Contributions to Music Education Vol. 44, pp. 127–144.

SOMMER FORRESTER
University of Massachusetts Boston

The Evolution and Use of Verbal Protocols in the Study of Music Teacher Cognition

The purpose of this literature review is to define verbal protocols and explore how two methodological tools — think-alouds and stimulated recall — may apply to research in music education practices. Pinpointing the inner workings of these processes may extend the ongoing work within music education and further support how novice music teachers notice, observe, and understand the nuances involved in music teaching. Across the reviewed body of research in music education, stimulated recall and think-alouds helped participants access their tacit knowledge and think metacognitively about their thought processes while solving musical problems, listening, and teaching. Overwhelmingly, the participants across all of the reviewed music education studies demonstrated notable improvement in their ability to identify and describe aspects of their cognitive processes.
Keywords: teacher knowledge, music teacher education, verbal protocols, think-alouds, stimulated recall

Introduction

Teaching and learning are commonplace human activities that are intricate and complex (Ball, 2000; Grossman, Hammerness, & McDonald, 2009). Informal teaching happens throughout our day: parents and children teach one another, peers assist each other through work and play, and colleagues offer perspective and new ways to approach tasks. Because of the ubiquitous nature of informal teaching, it is often assumed that professional classroom teaching is simply learned through experience (Ball & Forzani, 2009, 2011; Cohen, 2011); however, scholars argue that professional teaching is specialized work that is complicated and unnatural as it involves identifying and examining topics through the perspective of the learner (Ball & Forzani, 2009).

As such, professional teaching demands the continuous acquisition and retrieval of specialized knowledge, skills, cultural competency, relational sensitivity, and the ability to "unpack" knowledge to make it accessible to someone else (Ball, 2000; Ball & Forzani, 2009, 2011; Clark & Lampert, 1986; Freeman, 2002; Lampert, 2000; Nilsson, 2008; Sherin & van Es, 2009; Verloop, Van Driel & Meijer, 2001). Teachers make decisions and problem-solve with a high degree of fluency in a dynamic environment. The fluency and automaticity with which teachers call on their practical knowledge, skills, subject-matter knowledge, pedagogical knowledge, situated and contextual knowledge, and personal knowledge, highlights the demands of specialized expertise (Ball, 2000; Ball, Thames, & Phelps, 2008; Grossman, 2005; Kagan, 1990; Lampert, 2000; Lortie, 1975; Shulman, 1987).

Scholars note the importance of finding ways to capture, represent, and describe teachers' routinized and tacit knowledge (Meijer et al., 2002), as it may offer insights into how pre- and in-service teachers develop practical knowledge. Meijer et al., noted this aspect of research may result in:

> (a) a deeper insight into the cognitive aspects of teaching; (b) an understanding of the complexity of teachers' practical knowledge and how this is related to teaching practice (i.e., it is based on, develops in, and influences teaching practice); and (c) encouragement of student teachers to reflect and elaborate their own developing practical knowledge. (p. 407)

Yet, this type of inquiry is difficult to access for three reasons: (a) knowledge is often held unconsciously; (b) teacher cognition is contextual; and (c) there is a lack of specific language to describe cognitive function and action (Kagan, 1990; Lampert, 2000; Lortie, 1975).

In the case of music teaching and learning, accessing music teachers' knowledge is further complicated by the temporal nature of the subject matter. The in-the-moment cognitive processes and decisions that occur while creating, performing, and listening to music are often communicated through nonverbal exchanges among students and between students and teachers. Music teaching and learning is unique to other subject areas as it engages teachers and students in a collaborative and creative endeavor that is intangible, contextually bound, and informed by the experiences and emotions of the individuals who are engaged in the process. The purpose of this literature review is to define verbal protocols and explore how two methodological tools — think-alouds and stimulated recall — may apply to research in music education practices.

Exploring Teacher Knowledge

Teachers, like physicians, make decisions in changing environments (Grossman, Compton, Igra, Ronfeldt, Shahan, & Williamson, 2009; Shavelson & Stern, 1981). The fluency of their actions becomes automated through practice, which makes it difficult for an observer, researcher, or novice to identify the cognitive processes that guide and inform the action (Berliner, 1986; Bransford, Derry, Berliner, Hammerness, & Beckett, 2005). Deconstructing experienced teachers' knowledge into understandable representations provides an opportunity to reveal what informs teachers' decisions. Furthermore, this process creates a space to examine how teachers synthesize their knowledge about students and the subject matter, and how teachers apply their knowledge in the moment as they are teaching. Black and Halliwell (2000) suggested that accessing, deconstructing, and analyzing the inner-workings and application of experienced teachers' practical knowledge is challenging.

