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Studying Music Teachers' Awareness of Students' Musical Thinking through Video Stimulated Recall Techniques

Summary

This article examines the strength of stimulated recall methodologies as a means for capturing teachers' awareness of student thinking. First, I address the nagging validity questions associated with stimulated recall techniques. Second, using Schön's (1983) framework of reflection-on-action and reflection-in-action, I turn to general education research to differentiate between studies that use stimulated recall techniques to gather teachers' retrospective points of view with those studies that seek to access teachers' immediate reactions to students' thinking and learning. In order to understand the differences between these approaches, I review the video technology and interviewing techniques used by researchers to meet their goals. I examine the advantages and challenges of archival and point-of-view video cameras as well as collaborative annotated video programs. Finally, I consider music education research studies that have used video stimulated recall techniques to study teacher thinking on student thinking, as well as implications for future music education research.

Keywords*: stimulated recall, video, validity, teacher awareness, teacher noticing, student thinking*

1. Introduction

Video stimulated recall techniques have been used for years in qualitative research, and widely in music education research to access teacher and student thinking in music teaching and learning (Ankney, 2014; Barrett & Rasmussen, 1996; Burnard, 2004; Mellor, 2008; Miksza & Austin, 2010; Odena, 2001; Powell, 2014; Rowe, 2009). Stimulated recall is useful when capturing "particularly complex, interactive contexts" within naturalistic settings (Lyle, 2003, p. 861). More recently, researchers in the field of education have been interested in using adapted stimulated recall techniques to examine teachers' ability to reflect in detail on student thinking. Through the latest advances in video technology, researchers are studying how teachers see and develop awareness of student thinking such as what processes they use to solve problems (Pea, 2006; Sherin, Russ, & Colestock, 2010) by observing their *reflection-on-action* and their *reflection-in-action* (Schön, 1983). Comprehensive profiles of teachers' actions and behaviors in response to students (Meijer, Verloop, Beijaard, 2002) are being developed due to advances in video camera and software technology, as well as varied approaches to interviewing techniques. In pursuing an understanding of teachers' awareness of student thinking, researchers are attempting

to not only understand what teachers see, but how and why they respond to students. These findings are being used in preservice curricula and professional development opportunities to better understand and refine teachers' responsiveness to students' needs (Borko, Jacobs, Eiteljorg, & Pittman, 2008; Goldsmith & Seago, 2010; Rodgers, 2002). Researchers have referred to their inquiry into teacher awareness of student thinking as observing a teacher's *situation awareness* (Endsley, 1995; Miller, 2010), *interactive cognition* (Mejer, Verloop, & Beijaard, 2002), or as their ability to *notice* student thinking (Sherin, Colestock, & Russ, 2010). Regardless of the terminology used, a consistent method utilized for understanding teacher awareness of student thinking is stimulated recall through video technology.

In this paper, I address the strength of stimulated recall methodologies that use video as a means for capturing teachers' awareness of student thinking. First, I begin by addressing the nagging validity questions that often belie stimulated recall methods. Secondly, using Schön's (1983) framework of *reflection-on-action* and *reflection-in-action*, I turn to math and science education research to differentiate between studies that use stimulated recall techniques to gather teachers' retrospective points of view with those studies that seek to access teachers' immediate reactions to students' thinking and learning. It is helpful to reflect on this research outside of music education, because math and science education researchers have developed research techniques for observing and refining teachers' abilities to recognize student thinking within their respective disciplines. In order to understand the differences between studies that take a reflection-on-action versus a reflection-in-action approach, I review the video technology and interviewing techniques used by researchers to meet their goals. Finally, I consider music education research studies that have used video stimulated recall techniques to study teacher thinking on student thinking, as well as implications for future music education research.

