# SECONDARY CHORAL MUSIC EDUCATORS' USE OF TECHNOLOGY-ASSISTED ASSESSMENT TOOLS

BY

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DISSERTATION

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Music Education
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2018

Urbana, Illinois

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ABSTRACT

Assessment of student learning is a crucial part of what all teachers do in all disciplines and at all levels. Music educators often find administering and documenting this important step of the educational experience difficult due to a myriad of curricular and logistical challenges, but the expectation that music teachers conduct and record regular and systematic assessments has increased with educational reform efforts that rely on student growth as a measure of teacher accountability. The potential for using technology to assist with student assessment in the music classroom is substantial; however, technology integration in secondary music ensembles in particular has been found to be inconsistent.

The purpose of this study was to investigate secondary choral music educators' use of technology-assisted assessment tools by determining their rationales for using certain assessment-related technology; their perceptions of the efficacy of using technology for assessing choral students; and the relationships between demographic, educational, and attitudinal factors and their reported technology use. Data were obtained through a researcher-designed survey completed by 658 secondary school choir teachers who were members of the National Association for Music Education in U.S. states that require documentation of student growth as part of teachers' performance evaluations.

Results indicated that choral music educators used technology-assisted assessment tools infrequently compared with their colleagues in other disciplines, with a large percentage of choir teachers reporting that they never use technology for many areas of choral student assessment. Select technological tools were used by a large percentage of teachers (e.g., laptops, smartphones, online collaborative platforms), but many respondents reported that they use a limited range of tools when assessing choral students. While the teachers cited benefits to using

technology-assisted assessment tools (e.g., efficiency in calculating and assigning grades, providing timely assessment feedback for students), many barriers were found to impede successful technology integration (e.g., lack of time, lack of resources, high cost of implementation). Multiple regression analyses revealed that choir teachers' comfort with technology-assisted assessment tools predicted a significant increase in the frequency with which they used them as well as the variety of technology tools they use. Personal and school-related demographic variables were not significant predictors of choral music educators' frequency of technology-assisted assessment tools use.

This study suggests a number of implications that could inform current practice or policy and potentially help choral music educators assess their students in more efficient, effective, and practical ways. By identifying types of technology-assisted assessment tools that are being used most often, teachers and administrators may be able to work together to prioritize the allocation of resources and provide technology that would benefit choral students. Since barriers such as time constraints and high cost were found to limit music teachers' use of technology, it is suggested that school administrators provide time for teachers to incorporate technological tools that will assist in student assessment, especially since administrators are now requiring a new level of assessment documentation for teacher evaluation. Finally, as comfort with technology-assisted assessment tools was the most significant predictor of increased frequency of use, those involved in the assessment process need to look for ways to help teachers feel more comfortable with technology, such as increased access to quality professional development.

ACKNOWLEDGMENTS

I would like to thank the many people who have aided in the completion of this dissertation. First of all, this project would not have reached its conclusion without the unwavering dedication and expert guidance of the members of my doctoral committee at the University of Illinois at Urbana-Champaign. Their expertise as scholars in the field of music education has inspired me to become a better researcher, writer, thinker, and teacher. The many things they have taught me will continue to influence my work throughout my career, and I am extremely appreciative of the extra work they put in to accommodate my nontraditional doctoral trajectory. Thanks to Dr. Donna Gallo, Co-Director, who took on the role of statistical guru and went well above and beyond to help develop chapters three and four even before she officially became my Co-Director. Dr. Janet R. Barrett, Co-Director, guided my work since I started my doctoral journey, always challenged me to see the bigger picture, and has by far the keenest eye for APA I have ever encountered. Dr. Louis Bergonzi helped direct this project throughout major parts of its development and spent many hours with me on Skype during my planning period discussing word choice. Dr. Bridget Sweet always provided valuable insight as an experienced choral researcher and practitioner. Dr. Jeananne Nichols joined the committee at the end of the voyage but offered an important perspective as a champion of music students and teachers whose voices may not always be heard.

I want to thank my colleagues and friends at Western Illinois University, particularly Dr. Chris Lapka, who started me on my academic path as my undergraduate advisor 20 years ago and continues to be a mentor for me now as a colleague. Thanks to Dr. Tammie Walker, Director of the WIU School of Music, for her patience and assistance as this project lingered longer than expected. I am also very appreciative for Dave Towers and Colin Harbke of the WIU Center for

Innovation in Teaching and Research whose knowledge of statistical analysis was extremely helpful.

The pursuit of my doctorate would not have been possible with the love and support of my family. My mom was my very first music teacher and taught me to always do what I love. My dad instilled in me the value of hard work and a taught me that anything is possible if you try hard enough. To my daughters, Hannah and Olivia, who have heard the phrase, "I'm sorry... I'm too busy," way too many times… you no longer have to ask, "Dad, did you finish your dissertation today?" Finally, and most of all, I am eternally grateful to my wife, Laura Hawkins, who juggled our two children while I stole away to a library many a night, who moved our family three times along the path to my first position in higher education, who drove the car during long trips so I could write in the passenger seat, and who is always there for me, in good and bad, no matter what. You deserve an honorary degree for all of the extra work *you* have done. I love you, and I look forward to sitting beside you on the couch without a computer on my lap very soon!

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# CHAPTER 1

# INTRODUCTION

Assessment of student learning is a crucial part of what all teachers do in all disciplines and at all levels. While dynamic instruction and engaging learning activities are important, how teachers determine whether or not a student "got it" is arguably even more imperative than teaching the content in the first place. When effectively integrated into the teaching/learning process, even informal, undocumented assessments can inform teachers' instruction by providing important information about their students' achievement. Unfortunately, many teachers often find administering and recording this important step of the educational experience difficult.

The recent focus on quantifiable student assessment data prevalent in schools has created a heightened sense of urgency around music teachers' assessment practices (Robinson, 2015). The expectation that music teachers conduct and document regular and systematic assessments has increased with educational reform efforts that rely on measures of teacher accountability. While music educators look to assessment for evidence of their students' learning even if they are not required to do so—as part of a "planning, teaching, and assessing" cycle inherent to teaching—secondary choral music teachers, in particular, struggle with the assessment of student learning due to a myriad of curricular and logistical challenges (Henry, 2015). The commitment music teachers have to their students and their profession, combined with new teacher evaluation requirements, has led practitioners and researchers to investigate constructive ways to assist teachers with student assessment.