Like other professionals, novice and experienced teachers have different schemata. Novices' development of professional knowledge demands an understanding of what is required for practice, how knowledge is developed, and why (Ball, Thames, & Phelps, 2008; Bransford et al., 2005; Meijer et al., 2002; Westerman, 1991). Scholars note that novices are able to verbalize their thinking, whereas experts might struggle with articulating in detail their thought processes as their thinking and actions become automated over time (Bransford et al., 2005; Ericsson & Simon, 1980). This challenge is particularly relevant to the study of teacher cognition and teacher education as tacit or automated thinking and processing are not easily reported (Taylor & Dionne, 2000).

Westerman noted the difference between the thinking and decision-making processes of expert and novice teachers, including: (a) integration of knowledge; (b) student behavior; and (c) interaction among the pre-active, interactive, and post-active stages of decision-making (p. 295). Westerman advocated for an integrated approach that provided opportunities for experienced teachers to think systematically about what informs their decision-making and problem-solving techniques while creating a space where novices can develop their schemata for classroom teaching. Scholars argue that the inconsistent use of professional language for describing and analyzing practice is an impediment for examining teacher cognition (Ball & Forzani, 2009, 2011; Kagan, 1990; Lampert, 2000; Lortie, 1975; Yinger, 1986).

This limitation, combined with the nature of unconsciously held tacit knowledge and the contextualized nature of teaching, can result in research that yields a very small sample (Kagan, 1990). As a result, educational researchers contend the need for a common professional language for describing and analyzing teaching,

multidimensional research methodologies, and triangulation to strengthen the internal validity of the research on teaching and learning (Ball, 2000; Ball & Forzani, 2009, 2011; Ball, Thames, & Phelps, 2008; Forrester, 2018; Grossman, et al., 2009; Kagan, 1990; Lampert, 2000; Meijer et al., 2002; Millican, 2013, 2014; Verloop et al., 2001; Yinger, 1986).

Research Protocols and Cognitive Psychology

Defining Verbal Protocols

The practice of researching human cognitive processes stems from cognitive psychology. Following a long period of studying human performance and abilities, cognitive psychologists began using verbal protocols as a methodological tool to gather and interpret the thought processes of participants. Ericsson and Simon (1980, 1984, 1993) defined verbal protocols as the participant's account of his or her mental processing. This account ranges from how participants hypothesize their thinking processes or problem-solve during a given task, how participants think while carrying out a task, to a retrospective account of how participants complete a task or solve a problem (Ericsson & Simon, 1980, 1984, 1993; Taylor & Dionne, 2000).

Building on the work of Ericsson and Simon (1980, 1984, 1993), Miller and Brewer (2003) defined verbal protocol analysis (VPA) broadly as "a method for collecting and analyzing verbal data about cognitive processing. The method involves making a detailed record of a person's verbal report while they are engaged in carrying out a task" (p. 333). In their seminal work on verbal protocols, Ericsson and Simon (1980) differentiated between concurrent, introspective, and retrospective protocols. Concurrent protocols, such as think-alouds, are a description of thinking while engaged in a task. Introspective and retrospective protocols, such as stimulated recall, draw on short-term memory to recall thinking while completing a task.

Methodological Tools: Think-Alouds

The aim of think-aloud methodology is to explain every step taken by the participant while they are engaged in a task or problem (van Someren, Barnard, & Sandberg, 1994). For example, a researcher who wishes to learn more about how music teachers approach score study and rehearsal strategies, might ask participants to think aloud and describe, in detail, their score study process and how they make determinations about rehearsal strategies based on their knowledge of the music and the developmental stage of the musicians in the ensemble.

Think-alouds require concurrent verbalizations and discourage introspection (i.e., talking about cognitive processes), whereas, introspection and retrospection protocols occur after the fact. Take for example, an examination surrounding how music teachers approach score study and rehearsal strategies. In this case, capturing the in-the-moment thought processes of the participant's actions, while doing the action, differs from asking the participants to discuss what informed their decisions, after the fact. Richardson and Whitaker (1996) described the role of the researcher in establishing the think-aloud protocol. The authors noted, once the participant understands the procedures:

> The researcher then fades into the background while the participant completes the task, only offering scripted prompts to "keep talking" if the participant is silent for more than a few seconds. The researcher is prohibited from asking questions or otherwise directing the participant's thinking, as this would interfere with the task and alter the very thought processes under construction. (p. 39)

Scholars caution that think-alouds should not be confused with other forms of verbal data collection protocols such as interview responses, as this methodological tool is geared toward capturing the participant's thought processes in the moment (Richardson & Whitaker, 1996).