2. Validity Issues Associated with Video Stimulated Recall

When using stimulated recall to investigate teacher thinking, the method "generally involves the replay of a videotape or audiotape of a teacher's lesson in order to stimulate a commentary upon the teacher's thought processes at the time" (Calderhead, 1981, p. 211). Researchers have also studied teachers' reflective abilities using video from other classrooms in order to elicit teachers' interpretations of student thinking (Borko, Jacobs, Eiteljorg, & Pittman, 2006; Hennessy & Deaney, 2009; van Es & Sherin, 2008). Such variations on stimulated recall seek to elucidate teachers' tacit knowledge on a subject or setting in which they themselves have similar teaching experience. While stimulated recall is advantageous for triggering a participant's memory and or for seeking participants' complex thinking on a naturalistic setting, there are a number of validity issues that need to be addressed. Lyle (2003) explains that some of the concerns include: "immediacy of the recall, the memory accessed by the video image, the extent of the incursion into tacit knowledge, the potential for secondary ordering of the cognition, and the potential for bias in the responses (p. 871)."

Despite these challenges, researchers have found that stimulated recall techniques offer rich perspectives on individuals' cognition and because of this have sought ways to increase the validity of the methodology. Procedures used to increase validity include limiting the time lapse between videotaped lessons and interviews (Kane, Sandretto, & Heath, 2004; Lyle, 2003;

Sherin, Colestock & Russ, 2010), collecting other data sources to triangulate findings within stimulated recall interviews including such data as background interviews, archival classroom material, and participant self-assessments (Kane, Sandretto, & Heath, 2004; Meijer,Verloop & Beijaard, 2002), and the development of video technology that accesses teachers' in-the-moment cognition (Miller, 2010; Sherin, Colestock, & Russ; 2010).

Yet, not all researchers are interested in gaining access to teachers' in-the-moment cognitive perspectives as they teach in the classroom. Researchers are also interested in studying teachers' reflections on student thinking as well as their aptitude for monitoring student thinking. They have even built professional development curriculums around stimulated recall activities to monitor changes in teachers' thinking (Hennessy & Deaney, 2009; van Es & Sherin, 2008). These professional development opportunities are for teachers of all ages and experience levels and often last throughout the school year giving researchers the ability to study the impact of variations in stimulated recall techniques on teachers' professional vision (Borko, Jacobs, Eiteljorg, & Pittman, 2008; Goldsmith & Seago, 2010; Schepens, Aelterman, & Van Keer, 2007; van Es & Sherin, 2008). Researchers have also gone so far as to create communities of practice (Wenger, 1998) where the teachers are co-researchers in the analysis of their video data (Hennessy & Deaney, 2009).

If stimulated recall procedures utilizing video are so variable in nature, and have unique validity issues, what determines how and why they should be used used? Calderhead (1981) explains that "what counts as an appropriate explanation to the researcher depends upon the model which the researcher adopts or constructs, which may in turn depend upon the purposes of the research" (p. 215). Therefore, while many researchers may be interested in understanding the teachers' awareness of student thinking, their research is directed by their different purposes. Some researchers go about collecting data that is far more focused on teachers' ability to *reflect-on-action,* such that the researcher observes the "inquirer criticize and restructure his (or her) intuitive understandings" (Schön, 1983, p. 277) of a teaching moment. And yet, there are those researchers who want to come as close to the teaching moment as possible to understand teachers' *reflections-in-action* where they experience "surprise, puzzlement, or confusion in a situation which he (or she) finds uncertain or unique" (Schön, 1983, p. 68). Therefore, a thorough examination of the strength of stimulated recall procedures can never be separated from the aims of the research itself. It is this principle that will guide further discussion.

3. Capturing Reflection-on-Action

Researchers interested in understanding how teachers reflect on student thinking have access to powerful technological tools that go beyond the standard point and shoot capabilities of video cameras. For instance, Pea (2006) and his colleagues at Stanford University have developed video and software technology in their DIVER project that allows teachers not only the ability to see their classroom as a 360° panoramic vista, but to also focus on any point of the classroom for further investigation and commentary. The software that accompanies the camera was initially developed to eliminate perspective bias on the classroom which happens when only one video camera records a limited view of classroom interactions. The software also enhances va-

lidity in research findings by allowing several teachers and researchers to analyze multiple perspectives of the classroom in order to build an accurate interpretation of thinking and learning as it unfolds.