Technology is frequently viewed as a means to assist teachers with the challenges of assessment, and especially so given the prominence of digital technology in today's society (Horn & Staker, 2011). There is evidence that technological tools are being used successfully in

general education for a variety of purposes related to instruction, assessment, and student engagement (Pressey, 2013; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011; VeraQuest, 2013), but music teachers' technology integration is limited even though they maintain a positive attitude about using technology-assisted assessment tools (Nielsen, 2011). The potential for using technology for student assessment in the music classroom is substantial, and policy recommendations are plentiful. Still, technology integration in secondary music ensembles has been found to be infrequent compared with their colleagues in other disciplines (LaCognata, 2010, 2013; Russell & Austin, 2010; VeraQuest, 2013).

Despite substantial technological advances in the past decade, very few researchers have conducted studies on the use of technology-assisted assessment tools in music education. This is especially evident in choral music education (Henry, 2014). This study aims to fill this research gap by examining the current assessment practices of choral music educators, how they use technology for assessment purposes, and the reasons they choose to use these technological tools.

In this chapter, I discuss assessment in the secondary choral classroom by looking at past practices and current trends to identify how the use of technology-assisted assessment tools might affect future practices and efficacy of choral music student assessment. I begin with a general overview of assessment in music education and a more detailed examination of the particular difficulties faced by teachers of performance-based choral ensembles. Specific issues related to sight-singing assessment are also explored, as teaching and assessing sight-singing is a distinct focus in the secondary choral curriculum. I then address the issue of technology use in music education and identify known tendencies among music teachers who may or may not be using technology-based assessment in their classrooms. Finally, I argue for more research on the

role of technology-assisted assessment tools in choral music education and present a series of research questions for this study.

## Assessment in Music Classrooms

Music teachers and scholars have been developing assessment practices for decades, regardless of the recent requirements implemented as a result of educational reform efforts (Russell & Austin, 2010). Assessment, in the most fundamental sense, is the process of gathering evidence of student understanding (Wiggins & McTighe, 1998). This evidence has been used for various purposes in the music classroom, including diagnosing student needs, providing feedback to students, placing students in instructional groups, assigning grades, as well as planning, coordinating, and evaluating instruction (Airasian, 2004; Stiggins & Conklin, 1992). Wiggins and McTighe (1998) advocate that teachers begin planning by considering how students will meet key curricular goals, and then filling in from that desired end point the steps they will need to achieve the goal, a process called "backward design." In the context of a music class, this might involve a teacher first determining that the class will be learning about the intervallic construction of a melodic minor scale (curriculum), then developing an assessment where students identify the scale on the staff by sight and sing it (assessment), and then finally designing activities to teach the content (instruction). In this way, the overarching goals are determined prior to the beginning of instruction, and all three areas (curriculum, instruction, assessment) play a role in the overall educational process. Students' demonstration of learning becomes the main driver of curriculum and instruction.

To further understand the ways and reasons music teachers assess their students, Abeles (2010) identifies two general "functions" of assessment in the music classroom: formative and

summative. Formative assessment represents assessment *for* learning and is meant to monitor student learning in progress in order to move learning forward. In contrast, summative assessment is used as an assessment *of* learning. The reason teachers use summative assessment is to ascertain what a student has learned following an instructional unit, often to assign grades, determine preparedness for a new level of learning, or make another type of final judgment.

Music educators routinely employ formative assessment as an everyday part of teaching music (Fautley & Colwell, 2012). Teachers hear and see students making music in real time, and they assess this aural and visual evidence to provide feedback, often using informal checks for understanding during the rehearsal process, singing and playing tests, or self- and peer-assessments. Formative assessment in the music classroom effectively advances learning in the moment, but is not always written down and is not easily communicated to someone outside the classroom. Indeed, teacher observation is the most commonly reported assessment method that secondary music teachers employ (LaCognata, 2013; Russell & Austin, 2010; United States Department of Education, 2011). It is a process reliant on the immediate exchange of ideas between teacher and student, and this process is difficult to quantify and record.

Some music educators rely on summative assessments—such as multiple-choice written quizzes on intervals and scales to demonstrate students' understanding of music theory, for example—in an attempt to document student learning in a more quantitative manner (Russell & Austin, 2010). Abeles (2010) asserts that "when teachers think of qualities of good assessment, they may believe that the gold standard—in other words, what they should strive for—is traditional scientific measurement" (p. 171). He argues that these traditional measures of student achievement have their place and may produce the data that many teachers and administrators desire, but these assessments often tend to focus on declarative knowledge about music, such as

in a quiz question asking, “In what year was W. A. Mozart born?” Abeles cautions that these types of tests represent only a fraction of students’ musical knowledge and ability, and he recommends that teachers need to keep looking for alternative ways to show deeper or richer summative evidence of student learning in the context of what musicians do—sing, play, compose, improvise, and listen to music. O’Toole (2003) argues that “most of the learning in performance ensembles is not easily captured by paper-and-pencil tests” (p. 77). A final singing or playing test for individuals within a group, for instance, could be a more authentic summative assessment than a written test for a performance-based class. A performance at a concert would be a summative assessment for the group as a whole, showing the culmination of their work in the ensemble.

Multiple researchers have divided the various formats music teachers use to administer both formative and summative assessments into two general categories: written and performance-based (Kotora, 2005; LaCognata, 2010, 2013; Russell & Austin, 2010). Each of these research studies will be examined in-detail in chapter two; however, in summary, written assessments can include traditional paper-and-pencil tests, homework assignments, projects, journals, or similar forms of testing in which students write down their answers. Performance-based assessments often come in the form of individual singing and playing tests, ensemble performances, or auditions. Given the variety and complexity of these assessment formats, a discussion of music teachers’ assessment practices could take many directions, and an important goal of the current study is to delineate music teachers’ decision-making processes regarding student assessment. In the following section, assessment in secondary choral ensembles is discussed to explore what is known about the particular nature of choral ensembles and student

achievement in those ensembles, as well as how choral music educators have attempted to document evidence of student learning in an ensemble setting.

