflection on their science teaching, and developing explanations based on that evidence (Author, submitted). Compared to their summer reflective writings, the framework questions and prompts encouraged the participants to go more in-depth about the focus of their reflective writing.

Table 2
An excerpt from Brenda's Academic Year VAT Analysis 2

Students have gathered leaves for our inquiry based leaf identification activity. We are discussing the leaves they have gathered and comparing and contrasting to our original list of characteristics which scientists might use for classifying and identifying leaves. There seems to be lots of student participation. They seem genuinely interested and excited about the activity. I was pleased that the students seem engaged in the activity. It was somewhat surprising because I felt during the lesson that there seemed to be a lot of dead time. Being able to gather their own leaves and then use books and idenfication[sic] sheets to help the activity created more interest and excitement in the lesson I believe, than just reading about leaf identification within a science text. Having students actively engaged in learning is very rewarding for a teacher, because it makes me feel like I am making a difference and they are learning the material. Students' learning is at a higher level I believe when they are actively engaged in the lesson. Manipulatives and the setting helped to add to the transfer of information for this lesson. When students are involved in the learning process actively, not just listening to a lecture, they tend to retain information longer and it becomes more meaningful to them. The issue of engaging students and using manipulatives is related to teaching as a whole. State Science Standards that relate to the issue of engaging students: S4CS1/S5CS1: Students will be aware of the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand

how the world works; S4CS8/S5CS8: Students will understand important features of the process of scientific inquiry; S5L1: Students will classify organisms into groups and relate how they determined the groups with how and why scientists use classification. I strongly believe that engaged students will transfer the learning better, that manipulatives help increase interest, excitement, and transfer of learning, and that students should be involved in inquiry based learning as much as possible. Many of the items I mentioned in my teaching philosophy statement relate to this issue, including, students learn at different rates and through different styles, connect all learning to real-life applications and integrate across curriculum for maximum transfer of learning, students need to be taught to question things, discover the answer to a problem, inquiry-based learning, with students discovering truths about the world around them. I also acted as a guide and a facilitator, guiding and coaching them instead of disseminating information. I strive to provide a warm, caring environment even when I am stretching and pushing them beyond their comfort zone. Students should be willing to be risk-takers. I do not believe this lesson/issue contradicted any of my beliefs; in fact, it supports all of my beliefs as mentioned above. I also believe it supports the beliefs about teaching and learning where students are using manipulatives, actively engaged, interested in the lesson and transferring information. As a comparison, you could teach the lesson from a text book[sic] without pictures, just using verbal descriptions of leaves and the identification steps to see if students could successfully identify the leaves. I do not think it would work as well as this lesson at all.

Change in length and depth of reflections. The length, depth, and use of the participants' academic year analyses were very different from the analyses they developed during the summer. After the introduction of the reflection framework, which required participants to respond to seven prompts, the participants lengthened the average lines of text they created in their reflective writings. For instance, Betty went from an average of 25 lines of text to an average of 66.3. Sarah went from 18.7 lines of text to an average of 42.3. Patricia and Brenda went from averages of 12 and 35.5 respectively to averages of 97.7 and 127.7. As for the depth of the reflective writing in VAT, it changed dramatically for some participants with the introduction of the framework. In the summer, the participant often used a line or lines of text to simply identify the part of the lesson, such as, "Conclusion." (Patricia, Summer VAT Analysis) or provide reasoning for their use of teaching strategies. The participants' statements, however, began to provide more detail and explanations about their teaching practice after the framework was implemented. The excerpt in Table 2 illustrates the depth and detail the participants incorporated into their reflective writings as they used the reflection framework to examine their science teaching. While not all of the participants' reflective writings were as lengthy as Brenda's example (Table 2), the amount of detail and length of the VAT analyses increased as the participants responded to the framework questions. The framework prompted the participants to discuss different aspects of a teaching issue (e.g. their beliefs about the issue, how they felt about the issue, how it impacted their teaching, and how it impacted their students' learning) that they focused on as they analyzed their teaching. The participants did not intuitively mention these issues or discuss these issues in much detail when analyzing their summer videos. The format of the framework (i.e. multiple open-ended questions) required the participants to go beyond simple short answer responses and explicitly discuss the impact of and influences behind their teaching issue.