DIVER software works hand in hand with the video technology in a two step process. First, five cameras and five mirrors are placed carefully around the classroom, while sound is recorded on multichannels using a microphone array. The images captured by the video are then stitched together to give a panoramic classroom view. Secondly, the DIVER software then translates the video footage into a *virtual camera* interface from which researchers and teachers can zoom in on any portion of the classroom to watch, listen, and comment upon what they see. Thus, the *virtual camera* "obviate(s) the need to make real time decisions about what is 'important' to shoot" (p. 20). The annotations of the video, or the DIVE, are then recorded into a WebDIVER server where researchers or participants can access commentary and clips. The software provides a platform for what Pea (2006) calls *guided noticing* which is a "fundamental human capacity of referring and (can serve as) the establishment of shared attention" (p. 10). This technology can be used for a myriad of research interests, but offers incredible possibility for engaging teachers in stimulated recall interviews on teachers' awareness of student thinking. It also provides teachers the opportunity to observe interactions retrospectively that they were not able to notice while the lessons were actually taking place. DIVER, as well as other video annotation programs such as Transana and Constellations, are powerful programs for engaging teachers and researchers in detailed analysis of video and can operate as vehicles for collecting and categorizing their analysis.

Other video annotation tools such as Edthena, VAST, VITAL, VAT, VideoTraces, VideoPaper, MediaNotes, and StudioCode (Rich & Hannafin, 2009) as well as Vialogues allow teachers the opportunity to select their own clips, write comments on the teaching episode, and share their experiences with others for discussion in professional development communities as well as for research. While these programs do not offer the sophisticated *virtual camera* of DIVER, the annotation software provides an interface for monitoring the reflections of multiple teachers and for providing researchers tools for interrogating teachers' thinking on student learning. These tools are used in preservice programs (Halter, 2006; Rich, Recesso, Allexsaht-Snider, & Hannafin, 2007; Trier, 2003) as well as in researchers' investigations of teachers' reflective abilities (Bryan & Recesso, 2006; Collins, Cook-Cottone, Robinson, & Sullivan, 2004, Powell, 2005; van Es & Sherin, 2002). For example, Sherin and van Es (2005) used VAST while studying math teachers' noticing of math lessons in video clubs. Over time, Sherin and van Es found that participants became more astute at selecting and noticing clips with student thinking.

However, one concern that must be considered when selecting video annotation software for stimulated recall is the amount of time that lapses between the selection and upload of video clips until the actual interview with the teacher (Rich & Hannafin, 2009, p. 63). This perhaps interferes with the validity of teachers' reflections particularly in studies that are focused on teachers' in-the-moment perspectives. However, if researchers are more concerned with documenting teachers' knowledge and beliefs on thinking and learning, the lapse in time may not be as much of a concern. The video archiving capability of these annotation programs is also useful for researchers that seek to stimulate teachers' perspectives on student thinking from video clips from classrooms other than their own.

3.1 Interview Procedures

An integral part of using sophisticated recording and annotation technology for stimulated recall is the researchers' ability to direct teachers' attention to specific clips for discussion. Video annotation technologies as well as simple shoot and capture recording devices must be accompanied by interviewing techniques that focus teachers' reflections on classroom interactions in a way that exposes their perceptions and beliefs on student thinking. The purpose of a researcher's work (e.g. preservice education, professional development, categorization of cognition) as well as the ongoing interaction with the participant plays a significant role in how one goes about shaping his or interview procedures.