## Assessment in the Secondary Choral Ensemble

Music course offerings in secondary schools can be diverse (Fautley & Colwell, 2012); however, in many U.S. high schools and middle schools music instruction exists predominantly in performance-based ensembles (band, choir, orchestra) where the focus is primarily on the presentation of musical literature as a group (Abril & Gault, 2008; Miksza, 2013; United States Department of Education, 2011). Like their instrumental music colleagues, a choral music educator's effectiveness is judged not only on the musical quality of an ensemble's performance—at a public concert or contest, for instance—but also by the evidence of individual students' musical skills and understanding (Furby, 2013). The challenges of the large ensemble include not only the complexity of record keeping accompanied by a high volume of administrative responsibilities, but also the assessment of individual student learning (Henry, 2015; Kotora, 2005; Scheib, 2003; Tracy, 2002).

Historically, secondary choral music teachers directing these ensembles have struggled to assess individual student learning in a meaningful manner for a number of reasons having to do with the very nature of the large ensemble tradition (Kratus, 2007; Williams, 2011). One explanation may be that because the focus is often on the performance of repertoire by the entire choir, the assessment of an individual student's musical progress or content knowledge is not typically emphasized. Henry (2015) notes that individual assessment may not be seen as authentic to the nature of choral ensembles because the only time students perform their parts outside of the ensemble context is for assessment. Second, the achievement of the group as a whole can be evidenced by ratings obtained from adjudicators at a choral contest, however, these

scores are not valid indicators of individual student learning (Broomhead, 2001; Hash, 2013; Henry & Demorest, 1994) and can be biased by non-musical factors. In fact, Hash (2013) found that ensemble contest ratings and rubrics are not designed to measure individual skills, and, at best, are only valid assessments of a group performance in a very specific context. Further, he concluded that nonmusical factors such as performance order, ensemble names, judges' training and experience, length of the contest day, difficulty of repertoire, ensemble size, and participation of exceptional learners can influence contest scores, raising concerns of the integrity of those ratings.

Another issue that affects assessment practices in secondary choirs may be that, since most choral music educators teach students solely in the large ensemble setting (Tracy, 2002), individual student assessment is often seen as too time-consuming and impractical (Henry, 2015). Although it is rather common for instrumental music programs to include a separate time for small-group work outside of the large ensemble settings during which individual assessments are more easily conducted, these "pull out" sessions are not common among choral programs (Henry, 2015; Tracy, 2002). Perhaps choral programs that do allow teachers opportunities for individualized or small groups sessions would be more likely to assess individual achievement of their singers, but Tracy (2002) found that only 20% of choral music educators reported teaching in these settings. In tandem with the challenges of evaluating individual student achievement in this particular setting, the documentation of quantitative assessment data appears to be difficult for choral music educators due to the large numbers of students they have to assess, lack of instructional time to do so, and inadequate training in assessment techniques, among other barriers (Kotora, 2005).

**Assessment of sight-singing**

A musical skill that is particularly relevant to the choral ensemble, and one that will be important in the current study, is sight-singing—defined as "the reading or singing of music at first sight in order to perform it" (The Oxford Dictionary of Music Online, n.p.). Researchers have established that choral music educators value teaching sight-singing (Demorest, 1998) and tend to teach it frequently in their choral ensembles (Demorest, 2004; Kuehne, 2010). However, choral music teachers have not been found to assess sight-singing skill, especially that of individual students, on a regular basis (Demorest, 2004; Henry, 2001, 2015). Individual testing has been found to be an effective means of improving sight-singing performance (Demorest, 1998, 2004; Killian & Henry, 2005). Assessing sight-singing is complicated from physical and psychological standpoints (Henry, 2015) having to do with physiological changes of adolescence, issues of vocal timbre, difficulty retaining the pitch center, and undeveloped vocal technique in young singers. Henry also points out that the "singling out" of a singer when asked to perform a passage at sight individually tends to contribute to high levels of anxiety in young singers.

Choral music educators also may not have the resources to feel adequately prepared to assess sight-singing successfully. While formal tests of sight-reading achievement are available for music educators to use, this is a developing area in the choral setting. For band and orchestra teachers, the Watkins–Farnum Performance Scale (Watkins & Farnum, 1962) and the Farnum String Scale (Farnum, 1969) have been available for decades. Tests for use by vocal/choral teachers, such as the Vocal Sight-Reading Inventory (Henry, 2001, 2011)—an example described in detail in chapter two—are more recent developments and are still not widely used. Researchers have also noted that many standard choral methods texts do not include sections on sight-singing assessment (Floyd & Haning, 2015; Robinson, Gackle, Renfroe, & Usher, 2010).

**Use of Non-Achievement Criteria and the Assignment of Letter Grades**

Surveys of choral music educators have established that because of the complications involved with student assessment in performance-based ensembles, secondary choir teachers tend to turn to non-achievement and/or non-musical criteria, such as attendance, attitude, or participation in lieu of meaningful, discipline-specific assessment when evaluating their students (McClung, 1997; McCoy, 1991; Russell & Austin, 2010; Tracy, 2002). The researchers point to teacher preparation as a possible factor, in that choral music educators report not feel adequately prepared by their undergraduate programs to assess their students' learning (Kotora, 2005; McClung, 1997; Tracy, 2002). Additionally, teachers of music ensembles tend to develop assessment strategies based on personal preference or convenience rather than what research suggests is the best practice (Kotora, 2005; Russell & Austin, 2010). Russell and Austin note that "the net effect of these factors is that there is little professional consensus as to what teachers should assess, how they should assess or when they should assess" (p. 38).