Stimulated Recall

In 1953, Bloom and his colleagues at the University of Chicago audiotaped lectures and replayed them for students to see if they could recall activities, gestures, and notable points in the lecture. Bloom described the procedure as a means of "reviving [students'] memories and thoughts during the lecture" and noted within two days participants' responses yielded: "95 percent accurate recall of such overt, checkable events" (Stough, 2001, p. 162). This technique used by Bloom is one of the first instances where stimulated recalled was employed as a method for accessing cognition.

Scholars note stimulated recall protocols serve as a cognition-capturing device for situations where think-alouds would interfere with the task of performance being studied (Gass & Mackey, 2016; Stough, 2001). For example, in a classroom context, an educator would be unable to meet the needs and demands of teaching while simultaneously reporting their thinking. When using stimulated recall, the task or problem-solving activity is recorded and replayed to the participant after the activity. During the recall session, the participant self-reports, retrospectively, on their thought processes and emotions while they were engaged in the task.

The recall session is an opportunity for the participant to "relive" their actions in retrospect and verbalize their original thought processes (Calderhead, 1981; Gass & Mackey, 2016; Stough, 2001).

It is important to recognize the limitations and threats to validity associated with stimulated recall so that researchers can minimize them at the onset of data collection. Calderhead (1981) stressed the need for the researcher to establish rapport with the participant prior to the study, to help quell the potential anxiety and confidence issues that may arise when the participant reviews the footage during recall sessions. The researcher must be careful not to prompt or influence responses from the participant; furthermore, if the participant is unable to verbalize aspects of their tacit knowledge, this must be documented accurately as data. Ensuring the necessary steps are in place prior to data collection can help minimize the potential threats to validity (Calderhead, 1981; Gass & Mackey, 2016; Lyle, 2003; Stough, 2001; Wade, 1990).

Application: Stimulated Recall and Think-Alouds in Education Research

Scholars in education research have used verbal protocols as a means to discover the processes and underlying knowledge that guides teacher decisions, reasoning, and action (Housner & Griffey, 1985; Sherin & van Es, 2009; Stough, 2001). Housner and Griffey (1985) used stimulated recall and think-alouds to examine and compare experienced and novice physical education teacher's ability to plan instructional activities. Think-alouds were used to capture the participants' decision-making processes during the planning sessions prior to the class, and stimulated recall was used to access the participants' thinking following the class. The data revealed similarities in how the experts and novices planned for instruction; however, the participants' approach and descriptions surrounding the decision-making processes that guided their instructional strategies during the lesson varied greatly. The experienced teachers demonstrated stronger metacognitive and self-regulatory skills when planning for instruction compared to the novice participants. The use of two methodological tools allowed for an in-depth analysis of the participants' thinking before, during, and following instruction.

Stough (2001) examined the nature of instructional thinking of experienced special education teachers in a two-part study that involved experienced teachers and preservice teacher educators. Similar to Housner and Griffey (1985) in the first portion of the study, in-service teachers reviewed video footage of their teaching and verbalized the thoughts and feelings that motivated their instructional decisions during a particular moment.

In the second portion of the study, preservice special education teachers served as participants. The experimental group viewed the data from the in-service teacher participants, whereas the control group did not have access to in-service teacher data. Stough (2001) determined that the preservice teachers in the experimental group developed a capacity to observe and learn from the in-service teacher participants. In viewing the in-service teacher data, preservice teachers had opportunity to observe what the expert participants deemed challenging, how the expert participants dealt with challenging situations in the moment, and what motivated the expert participants' thinking following the class.

Sherin and van Es (2009) chronicled mathematics teachers' knowledge-based reasoning skills and their development of noticing. Eight teachers, with varied levels of experience, formed two video club groups at two different schools. The participants' representations of practice were recorded, viewed, and discussed during the club meetings. The researchers examined how the conversations amongst the teachers changed over the course of the study and the influence the video club had on participants' thinking and decision-making processes in the classroom.

The researchers determined that, over time, the participants became less reliant on the researcher prompts to generate discussion points; rather, the participants were able to notice, name, and articulate complex issues related to student thinking that took place during their class. The findings are consistent with past research where participants developed the skills to observe and name aspects of their thought processes through the use of stimulated recall and think-alouds (Housner & Griffey, 1985; Stough, 2001).

Music Teaching and Learning

Researchers in music teacher education have used verbal protocols and methodological tools such as think-alouds and stimulated recall to examine in-service music teachers' in-the-moment decisions, action, and reasoning with students, and preservice teachers' ability to observe, name, and deconstruct aspects of practice.