Studies focused on teachers' development of *reflection-on-action* are often centered around professional development and preservice teaching programs. Borko, Jacobs, Eiteljorg, and Pittman (2008) developed the Problem-Solving-Cycle (PSC) model for professional development of mathematics teachers. The goal of the professional development cycle was to address innovative approaches to mathematical problem-solving, and to also move teachers' focus from themselves to students' mathematical thinking. Teachers were recorded in their lessons with one camera focused on the teacher, and another on a group of students. Facilitators then selected clips for group discussion at the PSC workshops. All workshop discussions were recorded and analyzed to determine developments in the teachers' reflections over time. Researchers categorized the content of conversations as focused on either "(a) teacher's thinking, (b) students' thinking, (c) pedagogy, [or] (d) mathematics" (p. 425). Facilitators in the discussions played an important role in setting up, focusing, and following the group's discussion of video clips. During sessions focused on understanding teachers' perceptions of students' mathematical thinking, facilitators asked questions such as, "*What evidence of student learning can you see in this clip? Can you try to get inside the kid's head?"*(p. 430). Such questions led the group into deep analysis of students' thinking which illuminated the level of sophistication in teachers' reflections. Over time, the researchers found that teachers were able to reflect more productively on students' thinking and learning, but that accessing this type of thinking was also likely related to "increasingly focused and challenging facilitation" (p. 432).

Goldsmith and Seago (2010) also describe the importance of a facilitator in drawing out teachers' reflections on student thinking. The researchers studied the effect of the Learning to Teach Linear Functions (LTLF) program by administering pre and post-test analyses of teachers' reflections on student thinking among professional development and non-professional development participants. They found that participants in the treatment group were far better at using evidence to back their claims on student thinking, and were more apt at identifying students' potential thinking for linear functions. However, throughout the study Goldsmith and Seago explain that interview methods of teachers' awareness of student thinking played a vital role. The researchers

> expected that teachers would tend to use artifacts (video) as bases for discussing their own experiences and opinions instead of as data sources to be analyzed and explored. For this reason, they (facilitators) both actively guided and supported teachers in identifying evidence from artifacts to support claims about students' mathematical thinking. (p. 175)

Researchers had to pursue a direct line of inquiry into teachers' awareness of student thinking in order for conversations to be productive for the study. Had the researchers not redirected teachers' focus, they may not have been able to identify what teachers actually saw in students' thinking. This example clearly demonstrates that the purpose of a study directly affects the interviewing procedures associated with video technology.

Finally, another pertinent issue effecting interview procedures is who controls the selection of clips for discussion. In studies seeking to understand teachers' reflections-on-actions, participants or researchers may be given the authority to select clips from the complete video recording. van Es and Sherin (2008) gave participants in their video clubs the opportunity to select clips for group discussion. After teachers made their initial selections, and shared them with their professional development community, the facilitators observed the direction of teachers' noticing and redirected conversation as necessary. However, the decision to allow teachers the opportunity to select their own clips is likely effected by the length of the study, the video technology used, the time given for interviews, and the overall objectives of the study. As we saw in Borko et al. (2007) and Goldsmith and Seago (2010), researchers may also select video clips and play a more direct role in guiding teachers' discussions on student thinking.

4. Capturing Reflection-in-Action

With advances in technology, researchers are coming closer to teachers' in-the-moment classroom thinking. Researchers interested in using these new technologies are not only concerned with improving the validity of their findings, but are truly curious about teachers' ability to notice students' thinking (Miller, 2010; Sherin, Russ, & Colestock, 2010). Meijer, Verloop, and Beijaard (2002) refer to this also as teachers' *interactive cognition,* and it is the dynamic and complex interplay that unfolds between teacher and student as they negotiate meanings and actions based on classroom activities.

Using a wearable archival camera, Sherin, Russ, and Colestock (2010) studied teachers' interactive cognition by observing what teachers noticed in math and science students' thinking. Wearable archival cameras are most commonly seen in extreme sports, as athletes try to capture their point-of-view during athletic events. While there are number of wearable archival cameras available on the market, Sherin et al. used the Deja View CamWear 100, which clipped on either a pair of glasses or a baseball cap and had a recording mechanism attached to the teacher's waist. Teachers held a remote control in their hand that enabled to control when they wanted the camera to record. Teachers then used the small one inch camera to record interesting moments in response to the following prompt: "*Press the record button on the camera when something interesting happens in class, when something seems interesting to you*" (p. 83). When the teacher pressed the save button, the previous 30 seconds of classroom interaction were saved as a separate file. The participants were able to capture a limitless number of interesting moments in their teaching, but on average saved 18 segments per hour of instruction. The researchers then reviewed the segments with the teachers in the same school day using an open conversational interview technique.