Researchers found secondary music students' grades were heavily based on non-achievement, non-musical criteria, in some cases constituting 50-60% of grade weight (McCoy, 1991; Russell & Austin, 2010). Many of the extant studies related to assessment in music education do not draw a clear distinction between the terms *assessment* and *grading*, with the terms being used interchangeably, especially in much of the earlier literature. As Barrett (2006) notes, "grades are a persistent conundrum for music teachers. If music learning is rich and multidimensional, a single letter grade is a weak vessel for conveying a nuanced and comprehensive evaluation of student learning in music classrooms" (pp. 9-10). Barrett explains that assigning a grade requires a teacher to reduce evidence of student learning to a single symbol and that assessment can exist successfully even without assigning a grade. Further,

formative assessment in the music classroom might be more appropriate and more telling in some instances than a summative letter grade.

The difference between grading and assessment is the difference between reporting a highly compressed final evaluation and gathering evidence of student learning. Lehman (1998) argues that it is a problem when attendance at a concert plays a more substantial role in students' grades than the knowledge of the music they are performing. He criticizes this practice in stark terms: "Using grades to reflect criteria not based on the subject matter is at best dramatically inconsistent with the dominant culture throughout the school and at worst a blatant misuse of the grading system" (p. 38). This "musical malpractice," as Lehman calls it, is a difficult tradition to break, but it is crucial that music educators strive to find balance in how and why they assess. Kotora (2005) notes that assessment of concert attendance tells us little about students' musical development, and suggests that using a variety of assessment methods is preferable because it allows students to demonstrate their understanding in multiple ways.

## Technology's Potential Role in Assessing Music Learning

Multiple music technology experts suggest that music teachers can integrate technological tools to help make their assessment practices more effective or efficient (e.g., Bauer, 2014; Dammers, 2012; Dorfman, 2013; Nielsen, 2011). Dorfman (2016b) points out that states and school districts have devoted considerable resources to improving technological infrastructure and supporting technological integration. Meanwhile, articles related to the idea that technology that might help secondary choral music teachers document student achievement have become more common (e.g., Criswell, 2012, 2017; Pellegrino, Conway, & Russell, 2015). Though the availability of technological resources may be increasing, these sources imply that

music teachers use technological tools infrequently in their classrooms, especially for assessment of student learning (Bauer, 2012; Henry, 2014; Nielsen, 2011).

A number of music education policy recommendations and initiatives are underway in which technology plays a significant role (Bauer, 2010). The National Association for Music Education (NAfME) has consistently promoted the successful integration of technology in music classes through ongoing publication of technology-related practitioner articles, professional development opportunities made available at conventions and online, and a position statement on assessment that specifically discusses technology's role (NAfME, 2017), and through its influence in the development of the updated national standards in music. The National Core Arts Standards (NCAS; State Education Agency Directors of Arts Education [SEADAE], 2014) suggest the use of technology often throughout all of the disciplines as well as in the Model Cornerstone Assessments (National Association for Music Education, 2015). Two national associations devoted to the use of technology in music instruction have been established, in part, to acknowledge this professional need, the Technology Institute for Music Educators (TI:ME) and the Association for Technology in Music Instruction (ATMI). For example, TI:ME has developed technology competencies for music education that specifically address technology's potential in music student assessment (Rudolph, 2005).

Despite this attention from professional and scholarly associations and groups, there is sustained empirical evidence that music teachers collectively, and choral teachers in particular, have been slow to integrate technology in the music classroom, whether for instructional or assessment purposes (Dorfman, 2013; Dorfman & Dammers, 2015; Henry, 2014; Nielsen, 2011; Webster, 2011). Dorfman and Dammers note that a general perception exists throughout the profession that significant barriers stand in the way of music teachers' successful integration of

technology. Music teachers who use technology tend to use it more for instruction than assessment of student learning (Dorfman, 2008; Dorfman & Dammers, 2015; Nielsen, 2011), and further, they tend to use it primarily for administrative purposes (designing concert programs, communicating with parents) than for either instruction or assessment (Nielsen, 2011). Choral music educators have cited their limited time for implementation, unavailability of resources, and lack of training as the variables that most affect their use of technology-assisted assessment tools (Bauer, 2014; Nielsen, 2011). Dorfman (2013) summarizes three additional reasons why music teachers have difficulty integrating technology:

> 1) While using technology to learn music is not new, technological pedagogy is. Current teachers have few models from their own education of people who do this skillfully; 2) Teacher training (both pre-service and in-service) models to support music technology pedagogy are not fully developed; 3) Opportunities for improving skills as a technology-based music teacher are rare, and can be difficult to find. (pp. 20-21)

Although music teachers' level of technology integration has been low, their general attitude about technology has been positive (Nielsen, 2011). They also have consistently communicated a desire to learn more about technology and its use in the classroom (Dorfman, 2008). The disconnect between music teachers' positive attitudes or potential for successful technology integration and their lack of actual realized use of technology for student assessment is one of the key research problems identified in this study.

Dorfman and Dammers (2015) say that the profession is at a "critical juncture" in respect to technology, meaning that technology integration can either grow as an effective way for music teachers to elicit evidence of their students' learning in ways that traditional assessment methods cannot, or it can continue to be used as a surface-level tool. The small number of studies that

have been conducted on the use of technological tools for music assessment purposes show that about one in four music teachers say they never use technology to assess their students (Nielsen, 2011) and those that do use it infrequently (Dorfman, 2008). There are recent examples of secondary choral music teachers who employed technology such as handheld digital recorders (Hawkins, 2016) or SmartMusic (MakeMusic, 2017; Henry, 2014) to assist with their assessment of student learning, however, research in this area is extremely limited. Choral music teachers lack models of technological integration in the educational setting, and it is unlikely that they will successfully incorporate technology into their teaching without assistance (Dorfman, 2013). Research has shown that professional development experiences, such as music technology workshops, have a positive impact on successful technology integration; moreover, some scholars suggest that school districts, universities, and professional organizations should increase access to professional development regarding technology (Dorfman & Dammers, 2015).

The last survey study that was conducted solely on secondary choir teachers' assessment practices was Kotora's (2005) study of high school teachers in Ohio over ten years ago. Though Kotora's study focused very little on technology, he called for further research in the area saying, "With the increased availability of computer, audio, and video technology, it would be most interesting to look at how technology is being utilized by choral music teachers in assessing and documenting student achievement in choral music performance classrooms" (p. 76). In a closely related study that surveyed K-12 music teachers' attitudes regarding technology use for assessment, Nielsen (2011) suggested future research on best practices for using technology-assisted assessment tools in music education in general. It is surprising that so little empirical research has been conducted on the topic, especially considering music teachers' positive attitudes about technology-assisted assessment tools.