Participating in the reflective cycle. During most or all of their summer VAT analyses, each participant was able to identify an issue of practice, whether it was a general pedagogical issue, such as "[working] on ways to draw in the one student who was very shy and wouldn't[sic] participate." (Betty, Journal Entry 1) or an issue specific to science teaching and learning, such as "doing too much for [students]" and not letting them conduct their own inquiry investigations (Patricia, Summer VAT Analysis). They were able to begin engaging in the cycle of reflection by at least identifying an issue of practice they would like to focus on and framing the context for the problem. The cyclical nature of reflection focuses on naming a problem, framing a problem, experimenting to solve the problem, experimenting to solve the issue, and reframing the problem in light of new evidence (Schon, 1987). This reflective cycle may continue until an issue is solved and a new issue is being examined. While the participants did not always indicate in their reflective writings that they engaged in the entire reflective cycle, their writing indicated that they were at least able to identify an issue of their teaching practice. Betty, Patricia, and Sarah's summer reflective writings showed evidence of them starting to engage in the reflective cycle by identifying an issue of practice. They were able to discuss why they thought their issue occurred but they did not provide a detailed discussion of their understanding of the issue. For example, Patricia's second summer VAT analysis focused on providing students with consistent, clear instructions. She realized that when she team-taught a lesson with another teacher that the students were confused about assignment instruction and their role. Patricia noted that she provided her students with a different level of support (i.e. did most of the experiment for them) than the other teacher. She also noticed that the instructions she provided were not exactly the same as the other teachers. While Patricia believed that they had the same understanding about the activity, she obviously "had interpreted the goal very differently that they [other teacher]" (Patricia, Summer VAT Analysis). In the summer, only one participant, Betty, identified an issue of practice, briefly explained it, and proceeded to implement and examine interventions to solve the issue of practice. She identified the need to engage a shy student in her science lessons and proceeded to implement multiple interventions (e.g. rearranging the room, one-on-one discussions, and wait time) to engage the student. She identified interventions that seemed to positively influence the student's participation in class and noted strategies that she would continue to implement (i.e. proximity, constant one-on-one monitoring of her understanding, talking about her personal interests).

During the academic year, the participants were able to continue to identify and frame an issue of practice like they did in the summer. All of the participants, however, were able to more thoroughly engage in the reflective cycle using the framework. They were able to develop explanations about their science teaching issues during the academic year. The framework encouraged the participants to use evidence about their teaching to frame the issue they were examining. While the framework supported the participants in this way, it still did not always encourage the participants to critically reflect on each teaching issue. With the exception of Brenda, the participants still had trouble discussing how the issue of their analyses could influence their teaching and/or student learning as prompted by the framework. Similarly, none of the participants were able to make connections between the issue they were examining and the beliefs they held about the issues in their summer VAT analyses. They did not refer to any belief statement they developed in their journal entries during the summer. The participants also often neglected to discuss beliefs they held about their teaching issue and whether the issue contradicted or supported their beliefs about science teaching.

How do teachers use the reflection framework to examine their teaching practice?

The purpose of the reflection framework was to help participants go beyond description of their teaching practice and focus on identifying and explaining issues in their science teaching practice. It was introduced to support the teachers in developing more in-depth and detailed explanations of their teaching practice. To do that the participants were asked to develop reflective writings in VAT using the reflection framework to guide their analysis of their science teaching videos. The participants were given the framework but not taught how to interpret the questions or prompts or how to respond to them. While participants used the reflection framework to guide their development of each VAT analysis during the academic year, they did not always use the entire reflection framework when creating their VAT analyses. The reflection framework was not embedded within the Video Analysis Tool and was provided to the participants as an electronic Word document via email and in paper form. Unless the participants had a copy of the framework with them as they analyzed their teaching videos or they remembered the framework questions, the reflection framework was unavailable to them while using VAT.

There were many prompts that participants did not respond to at different times when using the reflection framework to analyze their video in VAT. While the framework was implemented to support teachers in reflecting on their practice, they teachers did not always use it in its entirety. When using the reflection framework, there were two questions the participants most often left incomplete or unaddressed in their VAT analyses. Those questions related to (a) the teaching or curriculum standards that pertinent to the focus of their VAT analysis and (b) contradictions between their teaching practice and teaching philosophy. While there were other questions that were often not addressed in the VAT analyses, participants' attempts to address the above questions resulted in some interesting findings. The following section discusses teachers' use of these two prompts as they created their initial VAT analysis and/or when they revised their VAT analyses after feedback from the professional development facilitators.