Sherin et al. (2010) were able to collect thick descriptions of interesting moments from the teachers' retrospective description, the video clip itself, and their observations during the classroom interactions and interviews. By triangulating the data in such a manner, the researchers

found that "teachers [were] aware both of having noticed events in class and of their thinking about those events" (p. 85). Sherin, Russ, and Colestock suggest that the teachers are able to distinguish between two levels of awareness—one that occurs in-the-moment with one that is more metacognitive and reflective in nature. Therefore, the strength of this methodological approach not only lies in its ability to access teachers' *reflection-in-action* but also their *reflection-on-action*. The approach also gave researchers a close glimpse of teachers' many different types of thinking on student thinking. Researchers were able to see what teachers deemed important, such as a student response that indicated progress in a student's thinking, or an interesting approach used by a student for problem-solving. Sherin et al. then sought to categorize this thinking in order to understand the types of student thinking that were most visible to teachers. Perhaps the strongest implication of this research is that it allowed researchers to see how well students were or were not meeting teachers' "expectations for the lesson" (p. 90).

However, while the wearable archival camera offers many exciting research possibilities, Sherin et al. (2010) advise that the camera should not be used alone to capture data on teachers' awareness of student thinking. The camera poses some infringement on the natural day to day thinking of teachers. Some teachers indicated that there was a change in their teaching as result of wearing the camera. Because of this, Sherin et al. recommend that researchers should also collect data with other methods such as think alouds, researcher selected stimulated recall interviews, clips from other classrooms, and researcher observations of the teacher in the classroom.

In addition to wearable archival video cameras, eye-tracking systems offer another promising approach to monitoring teachers' interactive cognition. Eye-tracking systems have long been used in marketing, psychology, and cognitive research, but have only been recently used in educational research on teachers' cognition. Miller (2010) is in the process of using a mobile eye-tracking system that places a camera in front of the teacher to capture the direction of his or her gaze, and another to capture the interactions in the classroom. The images are then superimposed upon each other to plot diagrams of teachers' noticing (pp. 60-61). These visual diagrams, along with close observation of classroom interactions, offer another promising method for studying teachers' awareness of student thinking.

4.1 Interview Procedures

When interviewing teachers about their interactive cognition, it is important for researchers to get participants to distinguish between their in-the-moment thinking with their reflections on thinking. This is consistently seen across the research whether using newer technologies, or more traditional stimulated recall methods (Kane, Sadretto, & Heath, 2004; Odena, 2001; Schepens, Aelterman, & Van Keer, 2007; Sherin, Colestock, & Russ, 2010). For instance, Sherin, Colestock, & Russ (2010) went through a three stage process with participants: (1) teachers had to explain their experience with the wearable archival camera; (2) they had to describe the teaching moment itself; and (3), they had to decide whether the clip had captured what they intended to capture (p. 84). The third step of this process allowed participants to distinguish between their interactive cognition and reflections on the clip itself.

In approaches using more traditional stimulated recall approaches, researchers listen carefully for participant statements during interviews to determine whether participants are able to reflect-in or reflect-on the teaching moment. Schepens, Aelterman, and Van Keer (2007) were

interested only in comments made by their participants that referenced their interactive cognitions. Comments such as "I was thinking," and "I thought" signified in-the-moment thinking, and were followed by a researcher question such as "were you able to relive what you thought or felt during teaching by means of the video recordings? (Schepens, Aelterman, & Van Keer, 2007, p. 463). Schepens et al. used standard video cameras to capture teachers' interactions, but their careful interview and analysis allowed them to differentiate between reflection-in-action and reflection-on-action.