## Purpose and Research Questions

The purpose of this study is to investigate secondary choral music educators' use of technology-assisted assessment tools by determining their rationales for using assessment-related technology; their perceptions of the efficacy of using technology for assessing choral students; and the relationships between demographic, educational, and attitudinal factors and their reported technology use. Specifically, the study will answer the following research questions:

1. For what purposes and in what ways are choral music educators using technology-assisted assessment tools?
2. What factors enable or constrain choral music educators' integration of technology-assisted assessment tools?
3. What is the perceived efficacy of using technology-assisted assessment tools in the choral classroom?
4. To what extent do choral educators' demographics, professional backgrounds, comfort with technology, and levels of school support for technology predict
    a. the amount of time they spend integrating technology-assisted assessment tools;
    b. the variety of technologies used for assessment of student learning?

## Definition of Terms

*Assessment:* The process of gathering evidence of student understanding (Wiggins & McTighe, 1998). The term is also commonly used in practice and research in a general sense to describe a test or method used for the purpose of gathering evidence of student understanding.

*Test:* An instrument or method used to collect and record assessment data.

*Measurement:* "Considered a subset of assessment, measurement narrowly refers to the assignment of numbers to qualities" (Abeles, 2010, p. 170) and involves the quantification of test data (Boyle & Radocy, 1987).

*Evaluation:* A broader term, defined as judgments based on the data collected from a measurement or test (Nielsen, 2011, p. 9).

*Grading:* "A data-reduction process that uses a symbol to represent the results of an appraisal or evaluation" (Eisner, 1996, p. 76).

*Non-achievement Criteria:* Factors considered in assessment or grading that are not related directly to the content of a class. In the secondary music ensemble, the non-achievement criteria commonly cited by researchers are attendance, attitude, effort, and participation (Russell & Austin, 2010).

*Secondary Choral Music Educator:* Any high school or middle school faculty member (full-time or part-time) who is responsible for teaching a group of students to make music using their voices concurrently and collaboratively. Descriptions of this group vary by school and may include teachers who teach, but are not limited to, chorus, choir, or vocal ensemble.

*Technology:* Though often used generally, defined for the purposes of this study as hardware, software, and web-based programs/applications (Nielsen, 2011).

*Technology-Assisted Assessment Tools:* Hardware, software, and web-based programs or applications that enable a teacher to collect data on students' music knowledge and musical skill development (Nielsen, 2011).

*Technology Integration:* "In a broad sense, technology integration can be described as a process of using existing tools, equipment and materials, including the use of electronic media, for the purpose of enhancing learning. It involves managing and coordinating available instructional

aids and resources in order to facilitate learning. It also involves the selection of suitable technology based on the learning needs of students as well as the ability of teachers to adapt such technology to fit specific learning activities" (Okojie, Olinzock, & Okojie-Boulder, 2006, p. 67).

*Technology Use:* Can be used to describe a teacher physically interacting or engaging with a technological tool or, in the broader sense, a teacher enabling his/her students to employ technology in the educational setting. Can also be used to describe the frequency of use of technology-assisted assessments, the breadth of technologies used, and the function of their use.

## Significance of the Study

This study is significant to the music education profession for personal, practical, intellectual, and research-based reasons. First, it is important for any researcher to recognize and acknowledge the personal reasons for undertaking a lengthy study. My personal goals as a secondary choral teacher have influenced the approach of this study and informed its construction in ways that may not have been realized by a researcher with a different background. As a music education researcher, the decision to employ a quantitative survey design aided in my understanding of the assessment and music technology literature and will drive my personal research agenda as my career moves forward.

Second, the practical reasons for the study include the influence it may have on secondary choral music practitioners directly and indirectly. The insights gleaned from this study will help inform assessment practices at a time when choral teachers are in need of guidance. The study underscores problems with assessment in the secondary choral classroom: inconsistency of assessment strategies, infrequency of assessment administration, inefficiency of assessment tools, reliance on non-achievement criteria, and the overall lack of methods for

documenting the assessment of choral students. Investigating broadly why and how secondary choir teachers use or do not use technology to assist with these assessment issues will also help improve policy and decision making at the national, state, and local levels. The extent to which certain factors (time, cost, teacher preparation) enable or constrain choral music educators' integration of technology-assisted assessment tools will be directly applicable to both teachers and school administrators looking to support technology integration. Identifying and interrogating the reasons for choral music educators' low level of technology integration, despite their recognition of technology's potential for improving their efficacy, provides additional justification for this research.

Third, a survey specific to secondary choral teachers gives the profession additional empirical understanding of the relationships among choral teachers' attitudes toward, comfort with, and level of school support for technology and the amount of time teachers spend integrating assessment technology or the variety of technologies used for assessment. It also answers additional questions that previous research has not adequately addressed, including what types of technological tools secondary choral music educators are currently using for assessment, their rationales, and in what ways this affects choral instruction. Extending Nielsen's (2011) research on the attitudes of music teachers in regards to technology-assisted assessment tools and providing updated data related to Kotora's (2005) choral-specific study on assessment practices are valuable contributions to the music education knowledge base.

Finally, this study adds to the scholarly research and literature in the field because findings from the survey can serve as a foundation for future investigations on related topics, including those that might examine more closely how individual educators navigate technological advancements for assessment. This study will be a springboard for further research

because it is being conducted in a way that can be generalized or expanded to music disciplines other than secondary choral. Given the age of existing assessment studies related to secondary band, strings, or general music, the current study could certainly be adapted to provide more current information for those fields. From a research standpoint, the work done here can take the literature into new territory by expanding the investigation of technology use in music education assessment in a quickly changing technological culture.