Barrett and Rasmussen (1996) used videotaped cases of experienced general music educators as a tool to direct preservice music education students' attention from teacher knowledge to student thinking. Participants engaged in a general music activity and watched an experienced teacher (teacher A) conduct the same activity in the classroom setting. The participants then watched a video of teacher A think out loud as they watched a video case of another teacher (teacher B) conduct the same lesson. Barrett and Rasmussen noted:

> This hall of mirrors offered the students multiple representations of the same lesson sequence and musical content while shifting the participants'

> frame of reference. We hoped that the shift would reveal longstanding but unquestioned assumptions about teaching and learning, assumptions that could be addressed, confronted, and contemplated by others. (p. 79)

A study by Rowe (2009) examined students' and studio teachers' perceptions of gender interactions during private instrumental lessons. Rowe indicated that using semi-structured interviews and stimulated recall provided the participants with multiple opportunities to contemplate their interactions during the lesson. Citing Calderhead (1981), Rowe noted that the presence of a camera impacted some of the participants' behavior, and during the recall sessions, some participants experienced anxiety while watching and hearing themselves. Overall, participants (students and teachers) indicated that watching themselves on a video recording provided them with a new perspective on the lesson; moreover, they observed things that typically would go unnoticed while engaged in the teaching and learning process. Rowe concluded that using stimulated recall as a methodological tool gave the participants ownership in the research process and provided a rich dataset surrounding the teaching and learning process.

Within the last decade, researchers have become interested in pre-collegiate and preservice music teachers' experiences with teaching (Miksza & Austin, 2010; Powell, 2014). Miksza and Austin (2010) used stimulated recall protocols to interview 11 high school students enrolled in a 12-week pre-collegiate music teacher recruitment initiative. Participants served as coaches in a middle school outreach program. The researchers conducted three sets of interviews using stimulated recall protocols to elicit the participants' teaching experiences in the middle school outreach program. Over the course of the three interviews, the participants' self-concerns (i.e., communication, level of comfort, and expressed feelings) decreased, task concerns remained consistent, while their concerns about students increased. The researchers noted that the participants' teacher identity increased and that following the study, a large percentage of the participants went on to pursue music education at the collegiate level.

Using a similar design, Powell (2014) examined the concerns (self, task, and student concern) of 12 senior-level preservice music teachers using the Fuller and Bown (1969) teacher concerns model. Powell used stimulated recall protocols to interview the participants following their peer-teaching and field-teaching episodes. Powell noted the benefits of stimulated recall and suggested that over time, the participants became increasingly self-aware, "a sequence of peer- and field-teaching episodes accompanied by video review may lead to an increase in critical reflection by students in a methods course" (p. 373).

Similarly, Perkins, Aufegger, and Williamon (2015) explored the experiences of four student-teachers during a 10-week instrumental music program geared towards adult beginners in the United Kingdom. The researchers used stimulated recall as a tool to investigate how student-teachers developed their teacher practice over time, with a group of adult learners. Over the course of the study, participants' experiences and reflections indicated growth and a newfound understanding of how to approach teaching adult learners. Consistent with Powell (2014), the participants developed a greater ability to examine aspects of their teaching experiences through the use of stimulated recall protocols.

In a recent study, Forrester (2017) used stimulated recall protocols as a methodological tool to explore how experienced instrumental music teachers describe the intersections between teaching and conducting, and to gain insights into their decision-making processes while conducting and teaching. Using stimulated recall, the four participants reviewed their teaching episodes and rehearsals to identify, describe, and examine how their knowledge, skill, and experiences as teachers and conductors informed their in-the-moment decisions on the podium. Forrester noted that the participants struggled with naming specific aspects of their thought processes in detail, which suggests that their knowledge is highly automatized.

Furthermore, the participants found it challenging to think of their teaching and conducting as separate entities. Based on the data, Forrester concluded that instrumental music teaching demands a specialized form of knowledge that includes the integration, rather than the intersection, of teaching and conducting. The findings are consistent with past research (Perkins, Aufegger, & Williamon, 2015; Powell, 2014) surrounding the participants' ability to deconstruct aspects of their knowledge and practice through think alouds and stimulated recall protocols.

Broadly, the findings from the research in music teacher education are consistent with past research in the general education literature, in that participants developed a greater capacity to observe aspects of their thought processes through the use of verbal protocols (Barrett & Rasmussen, 1996; Forrester, 2017; Housner & Griffey, 1985; Miksza & Austin, 2010; Perkins, Aufegger, & Williamon, 2015; Powell, 2014; Sherin & van Es, 2009; Stough, 2001).

Application: Stimulated Recall and Think-Alouds in Music Education

Outside of music teacher education, researchers have used verbal protocols and methodological tools such as think-alouds and stimulated recall to examine the cognitive aspects of musical experience and the processes involved in doing music (Richardson & Whitaker, 1996). Think-alouds and stimulated recall were

used to examine students' cognitive processes during composition (Ainsworth, 1970; Burnard & Younker, 2004; Davidson & Welsh, 1988; Younker, 2000; Younker & Smith, 1996) and musical listening (Bundra, 1993; Richardson, 1996).