Addressing teaching and curriculum standards. Given that the participants were practicing elementary teachers, it was assumed that the participants were familiar with all of the state elementary science standards. The participants were also provided with copies of national and state science standards during the professional development experience. However, they did not choose to identify specific science content or science teaching standards when addressing these standards in their VAT analyses. Even with feedback prompting them to respond to these questions, the participants still did not answer the questions clearly. When addressing the question related to content or teaching standards, the participants often (a) mentioned a broad science concept or teaching strategy related to the focus of their VAT analysis, (b) listed standards that did not relate to the focus of their VAT analysis, (c) claimed there were not any relevant standards, (d) did not answer the question, or (e) listed science content curriculum standards. Only Patricia and Brenda identified specific curriculum standards that related to their teaching. With the exception of a few instances, the participants did not address the specific science curriculum standards or science teaching standards that related to the focus of their VAT analysis. The following paragraphs describe how the participants identified standards relating to their science teaching or science curriculum.

When Sarah was asked to discuss any standards that related to her second academic year VAT analyses, she discussed a broad concept related to science teaching, monitoring student understanding. Because she used such a broad focus for her VAT analysis, she had a hard time relating it to standards. Sarah stated "all the standards speak to demonstrating an understanding of a topic and that can be measured by doing an activity correctly" (Sarah, Academic Year VAT Analysis 2 refinement, Clip 3671). She did not identify how the National Science Education Standards (NSES) (NRC, 1996) or any other standards related to her teaching issue of demonstrating understanding. This may have resulted from her lack of knowledge about any teaching standards or the state and national science content standards. She did not receive training on the NSES Science Content or Science Teaching Standards (NRC, 1996) during the professional development course and she may not have had previous training on identifying or implementing the current state standards. While there were not any specific state content standards that she could have selected for her teaching issue, there were national science teaching standards that she could have selected.

Like Sarah, Betty did not list any specific science curriculum or teaching standards in her VAT analyses. Often, she did not see a connection between the issues she focused on and any teaching or content standard. As with Sarah and the other participants, Betty did not received any training on the NSES Science Content or Science Teaching Standards (NRC, 1996). She may also have lacked training in identifying or implementing state science standards. In her third VAT analysis, Betty examined the teaching strategies, such as lack of modeling and providing clear instructions, she used during a science lesson on camouflage. When she was asked, during feedback on her reflective writing, to discuss any relevant teaching or curriculum standards that related to her issue, Betty stated

> I believe that all of the standards present opportunities to model. I don't [sic] think any specifically mention modeling since it is an instructional strategy. I think the Process Skills standards are the most wide open to allow of all types of modeling as well as other hands-on instructional strategies (Betty, Academic Year VAT Analysis 3 refinement)

She did not list any specific teaching standards that related to the focus of her reflective writing but interpreted all content standards as affording teachers the opportunity to model strategies and activities to students. She believed that teachers should take the liberty to use modeling as a strategy while teaching science concepts associated with each standards.

Brenda used the reflection framework question to identify other content standards related to her science teaching issue. In her first academic year VAT analysis, which she stated would focus on students' understanding of science content, she failed to note any science content or teaching standards. Instead, Brenda discussed how Language Arts standards related to her focus. She typed,

> Many of the [state] Language Arts Standards apply to this situation: The student demonstrates comprehension and shows evidence of a warranted and responsible explanation of a variety of literary and informational texts. The student understands and acquires new vocabulary and uses it correctly in reading and writing. The student participates in student-to-teacher, student-to-student, and group verbal interactions. (Brenda, Academic Year VAT Analysis 1).

Brenda concentrated on how her lesson integrated certain language arts standards. She did not always seem comfortable discussing science content or science standards and her comfort level may have been due to her lack of training and knowledge of national and state science standards. Due to her comfort level with the science standards, she often referred back to content and activities she felt more familiar with discussing.