# CHAPTER 2

# REVIEW OF THE LITERATURE

The current state of assessment in music education was discussed in chapter one, including the reasons and ways music teachers assess their students, the particular challenges that teachers of performance-based choral ensembles face, and the disconnect between music teachers' positive attitudes about technology and their lack of technology use for teaching or assessing music students. The overarching issue as it relates to the current study is that choral music educators have historically been inconsistent with their methods of assessment, often relying on non-achievement criteria to assess students' musical achievement. Educational initiatives that emphasize increased teacher accountability (NCTQ, 2015) now require music educators to provide quantitative documentation of student growth through assessment, which is yet another complicating factor. Technology-assisted assessment tools may help teachers augment their assessment practices to meet these requirements, but research suggests that teachers have been reluctant to implement such tools.

The current study investigates choral music educators' use of technology to assist with student assessment. This chapter is limited to the secondary setting because of the distinctive curricular goals at that level and the specific challenges of assessment in music ensembles. The following review of literature is divided into two broad sections: (1) teachers' assessment practices in secondary music education, which examines assessment in secondary music ensembles, assessment in the choral classroom, as well as sight-singing assessment; and (2) music teachers' use of technology, which includes their use of technology for assessment, their attitudes towards technology, and their music technology preparation.

## Teachers' Assessment Practices in Secondary Music Education

According to the National Center for Education Statistics (NCES), who surveyed 1065 U.S. music specialists, nearly all secondary music teachers (98%) conduct at least one formal assessment of their students' learning during the school year (United States Department of Education, 2011). When asked to what extent they used certain types of assessment methods, 82% of teachers who assessed their students indicated that they used observation "to a great extent" to determine student progress and achievement in music. Assessment of performance tasks or projects was also used by 73% of teachers "to a great extent." Other assessment methods, such as short written answers, multiple choice or matching tests, and portfolios were used to "a small extent" or "not at all" by most teachers.

The NCES report appears at first to indicate that assessment in music classrooms is quite prevalent; however, this report is general in scope compared with the scholarly literature focused on music education assessment. It may give an incomplete view of the actual frequency, depth, or breadth of secondary music teachers' assessment practices as it only investigated six generic assessment methods. For example, while the report found that 73% of music teachers assess their students using performance tasks or projects to a great extent, it gives no indication what musical concepts or skills they might be assessing through performance (e.g., group concerts, sight-singing, presentation on the life of a composer) or the exact frequency a teacher might consider assessing "to a great extent." Although it may be helpful as a starting point, it is also important to review the more specific music education literature.

An interesting finding from the NCES study that can be helpful to understanding the role of assessment in music education is related to music course offerings. According to the study, secondary school students in the U.S. experience music education primarily in large

performance-based ensembles, with 96% of schools offering band and 85% offering chorus. This echoes a study by Abril and Gault (2008), who surveyed 540 secondary school principals and also found that large ensemble instruction is by far the most common offering; other courses such as piano, guitar, music composition, or music technology were offered by fewer than half of schools. Since the focus of secondary music ensembles is primarily on the presentation of musical literature for a group performance, teachers of these courses are typically called to instruct and evaluate the learning of many students at once rather than providing more individualized assessment. Though large performance-based ensembles have a longstanding tradition in U.S. music education (Miksza, 2013), there are numerous factors connected with this course format that may complicate the assessment process. The following sections will explore the research associated with music student assessment in performance-based ensembles in general as well as exploring specific studies on secondary choral ensembles.

**Assessment Practices of Secondary Music Ensemble Teachers**

Russell and Austin (2010) surveyed high school and middle school choir, band, and orchestra educators to determine commonly employed assessment and grading practices. Members of the Southwestern Division of the Music Educators National Conference (MENC; *n* = 352) responded to a mailed questionnaire (36% response rate) about their use of written and performance-based assessment formats. An a priori list of specific assessment formats and objectives, divided into written and performance-based categories, was derived from Austin (2003). Participants reported whether they used any of six written assessment formats, "quizzes, worksheets, exams, homework assignments, projects/presentations, and journals/notebooks," to assess nine different student achievement objectives, "knowledge of music terms, symbols, or notation; ability to analyze or evaluate musical performance; ability to identify musical elements;

music theory knowledge; music history knowledge; knowledge of performance practices or pedagogical principles; knowledge of cultural contexts associated with pieces of music; composition; and knowledge of compositional techniques" (Russell & Austin, 2010, p. 45). Teachers also indicated whether they used any of ten different performance-based assessment formats, "live in-class playing exams, live out-of-class playing exams, ensemble concert performances, in-class sectional performances, auditions, audio-recorded playing exams, video-recorded playing exams, chair challenges, festival ratings, and solo/ensemble festival ratings," to assess six different student achievement objectives, "playing/singing technique; prepared performance of ensemble excerpts; prepared performance of solo/chamber repertoire; sight-reading; memorized performance; and improvised performance" (p. 46).

According to Russell and Austin's (2010) findings, secondary music teachers assess a limited range of the listed student achievement objectives and employ only a few assessment formats. The only objectives more than half of teachers assessed using written formats were: students' knowledge of music terms, symbols, or notation (97%); ability to analyze and evaluate music performance (71%); and ability to identify music elements by ear or sight (62%). Written assessment formats were mostly quizzes (74%) and worksheets (68%). Objectives teachers most frequently reported assessing though performance-based formats were playing or singing technique (67%) and prepared ensemble music performances (64%). Performance-based formats used most commonly were live playing exams in class (82%) and ensemble concert performances (52%). The other performance-assessment formats were only used by a small percentage of teachers.

Russell and Austin also investigated teachers' use of non-achievement criteria in grading, such as attendance, attitude, and practice time. Though they often conflate the terms *assessment*

and *grading*, Russell and Austin found that secondary music teachers assessed non-achievement criteria more often than musical criteria and gave non-achievement criteria more grade weight. On average, 60% of secondary music students' grades were based on assessment of their attendance, attitude, and/or practice time.

Drawing attention to distinctive practices in choral music educators' work, Russell and Austin also report that secondary music educators' assessment and grading practices are influenced by their teaching levels and specializations. Middle and high school instrumental directors placed less emphasis on attitude than choral teachers; instrumental teachers assigned attitude 21% of the overall grade weight versus 38% for choral teachers. Choral directors placed less emphasis on performance assessment through singing/playing tests than instrumental directors at 21% versus 32% of the students' grades, respectively. Interestingly, middle school choral directors gave more weight to written assessment of music knowledge than their middle school instrumental colleagues but there was no significant difference between high school choral and instrumental teachers. The influence of teaching level and specialization may be important to note while reviewing the assessment literature, considering the current study focuses specifically on the secondary choral classroom.