Composition and the Creative Process

Ainsworth (1970) qualified musical creativity as a "process of making informed decisions" (p. 44). In doing so, the student elects to incorporate or reject material based on their previous musical experience, prior knowledge (conscious or unconscious listening and exposure to music), ability, or skills. Ainsworth indicated that this process happens internally at the cognitive level, and, in the case of composition, the process is realized through a musical symbol or sound. Ainsworth identified concerns with how students approach creative tasks rather than evaluating the output. How are decisions made? Are there generalizable similarities or differences in how individuals approach creative tasks? (p. 48).

Similar to other complex tasks, creative thinking is dynamic, non-linear, and moves between divergent and convergent thinking (Burnard & Younker, 2004). Nearly two decades later, Davidson and Welsh (1988) indicated a need for systematic research surrounding students' thought-processes during composition, "little is known about the mental and cognitive processes which support different orientations to the music task of writing a melody" (p. 261).

Adding to the ongoing need for systematic research into students' thought processes and strategies while composing, Younker (2000) stated:

> There is little guidance for music educators — both in the field and in training — about how to devise, structure, and engage students in appropriate compositional activities. Observing students compose, and analyzing their processes and strategies, may provide music educators with needed insights into how students approach composing activities. (p. 24)

Younker (2000) explored the thought processes and strategies of students aged eight (n = 3), eleven (n = 3), and fourteen (n = 3) while composing with technology. Using verbal protocols (think-alouds and unstructured interview techniques), Younker documented and analyzed the participants' thought patterns and strategies during three compositional activities. Data collection occurred before and after the activities to ascertain the participants' thoughts, behaviors, and decisions.

The analysis of the data revealed differences within and across the participant age group; however, the data revealed a continuum of strategies and thought processes that all three groups used while composing. Younker noted that the varying degrees of thought processes and strategies warrant further investigations, and

made recommendations for additional studies surrounding how students think while they are engaged in sound. Such suggestions may offer music educators further insights into how to support students during metacognitive and creative activities.

Burnard and Younker (2004) compared the individual students' cognitive processes while composing in terms of how they perceived, framed, and solved musical problems. Drawing from previous data banks from the UK, Australia, and Canada, the authors reanalyzed previous datasets to determine "what aspects of problem setting and solving characterize the commonality in composing strategies of students in which factors of age, musical background, and culture differ?" (p. 62). Data sets in this multiple-case study included a reanalysis of verbal reports, including think-alouds, stimulated recall, interviews, and musical products from previous studies where the authors examined students' cognitive processes while composing.

Using verbal protocols, the researchers gained insights into the how and why behind the participants' compositional strategies and their metacognitive processes. Through the cross-case analysis of the six cases, the authors noted the relationship between problem-solving, -setting, or -seeking and creativity while composing (p. 71). The findings support the extant literature that suggests students' decision-making processes are contextual and highly individual, students move through levels of creative thinking (simple to sophisticated), and students' compositional pathways are impacted by variables such as sociocultural factors.

Musical Listening

The cognitive processes involved in musical listening are difficult to access and observe. Bundra (1993) examined the listening processes of 17 school-aged children from second, fifth, eighth, and eleventh grade, to determine if there were differences in students' listening processes as they became older. Participants listened to six musical selections during 30-minute individual sessions and provided concurrent, free-form verbal responses (think-alouds) while they listened to the musical examples. Following the individual sessions, the participants were asked to reflect on their listening processes in a semi-structured interview. Based on the verbal protocol analysis, 17 categories emerged from the data. Bundra determined the variables of age, gender, and musical background impacted the descriptions and quantity of the verbal reports.

Richardson (1988, 1995, 1996) used verbal protocols and think alouds to develop a model for an adult music critic's cognitive and listening processes. Richardson (1996) used the model to examine the cognitive processes of children in

grades one through eight and compared their processes with the adult expert. Thirty-one participants from Chicago elementary schools listened to 10 three-minute recorded musical examples through headphones while simultaneously responding to questions posed by the researcher. The researcher sat behind the participants, and if the participants stopped talking for 20 seconds, the researcher prompted the participants to keep talking: "Please keep talking. Tell me what you're thinking" (p. 19). Richardson indicated the use of verbal protocols allowed the participants to speak freely and revealed a rich dataset surrounding the participants' thinking processes while listening.

The studies from the music education literature highlight the breadth of scholarship surrounding the complex and nuanced nature of thinking while engaged in music-related activities and teaching. Across this body of research, stimulated recall and think-alouds helped participants access their tacit knowledge and think metacognitively about their thought processes while solving musical problems, listening, and teaching. While accessing tacit knowledge is challenging, with practice, the participants became accustomed to the process of thinking out loud while engaged in a task and self-reporting, retrospectively, while responding to video. Overwhelmingly, the participants across all of the reviewed music education studies demonstrated notable improvement in their ability to identify and describe aspects of their cognitive processes. This development and improvement is consistent with scholarship from the general education literature (Housner & Griffey, 1985; Sherin & van Es, 2009; Stough, 2001).