Addressing contradictions between teaching practice and philosophy. It was assumed that the use of video would make it easy for the participants to identify contradictions between their teaching practice and teaching philosophy. The participants, however, did not always identify contradictions in their VAT analyses. The video in VAT allowed teachers to observe their classroom from a different perspective. This perspective often illustrated inconsistencies as well as consistencies between their teaching and their teaching philosophy. The reflection framework explicitly asked them to identify if the focus of their VAT analysis supported or contradicted their teaching philosophy. If they did not address the question at all or entirely during their initial analysis, they were given feedback on their reflective writing that prompted them to respond to this question again. The participants often viewed their teaching practice as mirroring their teaching philosophy. Some stated this view even though the teaching strategies they discussed in their VAT reflection were not always consistent with their teaching philosophy. Not recognizing inconsistencies may have been a result of participants' not revisiting the philosophy of teaching they developed at the beginning of the professional development experience as part of their summer journal entries or it may have been the result of their unwillingness to confront those inconsistencies. In general, the participants struggled with the idea of their practice not being consistent with their teaching philosophy. While some may have noticed contradictions, those participants may not have been in a frame of mind to confront contradictions between their teaching practice and the philosophy of teaching.

Only two participants, Brenda and Betty, were able to identify inconsistencies between their beliefs about science teaching and their science teaching practice. Brenda's response to the reflection framework questions in one VAT analysis illustrated her struggle with her teaching practice contradicting her teaching philosophy. Brenda's third academic year VAT analysis focused on a lesson about speed. While watching video of the lesson, Brenda was shocked at how her practice contradicted her teaching philosophy. She was especially surprised at her use of a teacher-centered lesson. Brenda stated "I contradicted my belief of allowing students to learn themselves while I act as a guide, coach and facilitator. By leading them directly step-by-step through the experiment, I was not acting as a coach and guide" (Brenda, Academic Year VAT Analysis 3). She realized her practice was inconsistent with her beliefs and tried to justify why she contracted her teaching practice. She used two reasons, which were "being videotaped" and "previous experiences with these students", to justify why she contradicted her teaching beliefs. Brenda was adamant about how planning to videotape her lesson influenced her instruction. She typed,

> I really wish I had not led the students directly through all aspects of the experiment. Again, I feel the majority of the reason behind this is due to the videotaping and trying to make sure there was a lesson to evaluate and comment on. I need to remember that even when coaching, guiding and facilitating students, the groundwork has already been laid. The best way lesson or testimony to teaching is that the students are able to continue the lesson without you. In that sense, I robbed myself and the students of that experience

during this lesson (Brenda, Academic Year VAT Analysis 3,)

Although she realized the contradiction, she still felt the need to justify her lesson planning. She believed the videotaping of her science lesson influenced the instruction she provided for her students. Brenda stated that the "lesson definitely was intended to be student centered" (Brenda, Academic Year VAT Analysis 3 refinement,). When asked to elaborate on student-centered activities and lessons she tried to implement, Brenda discussed an activity her students recently completed on Area and that some of her students had problems successfully completing the activities associated with her lesson. Brenda believed her observations of her students completing the Area activity influenced how she facilitated the lesson on speed. She stated

> In my defense, maybe that was why subconsciously I led the science lesson more directly. Students do need [student-centered] activities, but sometimes they need more direction and assistance along the way. This could also be because they have little confidence, due to the fact that most activities and lessons are kept teacher centered . . . . I believe most of math and science should be done as [student-centered] activities where students are discovering the answers and relationships among the various components of the lesson" (Brenda, Academic Year VAT Analysis 3 refinement).

In this excerpt, Brenda noted that she believed students need student-centered activities and science should be taught using student-centered activities. Brenda, however, often implemented teacher-centered activities. She believed the contradiction between her teaching philosophy and her teaching practice were justified. By discussing how the act of being videotaping and her observation of a previous science lesson influenced her instruction, Brenda illustrated the internal struggle she had with her teaching practice contradicting her teaching philosophy.

Discussion

The participants in this study often had problems engaging in the entire reflective cycle. Initially, they focused their VAT analyses on narrating events in the video instead of providing detailed explanation about their science teaching practice. After the introduction of the framework, the participants also had problems discussing standards that related to the focus of their VAT analyses or noting contradictions between their beliefs and teaching practice. They did not explicitly consider standards related to the focus of their VAT analyses or their teaching philosophies as they examine how the focus of their VAT analyses related to their beliefs about science teaching. These issues may have been a result of many influences including, but not limited to, the reflection framework used in this study and the support provided for the participants in completing their reflective writings (e.g. type of coaching needed for reflection). The following sections note the benefits and limitations of the reflection framework and its use with the participants.