Kane, Sandretto, and Heath (2004) were interested in the differences between what university teachers said about their teaching, in comparison to their actual teaching. In other words, the researchers were looking for differences between teachers' knowledge and beliefs about teaching with their actual in-the-moment cognition. The researchers began their stimulated recall interviews within 14 to 48 hours of the teaching episode, and always allowed the teacher to first comment on their objectives for the lesson. Once the objectives and goals of the lesson were explained, the participant could stop the video at any time in response to the following prompt:

> Now you're going to walk me through the lecture and tell me what was going on in your mind at the time. Try to distinguish between thoughts you had at the time and thoughts that you're having now as you watch the tape and make me aware of those differences. You can stop the tape as often as long as you need to explain your thinking (based on Marland 1984). (Kane, Sandretto & Heath, 2004, p. 291)

Research indicates that the explicitness of Kane et al.'s (2004) prompt may be necessary in order to get teachers to focus on student thinking in-the-moment (Sherin & van Es, 2005; Rodgers, 2002). Rodgers (2002) found that even teachers who engaged in lengthy professional development seminars had difficulty focusing on student thinking rather than themselves. Using a four phase process, Rodgers asked teachers to work on being present, describing, analyzing and experimenting on teaching moments. However, in the description phase, Rodgers worked to get teachers to "slow down and see, and to notice when they [were] jumping to conclusions" (p. 240). Rodgers' experiences with teachers are a strong reminder of the role that a facilitator or interviewer plays in guiding teachers to describe student thinking.

As one can see, interview techniques for studies on teachers' interactive cognition are not something that can be haphazardly put together. If a researcher intends to access teachers' interactive cognition, clear instructions and boundaries are necessary in the course of the interview itself. It may also be necessary for a researcher to explain or model the difference between describing the teaching moment itself, as compared to reflecting on a teaching episode based on one's knowledge and beliefs.

The approaches used to capture and interview teachers about their *reflect-in-action* does not guarantee that a researcher will not hear about a teacher's beliefs about a teaching and learning situation. Instead, the procedures described here are used to minimize that possibility and help teachers focus on objectively describing what was noticed in student thinking and how they responded. It is up to the researcher to filter through the differences in teachers' descriptions and to undertake the procedures that best access teachers' perceptual acuity if they are most interested in describing a teacher's ability to notice student thinking.

5. Frontiers for Music Education

While music education research has utilized stimulated recall methods with video in a variety of studies (Barrett & Rasmussen, 1996; Burnard, 2004; Mellor, 2008; Odena, 2001), the field has done less to utilize these techniques for research on music teachers' awareness of student thinking. However, several studies offer promising directions for research in our field. For instance, Burnard (2004) investigated the differences between descriptions of learning between a teacher and students in an eighth grade general music classroom. The researcher conducted stimulated recall interviews with video captured from that day's classroom activities. The teacher and student participants then separately identified "critical incidents" of learning that occurred. Burnard found that the teacher identified and described learning quite differently from the students. The teacher's descriptions of learning centered on *learning as evidenced by teaching*, such that the teacher described *what* was to be learned and *who* was learning based on her prior experiences. However, students were far more focused on *when* learning was occurring and *where* learning was occurring in the classroom. Students displayed the ability to describe the learning in-the-moment between individuals and content, whereas the teachers' comments were centered on the achievement of lesson plan goals. Burnard concludes that using video in the classroom is a powerful tool for music teachers to hear and perhaps better understand students' learning experiences. However, she views her stimulated recall method as more of a collaborative classroom tool, rather than a powerful research methodology. I would argue that many of her techniques could be used to harness and develop research and training of teachers' awareness on student thinking.

Odena and Welch (2007) used stimulated recall to investigate teachers' perceptions of creativity in the secondary general music classroom. After several standard interviews on teachers' educational backgrounds and their aims in teaching composition, Odena and Welch conducted one stimulated recall interview with researcher-selected video clips that were drawn from between 3 to 5 hours of footage from the teacher's classroom. The clips were meant to elicit teachers' perceptions of creativity in the classroom. The interviews were reflective and open in nature, and were not focused on teachers' in-the-moment cognition. Odena and Welch's procedures illuminated teachers' reflections-on creativity, and were appropriate for their research aims. The researchers concluded that teachers described creativity in terms of the pupil, environment, process, and products, and that the most influential aspect of their backgrounds on their perceptions of creativity were the teachers' own musical experiences.