Discussion and Implications for Practice

The evolution and application of verbal protocols in teacher education research marks an important shift in how scholars explore pathways to access teachers' tacit knowledge and thought processes that were previously unattainable through interview and observation protocols alone. Educational scholars noted the challenges associated with unlocking the inner-working of teachers' thought processes (Black & Halliwell, 2000; Kagan, 1990; Lampert, 2000), which leads to the need to purposefully examine teachers' routinized and tacit knowledge, and determine what guides teachers' knowledge and how teachers' decisions are influenced by their subject matter knowledge and contextual knowledge (Ball & Forzani, 2009, 2011; Kagan, 1990; Lampert, 2000; Meijer et al., 2000). The integration of technology in stimulated recall, particularly in teacher education, allows researchers to access teachers' knowledge — including subject matter, relational, and contextual knowledge — without disrupting the teaching and learning process (Barrett & Rasmussen, 1996; Forrester, 2017; Housner & Griffey, 1985;

Miksza & Austin, 2010; Perkins, Aufegger, & Williamon, 2015; Powell, 2014; Rowe, 2009; Sherin & van Es, 2009; Stough, 2001).

Traditionally, the use of verbal protocols, think-alouds, and stimulated recall in music education research have focused on accessing students' thought processes while engaged in musical tasks, including composition and listening (Barrett & Rasmussen, 1996; Rowe, 2009). Increasingly, music teacher education scholars are using verbal protocols to examine the thought processes and experiences of music teachers while engaged in teaching related tasks (Forrester, 2017; Miksza & Austin, 2010; Perkins, Aufegger, & Williamon, 2015; Powell, 2014), which may signal an emerging and fruitful area of scholarship for music teacher education research.

Future applications of verbal protocols in music teacher education research might include continued examinations of how novice, mid-career, and experienced music teachers' describe and deconstruct their thought processes while planning for instruction, teaching, conducting, and rehearsing. Extensions of this area of inquiry might also include developing a consistent and robust language to describe and analyze music teacher cognition and practice (Ball & Forzani, 2009, 2011; Forrester, 2017; Lortie, 1975). Developing a systematic, multilevel, and multifaceted approach to examine the intricacies and nuances surrounding music teacher knowledge, throughout the career stages, may assist in closing the gap between the theoretical and practical divide that poses challenges for music teacher education and general teacher education alike (Ball & Forzani, 2009, 2011; Ball, Thames, & Phelps, 2008; Forrester, 2017; Millican, 2013, 2014; Perkins, Aufegger, & Williamon, 2015; Powell, 2014).

In the case of preservice teacher preparation, providing students with insights surrounding how expert teachers make decisions in-the-moment might include studies that examine what guides in-service music teachers' decisions. What and how do expert in-service music teachers notice and analyze, and how do they solve the day-to-day teaching and learning challenges that occur with student learners in the music classroom? What guides expert music teachers' verbal and non-verbal responses, and how does this relate to what they hear from a musical standpoint and what they know about their students from a pedagogical standpoint? Pinpointing the inner workings of these processes may extend the ongoing work within music education and further support how novices music teachers notice, observe, and understand the nuances involved in music teaching.

Furthermore, providing opportunities for preservice and in-service teachers to think metacognitively about their teaching practice may support ongoing development in related areas of inquiry such as identity development and the relational aspects of music teaching and learning (Forrester, 2017). Verbal protocols, think-alouds, and stimulated recall are widely used in general teacher education

research. The development and application of these tools in music education and music teacher education research presents an opportunity to pursue relevant areas of research that pertain to the inner-workings and thought processes of students and teachers while engaging in music-making, observing music teaching and learning, and developing a robust professional language to describe the cognitive function and action that occurs during music teaching and learning (Ball & Forzani, 2009, 2011; Ball, Thames, & Phelps, 2008; Forrester, 2017; Kagan, 1990; Lampert, 2000; Lortie, 1975; Millican, 2013, 2014; Perkins, Aufegger, & Williamon, 2015; Powell, 2014). Going forward, the development and evolution of verbal protocols, think-alouds, and stimulated recall may be useful methodological tools for researchers looking to pursue future studies in these relevant and important areas of music teacher research.

References

Ainsworth, J. (1970). Research project in creativity in music education. *Bulletin of the Council for Research in Music Education, 22*, 43–48. doi:10/1177/875512339601500103.