Benefits of using the reflective framework as introduced

Even though participants were not able to thoroughly engage in the reflective cycle for each VAT analysis, most were able to face and address issues in their science teaching. A few of the participants even identified situations where their teaching philosophy was supported or contradicted by their science teaching practice. The participants, however, often struggled to reconcile their philosophy and practice when identifying instances in video clips where their

science teaching practice contradicted their teaching philosophy. Participants that were not able to identify inconsistencies between their teaching practice and philosophy of teaching may not have had the time to or chose not to revisit the philosophy of teaching they developed in their summer journal entries. They may have also only wanted to recognize aspects of their teaching practice that were consistent with their teaching philosophy or had a biased understanding of their teaching practices that resulted in them not being able to notice inconsistencies. During their VAT analysis presentations to their peers, the participants may have showcased analyses that would be viewed more favorably by their peers. Social desirability bias (Leite & Cooper, 2010), the notion of portraying certain actions or responses due to them being viewed favorably by one's peers or community, may have been a factor that influenced the participants' reflective writings and VAT analysis presentations. The participants may have identified how their teaching practice supported their beliefs about science teaching instead of contradicted them, in order to present the professional development facilitators and their peers with a positive impression of their teaching. Participants who were not able to identify contradictions, as well as ones who were willing to note inconsistencies, may have been uncomfortable confronting inconsistencies in their teaching beliefs and practice. Participants who recognized the inconsistencies between their beliefs and science teaching practice, however, began to develop an understanding of how their beliefs influenced their teaching practice.

Weaknesses of using the reflective framework as introduced

After the reflection framework was introduced at the beginning of the academic year, the participants used it in different and unexpected ways. Of the four participants, Brenda was the only participant who consistently used the framework as a specific guide to develop her reflective writings. She usually addressed each question in the reflection framework as she analyzed her video in VAT. While the other participants may have used the framework as a guide, they did not completely address each of the framework questions in their VAT analyses. The most common framework questions the participants did not address were: (a) making a connection between the teaching event and a teaching or content standard and (b) addressing beliefs about their issue. There are many reasons why the teachers may have not addressed those questions. For instance, only one of the participants, Patricia, was extremely familiar with state and national standards on science teaching and science curriculum. Even though they were provided with resources, such as the National Science Education Science Content and Science Teaching Standards (NRC, 1996) and copies of their state content standards, they were not provided with instructions on how to use or interpret the standards. The professional development facilitators assumed the teachers had an understanding of both the national and state science standards. Teachers' background knowledge can impact how they use and address framework prompts (Land & Zembal-Saul, 2003). By merely providing copies of the standards and not providing participants with opportunities to discuss the National Science Education Standards (NRC, 1996) or work with peers to interpret the standards, the professional development facilitators may have actually influenced whether or not those standards were used in the participants' VAT analyses. Also, the participants may not have addressed the question about teaching or content standards because of the focus of their reflection. Instead of choosing issues specifically related to science teaching and learning, participants may have focused on a pedagogical issues that related to teaching in general. Hence, they may not have seen the need to connect the focus of their VAT analysis to a specific science standard.

The process of learning to critically reflect on one's practice is a time consuming and intensive process. It is not something that is easily and quickly enacted. These factors, coupled with the multiple responsibilities and time limitations of teachers, make it hard for practicing teachers to take time to engage in reflection and focus on singularly or narrow issues of practice. The participants in this study often looked at large general issues of practice and were not able to focus solely on one narrowly define issue of teaching. Even with the introduction of the reflective framework, the participants in this study still struggled with the ability to critically examine their science teaching practice. The framework allowed them to begin examining their practice but it did not support them in becoming autonomously critically reflective about their practice. It did, however, begin to help them think about their teaching in ways that were not explicitly evident from their summer reflective writings. It provided them with a forum for and an awareness of reflection. The framework alone was not enough to encouraged teachers to critically engage in their teaching practice. They need coaching on how to reflect on one's practice and how to make connections among their teaching beliefs, their teaching practice and standards for teaching and learning.