Powell (2014) investigated the teaching concerns of pre-service teachers in peer-and field-teaching settings during a one-semester instrumental methods course. Using the Fuller and Brown (1975) model for teacher concerns, Powell analyzed pre-service teachers' comments concerning themselves, teaching tasks, and student impact.

Powell's study is particularly appropriate for discussion, because he was interested in whether 12 preservice teachers could observe student issues during teaching episodes. Stimulated recall interviews were used to access preservice teachers' reflections-in-action. Powell limited the amount of time passed from preservice teachers' teaching experiences to the interviews to no more than 48 hours. This was done to limit lapses in memory and reordered descriptions of actual events. As teachers watched the videos, they were allowed to stop the video when they wanted to comment on any concerns within the teaching environment.

Powell found that the preservice teachers spent very little time focusing on student impact concerns during peer-teaching experiences but instead mainly focused on themselves and ongoing teaching tasks. During field experiences, pre-service teachers focused more on student impact concerns, but it was still the least noticed category compared to teaching tasks and self-teaching concerns. Powell's findings suggest that field-experiences rather than only peer-teaching experiences are important in developing preservice teachers' ability to focus on student impact concerns while teaching.

Miksza and Austin's (2010) study differs slightly from other studies because their participants were high school students engaged in a college recruitment program for music education. Eleven high school band students partook in a collegiate mentorship and band education program that involved middle school band teaching opportunities. The program was designed for participants to gain a sense of what it was like to be a music education major and music teacher.

In the interview segment of Miksza and Austin's study, they used video stimulated recall techniques to access high school participants' thoughts and feelings on their teaching experiences with the middle school students and the development of their teacher identity. Participants participated in three video stimulated recall interviews and each interview happened a week after the original teaching experience. Researchers allowed the participants to stop the video when they saw something in the video that helped them recall the teaching episode. In the first interview participants were asked to simply explain what they were doing and feeling at stopped selections, but in interviews two and three the interviewers guided participants to discuss what they noticed about the students in the video.

Due to the time lapse between the teaching episode to the interview itself, and the design of the questions, Miksza and Austin likely received participants' *reflections-on-action* rather than *reflections-in-action*. This is appropriate considering that Miksza and Austin were most concerned about eliciting "participants' perceptions, changes in thinking [over the interviews], sense of personal improvement, and sense of teacher identity" (p. 10). Miksza and Austin were less concerned with participants' abilities to notice certain types of events, or moments that caught participants off guard in the moment of instruction.

Ankney's (2014) study on master jazz teachers' ability to notice student thinking during improvisation activities is an example of music education research focused on teachers' interactive cognition. Ankney outfitted three secondary-level jazz teachers with V.I.O 1.5 point-of-view (POV) cameras. Similar to the set-up in Sherin, Russ, and Colestock's (2010) study, teachers wore the camera lens on a baseball cap, the recording module on their waist, and they held a remote control in their hand. The POV camera captured a view of the classroom from the teachers' perspective. There was also a free-standing video camera placed in an unobtrusive location to capture all classroom interactions, and the researcher observed rehearsals. Teachers were instructed by the researcher to click the remote control when they noticed events that seemed interesting in the teaching and learning of improvisation. The prompt was purposefully very general to determine how often teachers noticed students' thinking in improvisation activities.

The V.I.O. camera offered flexible recording options. The camera could not only save small clips of interaction in the classroom, but had a continuous loop option. The continuous loop setting was selected in this study because it enabled the researcher to have one video file of an entire rehearsal and a separate text file that indicated at what times the teachers clicked the remote

control. These teacher-saved moments were referred to as tagged events. The three teachers were each observed for five rehearsals while wearing the V.I.O. camera.

Immediately following classroom observations, the researcher uploaded the continuous video file and tagged events file to a computer. These tagged events became the focus of the stimulated recall interviews. Stimulated recall interviews happened immediately after observed rehearsals to ensure that teachers would be able to recall what they were thinking in the moment of instruction. Participants watched the tagged events and described what they noticed while teaching and why they tagged the moment. Opening interview and final closing interviews were also conducted on a separate occasion to understand teachers' backgrounds and teaching approaches as well as determine whether wearing the V.I.O camera changed their teaching practices.