Ball, D. L. (2000). Bridging practices: Intertwining content and pedagogy in teaching and learning to teach. *Journal of Teacher Education, 51*, 241–247. doi:10.1177/0022487100051003013.

Ball, D. L., & Forzani, F. M. (2009). The work of teaching and the challenges for teacher education. *Journal of Teacher Education, 60*, 497–511. doi:10.1177/00224871093479.

Ball, D. L., & Forzani, F. M. (2011). Teaching skillful teaching. *The Effective Educator, 68*, 40–45.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal for Teacher Education, 59,* 389–407. doi:10.1177/0022487108324554.

Barrett, J. R., & Rasmussen, N. S. (1996). What observation reveals: Videotaped cases as windows to preservice teachers' beliefs about music teaching and learning. *Bulletin of the Council for Research in Music Education, 130*, 75–88.

Berliner, D. C. (1986). In pursuit of the expert pedagogue. *Educational Researcher, 15*, 5–13. doi:10.3102/0013189X015007007.

Black, A. L., & Halliwell, G. (2000). Accessing practical knowledge: How? Why? *Teaching and Teacher Education, 16*, 103–115. doi:10.1016/S0742-051X (99)00045-1.

Bransford, J., Derry, S., Berliner, D., Hammerness, K., & Beckett, K. L. (2005). Theories of learning and their roles in teaching. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world* (pp. 40–87). San Francisco, CA: Jossey-Bass.

Bundra, J. (1993). *A study of music listening processes through the verbal reports of school-aged children*. (Unpublished doctoral dissertation). Northwestern University, USA.

Burnard, P., & Younker, B. A. (2004). Problem-solving and creativity: Insights from students' individual composing pathways. *International Journal of Music Education, 22*, 59–76. doi:10.1177/02557614042375.

Calderhead, J. (1981). Stimulated recall: A method for research on teaching. *British Journal of Educational Psychology, 51*, 211–217. doi:10.1111/j.2044-8279.1981.tb02474.

Clark, C., & Lampert, M. (1986). The study of teacher thinking: Implications for teacher education. *Journal of Teacher Education, 37*, 27–31. doi:10.1177/002248718603700506.

Cohen, D. (2011). *Teaching and its predicaments*. Cambridge: Harvard University Press.

Davidson, L., & Welsh, P. (1988). From collections to structure: The developmental path of tonal thinking. In J. Sloboda (Ed.), *Generative processes in music: The psychology of performance, improvisation, and composition*. New York, NY: Oxford University Press.

Ericsson, K. & Simon, H. (1980). Verbal reports as data. *Psychological Review, 87*, 215–251. doi:10.1037/0033-295X.87.3.215.

Ericsson, K., & Simon, H. A. (1984). Verbal reports on thinking. In C. Faerch, & G. Kasper (Eds.), *Introspection in second language research* (pp. 24–53). Philadelphia, PA: Multilingual Matters, Ltd.

Ericsson, K. A, & Simon, H. A. (1993). *Protocol analysis: Verbal reports as data*. Cambridge, MA: The MIT Press.

Forrester, S. H. (2017). Music teacher knowledge: An examination of the intersections between instrumental music teaching and conducting. *Journal of Research in Music Education, 65*, 461–482. doi:10.1177/0022429417742124.

Freeman, D. (2002). The hidden side of the work: Teacher knowledge and learning to teach. *Language Teaching, 35*, 1–13. doi:10.1017/S026144480100172.

Gass, S. M., & Mackey, A. (2016). *Stimulated recall methodology in applied linguistics and L2 research*. New York, NY: Routledge.

Grossman, P. (2005). Research on pedagogical approaches in teacher education. In M. Cochran-Smith & K. Zeichner (Eds.), *Studying teacher education: The report of the AERA Panel on Research and Teacher Education* (pp. 425–476). Mahwah, NJ: Lawrence Erlbaum.

Grossman, P., Compton, C., Igra, D., Ronfeldt, M., Shahan, E., & Williamson, P. (2009). Teaching practice: A cross-professional perspective. *Teachers College Record, 111*, 2055–2100.

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. T*eachers and Teaching: Theory and practice, 15*, 273–289. doi:10.1080/13540600902875340.

Housner, L. D., & Griffey, D. C. (1985). Teacher cognition: Differences in planning and interactive decision-making between experienced and inexperienced teachers. *Research Quarterly for Exercise and Sport, 56*, 45–53. doi:10.1080/02701367.1985.10608430.

Kagan, D. M. (1990). Ways of evaluating teacher cognition: Inferences concerning the Goldilocks principle. *Review of Educational Research, 60*, 419–469.

Lampert, M. (2000). Knowing teaching: The intersection of research on teaching and qualitative research. *Harvard Educational Review, 70*, 86–99.

Lortie, D. (1975). *School teacher*. Chicago, IL: University Chicago Press.