Through the participants' use of the reflection framework, some specific limitations of the framework design were identified. One limitation of the reflection framework was its location. Although the framework was provided to the participants in both paper and digital form, it was not uploaded into VAT. Having the format uploaded into VAT would have made it readily accessible to the participants while they were developing their VAT analyses. A second limitation of the reflection framework was its format. The framework was not developed in a form that was easily embedded into the VAT system. The reflection framework was a set of questions, which asked participants to examine an issue of their teaching practice. By refining the format of the reflection framework into a rubric, the framework could have been easily embedded into the system. Often, the participants did not address all of the questions. This could have been a result of the two limitations listed above or a third limitation, the type and phrasing of questions used on the framework. The open-ended questions on the framework were developed for the participants to use for their academic year VAT analyses. The questions may have been too time consuming to address for each VAT analysis. Being that they were already viewing their video in VAT in addition to their normal teaching responsibilities, the time they had to adequately respond to the open-ended framework questions may have been limited. This may have resulted in a decreased motivation to address the framework questions or the participants choosing to not address a specific question or not addressing a question thoroughly. Additionally, the participants may have made a minimal or quick attempt to complete their VAT reflections for the professional development meetings.

A fourth limitation of the implementation of the framework was the need for additional coaching. The framework alone did not encourage critical reflection on their practice. Participants needed more support than the prompts provided in the framework. In order to support participants in thoroughly answering all of the reflection framework questions, they needed more feedback from the professional development facilitators on how to interpret and respond to the framework questions. They also needed the professional development facilitators to assist them in thinking deeper about issues that arose in the classroom and how they could categorize them. The participants did not receive training on using the framework but were expected to use it to analyze their videotaped science lesson in VAT. When participants analyzed

the videos in VAT, they were provided with feedback on their VAT analysis via email in Word document and via phone. The feedback focused on prompting the participants to respond to any questions that they did not thoroughly address or respond to at all. After feedback was provided to them, the participants were encouraged to return to VAT and refine their VAT analyses. The process of refining their VAT analyses required coaching from the researcher. As Schön (1987) noted, "The student cannot be *taught* what he needs to know, but he can be *coached*" (p. 17, italics in original). While the professional development facilitators, attempted to provide support to the participants via feedback on the participants' reflective writings, their feedback was not enough to adequately support the participants' examination of their teaching practice and use of the framework. The participants needed more than direct instruction on the process of reflection and reiteration of the framework questions during coaching. Coaching the participants by providing them with feedback on their reflective writings and reiterating prompts that were not addressed did not necessarily further the participants' understanding of how to engage in reflection. They needed coaching on how to narrow the focus of their reflection and how to relate it to standards of science teaching and the beliefs they hold about teaching and learning. The professional development experience provided an introduction to reflection, instruction on how to analyze video in VAT, and a very brief discussion about the reflection framework. Without additional coaching, however, the participants were not able to analyze their teaching practice thoroughly in their VAT analyses. Through individual coaching, the participants would be better able to examine their science teaching, address all of the questions in the reflection framework, and elaborate on or clarify statements they made in their initial VAT analyses. Better feedback would have provided them with an understanding of their abilities to implement various strategies or materials and helped direct their development of knowledge about their teaching practice (Luft, 2001).

Participants may have also responded differently to the reflective framework questions if they had been introduced to the framework during the summer workshop. They were only provided with the framework during the academic year. While they had more practice with VAT due to its introduction in the summer, the participants were not as familiar with using the reflection framework. Significant amounts of time should be provided for teachers to practice with science teaching approaches and materials (Rosebery & Puttick, 1998). Having additional time with the framework may have provided the participants with a deeper understanding the framework questions and opportunities to interpret them with their peers and professional development facilitators. This may in turn have encouraged them to thoroughly address each component of the reflection framework.

After the introduction of the framework in the fall, the depth and length of the participant's VAT analyses increased. This depth and increase in length, however, may not have been entirely due to the introduction of the reflection framework. During the summer workshop, the participants were reflecting on lessons that they co-planned and co-facilitated with a partner. Participants may have changed the way they taught their science lessons as well as reflected on their science during the summer. Reflecting on a lesson they co-developed and co-facilitated with a partner or taught in an extremely different form from their normal teaching practice may have influenced the participants' reflective practice. It was evident from one of Betty's journal entries that she changed her teaching practice (i.e. did not move around as much as she usually does) to collaborate with the other teaching during a co-taught lesson. Additionally, when

analyzing their videotaped lessons, the participants had to attend to additional distractions (i.e. viewing another teacher's teaching practice), uneasiness with reflecting on a team-taught lesson, or social undesirability bias. They also may not have wanted to critique a lesson partially planned and taught by a peer. Being uncomfortable with reflecting on other's teaching practice could have also impacted the participants' reflective writings.