Combined, the teachers saved 193 events. However, 43 of these tagged events were not related to students' during improvisation activities. Despite efforts to minimize lapses in teachers' memory there were a few instances where teachers could not recall why they tagged an event. At other times, they tagged an event because they were focused on their own pedagogy. However, these master teachers had described 150 tagged events where they were focused on students during improvisation activities.

Findings revealed that teachers noticed students' knowledge and skills, musical awareness, interactions, social and emotional development, and expressivity as well as whether students' actions aligned with their teaching goals. Teacher descriptions revealed that they did not believe a student could musically interact with others if the student did not have the foundational knowledge and skills for jazz improvisation as well as the musical awareness to hear and recognize what others were playing. This was a significant finding since previous research on improvisation achievement had not considered the interactional skills of students in overall improvisation achievement (Palmer, 2013; Watson, 2010). The researcher also found that teachers' used a variety of techniques to respond to students including giving technical or compositional critique; providing organizing metaphors; asking awareness, knowledge, or comfort questions; or giving procedural direction or factual information. Each teacher's noticing and responses were dependent upon their overarching, rehearsal, and or in-the-moment teaching goals.

The POV camera and immediate interviewing procedures in this study enabled the researcher to come as close as possible to the teaching moment to understand how master teachers saw and responded to students during improvisation instruction. In real time, the camera helped capture the importance of interactional skills and musical awareness in teachers' overall assessments of students' improvisation achievement. The use of the archival video camera again revealed the power of accessing both teachers' reflections-in and reflections-on teaching (Sherin, Russ, & Colestock, 2010). Reflections-in-teaching were the immediate objective descriptions of the tagged moments, taking the researcher directly into the details of what a teacher heard and saw in the moment of instruction. But teachers were also able to reflect-on the teaching and learning experience. For example, a teacher may have described that a student had successfully musically interacted during an improvisation with another student for the first time. The teacher would then go on to describe the importance of the tagged event in development of that student's improvisation skills and contextualize the moment in the larger understanding of what improvisation achievement means. Descriptions such as these, demonstrated the teachers' micro- and macro- noticing abilities. Because they were able to zoom in and out of the moment and

contextualize its importance, they were able to recognize and respond to students appropriately.

Yet, teachers' ability to reflect-in and reflect-on classroom interactions in Ankney's (2014) research also likely happened because participants were master teachers of jazz improvisation with many years of experience. As noted in Powell's (2014) research, more novice teachers have trouble focusing on student learning issues because they are more focused on themselves and task concerns during teaching episodes. The differences between the approaches in these studies is an excellent example of why researchers need to carefully select stimulated recall procedures that are appropriate for their participants. Teachers in Ankney's research did not feel the POV camera changed their moment to moment interactions with students, but the POV camera would have likely been an unduly infringement on Powell's preservice teachers as they were consumed with focusing on themselves and task concerns.

However, with recent advances in recording technologies, such as POV and archival video cameras as well as collaborative annotated video applications that can foster reflections between teachers on recorded teaching episodes, one has to wonder where music researcher can go with these technologies? As music education turns toward more individualized and creative endeavors in the classroom such as composition, improvisation, and projects utilizing the web and other multi-media resources, teachers will need to develop a keen sense of student thinking in order to respond and develop curriculum that meets students' needs. Researchers and professional development administrators in music education should consider not only teachers' ability to reflect-on, but to reflect in-the-moment on student thinking. In doing so, researchers' should apply rigorous interview protocol as well as new technologies that appropriately meet their research aims of either capturing teachers' knowledge and beliefs of student thinking or their interactive cognitions. Both perspectives are necessary, and will help us understand the development of music teachers as they seek to be more responsive to students' needs. Furthermore, researchers should provide detailed descriptions of the technologies and analysis used to identify teachers' awareness of student thinking so that we may begin to build a body of research on this topic in our field. Music education researchers' use of stimulated recall techniques combined with the latest video technology such as wearable archival cameras and annotation tools such as DIVER and Edthena will assist all those who work with music educators in understanding the complex demands on music teachers' cognition.

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