Lyle, J. (2003). Stimulated recall: A report on its use in naturalistic research. *British Educational Research Journal, 29*, 861–878. doi:10.1080/0141192032000137349.

Marland, P., & Osborne, B. (1990). Classroom theory, thinking, and action. *Teaching and Teacher Education, 6*, 93–109.

Meijer, P. C., Zanting, A., & Verloop, N. (2002). How can student teachers elicit experienced teachers' practical knowledge? Tool, suggestions, and significance. *Journal of Teacher Education, 53*, 406-416. doi:10.1177/002248702237395.

Miksza, P., & Austin, J. R. (2010). Eyes wide open: High school student reflections on music teaching experiences within a pre-collegiate recruitment program. *Bulletin of the Council for Research in Music Education, 185*, 7–20.

Miller, R. L., & Brewer, J. D. (2003). *The A-Z of social research: A dictionary of key social science research concepts*. Thousand Oaks, CA: Sage.

Millican, J. S. (2013). Describing instrumental music teachers' thinking: Implications for understanding Pedagogical Content Knowledge. *Update: Applications of Research in Music Education, 31*, 45–53. doi: 10.1177/8755123312473761.

Millican, J. S. (2014). Describing preservice instrumental music educators' Pedagogical Content Knowledge. *Update: Applications of Research in Music Education, 34*, 61–68. doi:10.1177/8755123314552664.

Nilsson, P. (2008). Teaching for understanding: The complex nature of Pedagogical Content Knowledge in preservice education. *International Journal of Science Education, 30*, 1281–1299. doi:10.1080/09500690802186993.

Perkins, R., Aufegger, L., & Williamon, A. (2015). Learning through teaching: Exploring what conservatoire students learn from teaching beginner older adults. *International Journal of Music Education, 33*, 80–90. doi:10.1177/0255761414531544.

Powell, S. R. (2014). Examining preservice music teacher concerns in peer- and field-teaching settings. *Journal of Research in Music Education, 61*, 361–378. doi:10.1177/0022429413508408.

Richardson, C. (1988). *Musical thinking as exemplified in music criticism.* (Unpublished doctoral dissertation). University of Illinois, USA.

Richardson, C. (1995, April). *Toward a global model of musical thinking*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

Richardson, C. (1996). A theoretical model of the connoisseur's musical thought. *Bulletin of the Council for Research in Music Education, 128*, 15–24.

Richardson, C., & Whitaker, N. L. (1996). Thinking about think alouds in music education research. *Research Studies in Music Education, 6*, 38–49. doi:10.1177/1321103X9600600105.

Rowe, V. C. (2009). Using video-stimulated recall as a basis for interviews: some experiences from the field. *Music Education Research, 11*, 425–437. doi:10.1080/14613800903390766.

Shavelson, R. J., & Stern, P. (1981). Research on teachers' pedagogical thoughts, judgments, decisions, and behavior. *Review of Educational Research, 51*, 455–498. doi:10.3102/00346543051004455.

Sherin, M. G., & van Es, E. (2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education, 60*, 20–37. doi:10.1177/0022487108328155.

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

Stough, L. M. (2001, April). *Using stimulated recall in classroom observation and professional development*. Paper presented at the Annual Meeting of the American Educational Research Association, Seattle, WA.

Taylor, K. L., & Dionne, J. P. (2000, April). *Managing the problem-solving process: The executive control strategy knowledge of professors and students.* Paper presented at the American Educational Research Association Annual Meeting, New Orleans, LA.

Van Someren, M. W., Barnard, Y. F., & Sandberg, J. A. C. (1994). *The think aloud method: A practical guide to modeling cognitive processes*. London, UK: Academic Press.

Verloop, N., Van Driel, J., & Meijer, P. (2001). Teacher knowledge and the knowledge base of teaching. *International Journal of Educational Research, 35*, 441–461. doi:10.1016/S0883-0355(02)00003-4.

Wade, S. E. (1990). Using think alouds to assess comprehension. *The Reading Teacher, 43*, 442–451.

Westerman, D. A. (1991). Expert and novice teacher decision-making. *Journal of Teacher Education, 42*, 292–305. doi:10.1177/002248719104200407.

Yinger, R. J. (1986). Examining thought in action: A theoretical and methodological critique of research on interactive teaching. *Teaching and Teacher Education, 2*, 263–282. doi:10.1016/S0742-051X(86)80007-5.

Younker, B. A. (2000). Thought processes and strategies of students engaged in music composition. *Research Studies in Music Education, 14*, 24–39. doi:10.1177/1321103x0001400103.

Younker, B. A., & Smith, W. H. (1996). Comparing and modeling musical thought processes of expert and novice composers. *Bulletin of the Council for Research in Music Education, 128*, 25–36.