Unlike Russell and Austin (2010), who surveyed teachers of various teaching levels and specializations (K-12 general music, choir, band, orchestra), LaCognata (2010) specifically investigated the assessment practices of high school band teachers, examining the formats of their assessments, their purposes for assessing their students, as well as the frequency with which they employed specific assessments. High school band teachers ($n$ = 45) from North Carolina and Missouri completed a web-based survey (response rate of 28%) which also divided assessments into the categories of written and performance-based. The assessment formats used

in this study were very similar to those used by Russell and Austin (2010). LaCognata found that teachers use written tests/worksheets infrequently; 40% of the respondents never administered them. Teachers used performance-based tests most frequently: 36% reported using them on a weekly basis and 38% using them monthly.

In a second study, LaCognata (2013) again surveyed the assessment practices of high school band teachers. From a simple random sample of 4,500 U.S. band teachers who were members of NAfME, 454 completed an online questionnaire (a 10% response rate) containing a combination of closed- and open-ended questions and five-point numerical rating scales. Teacher observation was the top format employed to assess students' learning, selected by 80% of the band teachers. Sixty percent of respondents reported using written formats to assess students' music knowledge, most frequently short answer test/assignments (39%) and self-assessments (32%). Performance assessments were employed by most of the band directors (89%). Of those respondents, assessments were commonly based upon scales/rudiments (93%) or the ensemble music being studied (92%).

LaCognata asked participants to rate the importance of 16 purposes for music student assessment and found that most teachers reported assessing "to provide feedback to students" ($M$ = 4.63 on a 5-point Likert scale where 5 indicates the most importance) and "to determine what concepts students are failing to understand" ($M$ = 4.63). Teachers also highly ranked purposes related specifically to instruction, such as "to determine whether instruction has been successful" ($M$ = 4.33) and "to determine future instructional direction" ($M$ = 4.26). This finding represents a departure from past band research that has found more importance placed on performance purposes, such as musical preparedness for a public performance (see Kancianic, 2006).

Results from the aforementioned surveys suggest that secondary music teachers can assess their students' musical achievement using various formats for many purposes. Music teachers' choice of assessment formats and their purposes for assessing students in their ensembles, however, are often limited or narrow in range. Further, non-achievement criteria such as attendance and attitude commonly take the place of musical criteria and are given more grade weight than students' musical knowledge or skills. The frequency with which secondary music teachers employ certain assessments as reported in the literature appears to vary. These issues present an occasion for more research in this area.

**Consideration of the National Core Arts Standards**

While a great deal of attention is paid to the various ways music teachers assess their students in the music education assessment literature, less emphasis has placed on the role of national or state standards in assessing music student learning. Since there has been a renewed interest in the standards following the adoption of the revised National Core Arts Standards (NCAS; State Education Agency Directors of Arts Education [SEADAE], 2014), it is appropriate here to examine the ways music teachers may consider them in music student assessment. In 2014, the National Coalition for Core Arts Standards recognized that the educational landscape had changed dramatically over the preceding 20 years and that music teachers were in need of additional support in the areas of curriculum, instruction, and assessment. The coalition responded by updating the National Standards for Arts Education, first developed in 1994 (Consortium of National Arts Education Associations, 1994). The new NCAS were designed as a framework to help teachers recognize areas of learning within their discipline as well as identify measurable and attainable knowledge and skills that could be assessed (Shuler, Norgaard, & Blakeslee, 2014). Most states have adopted the NCAS or adapted them for use in their teacher

evaluation systems, and the content within them has become a part of what teachers are expected to teach and assess. The NCAS describe four "artistic processes" (creating, performing, responding, and connecting) that help categorize the areas of understanding in music that may be assessed. For the purposes of this study, I will briefly describe each in relation to the discussion of student assessment in the order they are presented in the NCAS.

*Creating*: In this artistic process, students understand the creation of musical works by exploring factors that might influence composers' musical choices. This could include building skills in arranging musical works or improvising their own compositions through traditional or nontraditional music notation. It also might include analyzing written music and the music theory concepts that were used in its construction. Though assessment of students' compositional skills is not as common as assessment of other areas (Fautley & Colwell, 2012), the assessment of students' musical creativity could range from simple improvisations to composition projects of four-part chorales that require knowledge of complex music theory part-writing rules.

*Performing*: Students perform music in this artistic process. This occurs in the group setting or individually when students demonstrate, on instruments or with their voices, understanding of the physical, technical, and expressive qualities of music. Performance-based assessment is one of the most common forms of assessment in music education in the United States (Fautley & Colwell, 2012; Russell & Austin, 2010). Assessments could range from ensemble-based music contest ratings assessing a group of students, to informal playing or singing tests assessing an individual student during a private lesson.

*Responding*: Students respond to music by listening to and analyzing compositions in terms of the music's structure, elements, context, or expressive intent. Music students can also be asked to respond to music by applying the interpretations that they make in their singing or

playing. Assessments based on this artistic process involve students' listening to a musical work, live or via recording, and responding verbally or by writing in journals about the music encounter. Conducting post-concert, peer- or self- assessment of a performance using this responding standard is thought to be a common practice among performance-based ensembles (Abeles, 2010).

*Connecting*: In the final artistic process, students connect to music by synthesizing their musical knowledge and experiences when creating, performing, and responding to music. This embedded artistic process encourages music teachers to help their students make connections among the music that they encounter and their personal lives, different cultures, and other educational disciplines. Since NCAS's connecting artistic process is embedded within the other three, assessments can be based upon a combination of all artistic processes.