Summary and Implications

The introduction and use of the reflection framework presented participants with the opportunity to examine or revisit issues of their teaching practice. They used their previous knowledge of students and their teaching practice to guide the focus of their reflective writings and support the identification of issues of practice and development of explanations. Through their development of reflective writings, participants began to engagein the reflective process of naming and framing issues of practice (Schön, 1987). The complex nature of reflection and science teaching, however, was demonstrated in the participants' inability to critically use in reflective practice without substantial scaffolding.

While the participants used the reflection framework to guide their development of their reflective writings in VAT, the implementation of the framework did not provide the participants with adequate coaching to support the participants in thoroughly reflecting on their practice for each VAT analysis during the academic year. The participants' reflective writings were not always focused on specific science teaching issues and did not always use the framework as intended by the professional development facilitators. Yet, they were still able to begin engage in reflection by examining issues of teaching in general or identify problems in their science teaching. Additionally, the framework prompts sometimes supported the teachers in examining their science teaching and developing explanations about science teaching issues. These findings indicated the need to be intentional in engaging and supporting practicing science teachers to reflect on their teaching. Specifically, professional development facilitators need to be intentional in the selection and implementation of tools and coaching they provide to practicing teachers as they support them in reflecting on their teaching practice.

Many different tools have been used to assist teachers in their development of reflections on their teaching practice. The use of reflection frameworks is just one method for support teachers in examining their teaching practice. Teachers and teacher educators have utilized framework prompts for journaling to videotape reflection to engage teachers in reflective practice. Frameworks used with video support teachers in identifying, collecting, and recording evidence of teaching. Teachers' examinations of science teaching videos allow them to stop and look at teaching by creating opportunities for constructive criticism of their own or other's practice (Rosebery & Puttick, 1998). The design and implementation of reflection frameworks used to guide video analysis of science teaching videos can play a large role in how effectively participants use them to reflect as evident in this study. The reflection framework used in this study was able to help teachers begin to focus on reflection but critically examine their science teaching. While the idea of using frameworks is not unique, this framework was developed with the intent to engage teachers in critically examining one issue of practice within VAT as they analyzed their teaching. It was also developed with the understanding that teachers can use it with video outside of VAT if they choose to reflect on their teaching after the professional

development experience. Although the participants did attempt to use components of it as they reflected during the academic year, it did not engage them in deeper level thinking about teaching and learning.

While the use of the reflection framework had some benefits, such as supporting teachers in identifying inconsistencies in their teaching practice and helping them explicitly discuss their beliefs about science teaching, there were also disadvantages to the use of this tool in combination with VAT. The use of the reflection framework when creating reflective writings in VAT was time intensive. The teachers had to take time to both respond to the open-ended questions on the reflection framework and view video of their teaching practice in VAT to develop their reflective writings. The reflection framework was also not in a format that was easily (a) accessible (i.e. not embedded in VAT) to participants when creating their reflective writings in VAT or (b) completed due to the open-ended questions.

To thoroughly support teachers' use of frameworks, like the reflection framework used in this study, more research needs to be conducted on the format and language used in reflection frameworks. Researchers need to identify frameworks that will support teachers' critical examination of their teaching practice and development of reflective writings, yet require minimal coaching. Teachers do not always have a reflective coach to support their reflection on their science teaching and need frameworks and tools that provide some coaching support. Research also needs to examine how embedding frameworks in video analysis tools, such as VAT, can support teachers' reflective practice and reduce the amount of time necessary to analyze video of their teaching. Due to time constraints they have during school hours, teachers need tools that are easily accessible and do not require an inordinate amount of time. While the reflective framework used in this study needs refinement and was not always used as suggested, it did provide participants with a way of examining their science teaching practice and encourage them to more closely examine their teaching video. It helped the participants begin thinking about a component of teaching that is crucial to their success, reflective practice. Additionally, it helped them attempt to engage in some aspects of the reflective cycle as they examined their own science teaching practice.

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