Most pertinent to the current study is the NCAS's inclusion of the Model Cornerstone Assessments (NAfME, 2015). These are 20 teacher-designed and pilot-tested assessment strategies that correspond directly to the learning goals of the new national standards. The Model Cornerstone Assessments were developed to provide examples of both formative and summative assessment methods teachers can use as a guide when they are creating their own assessments. The creators aimed to "focus the great majority of classroom- and district-level assessments around rich performance tasks that demand transfer" (SEADAE, 2014, p. 16). Since the Model Cornerstone Assessments are currently still in the pilot testing stage, no empirical data related to how they are being used in secondary music ensembles is available.

The NCAS and Model Cornerstone Assessments may serve as a helpful framework for the development of music teachers' assessment practices; however, the music education assessment literature suggests that teachers of music ensembles tend to choose assessment

strategies based on personal preference or philosophy rather than state or national standards (Kancianic, 2006; Kotora, 2005; Russell & Austin, 2010). Russell and Austin (2010), for example, found that 70% of the music teachers in their study did not adapt their assessment practices because of a standards-based curriculum. Though they contend that "standards-based curricula should be considered a point of departure in formulating assessment strategies" (p. 51), more research is needed to determine if current music educators consider the NCAS when creating their assessments.

**Assessment in the Choral Classroom**

Assessment studies specifically focused on choirs are rare, but three commonly cited choral studies provide insight into secondary choir teachers' assessment practices (Kotora, 2005; McClung, 1997; Tracy, 2002). These studies identify a number of common challenges in choral music educators' assessment of their students. Among these challenges are teachers' reliance on non-musical measures of achievement when assessing choral students, the influence of amount of instructional time and student enrollment in a group format on their assessment practices, and choral teachers' lack of education in assessment techniques. Details of each study are discussed next.

McClung (1997) surveyed the students of the 1995 Georgia Senior High All-State Choruses, their choir teachers, and their principals to investigate the appropriateness of a variety of student assessment formats and grading practices, as well as attitudes and perceptions towards them. Though this study is now 20 years old and did not strongly differentiate between *grading* and *assessment*, it was one of the first studies to identify the lack of emphasis placed on student assessment in the choral classroom. All 615 students (100% response rate), 120 choir teachers

(80% response rate), and 117 principals (78% response rate) responded to separate surveys distributed during the All-State festival rehearsals.

Whereas written or performance-based assessments made up a small portion of the overall summative grade, 84% of the students responded that almost half to mostly all of their final choir grade was based upon participation, attendance, and attitude. According to the students, skill-based assessment through performance tests, such as sight-singing or "on-the-music" tests, made up 35% of their summative grade in choir. This finding was corroborated by the teachers' responses. Seventy percent of the teachers felt that written assessment formats were appropriate but the students indicated that written assessments accounted for only eight percent of their grade in choir on average. These findings are curious, considering that 90% of the participating teachers and 87% of the principals responded that they agreed that grades should reflect the achievement of specific learning objectives rather than participation or other non-achievement criteria. Bearing in mind the age of this study, its portrayal of the history or tradition of assessment practices in the choral classroom suggests the potential for further research.

Tracy (2002) went beyond describing assessment practices to look more closely at the factors affecting teachers' choice of assessments. In her study of high school choral teachers from the Southern Division of the MENC, 183 high school choral teachers responded (23% response rate) to a written survey on a broader set of topics, including instructional time, timing or frequency of assessment, enrollment, teacher-student ratio, education in tests and measures, philosophy, politics, and support for various types of assessment. Of these topics, an educator's personal teaching philosophy was found to be the most influential in his/her choices regarding individual student assessment. Approximately 70 to 80% of respondents who indicated an

"above average" or "strong" commitment to assessment evaluated their students regularly prior to performances, upon mastery of a concept or skill, and as needed for feedback. Fifty percent of teachers who said they felt assessment was "somewhat important" rarely or never assessed their students individually. Preparation in music tests and measures was also found to substantially affect choral teachers' assessment practices. According to Tracy, participants educated in general tests and measures were twice as likely to embed assessment in their daily instruction as their untrained colleagues.

Two factors that did not affect respondents' assessment strategies greatly in Tracy's study were class size and rehearsal time. Although teachers with choirs of fewer than 60 students were more likely to employ post-performance assessments, Tracy indicated that the size of the group had little influence on the overall timing or frequency of assessment. The number of hours of ensemble rehearsal time also was found to have little effect after conducting a chi-square analysis of instructional time cross-tabulated with assessment frequency. Tracy says that these results may indicate that other confounding variables affected the analysis. Still, it is interesting that two factors that other researchers suggest could greatly impact assessment decisions (Russell & Austin, 2010), were minor in her results.

Unlike Tracy, Kotora (2005) found that class size and rehearsal time did affect choral music teachers' assessment practices. In this study, 246 Ohio high school choral music teachers responded (43% response rate) to a written questionnaire about their assessment strategies; school, state, and national requirements; and undergraduate preparation in assessment. In the questionnaire, Kotora asked teachers if they used any of 12 "assessment strategies" determined a priori: video recordings; audio recordings; singing tests; written tests; written projects; student

portfolios; check sheets, rating scales, or rubrics; concert performances; individual performances; student participation; student attitude; and student attendance.

Despite concerns of time and balancing content, the teachers indicated that they used a variety of assessment strategies. Sixty-eight percent of the participating high school teachers reported using at least eight different assessment strategies from the list. Seventy-seven percent reported that they assess their students' skills via singing performance tests, and 74% reported assessing knowledge-based items via written tests. Though the teachers were only asked to indicate whether or not they used an assessment strategy (yes/no) and not the frequency of its use, Kotora found that the highest percentage of teachers assessed non-musical criteria such as participation, attendance, and attitude, mirroring McClung (1997). Specifically, student participation was assessed by 86% of the high school choral teachers, student attendance by 85%, and student attitude by 74%.

Kotora concurrently administered a second questionnaire to choral methods professors at Ohio colleges asking whether they taught preservice teachers to use the assessment strategies contained in the teacher survey; of 38 professors, 20 responded (53% response rate). He found the 12 assessment strategies identified above were taught by few of the professors. The most-taught strategies—video recordings, written tests, concert performances, and student attendance—were taught by 55% of the professors, and half of the participating professors taught strategies related to student performance assessment through singing tests. Overall, 85% of the college professors felt that their courses generally provided "adequate preparation" for future music educators. The high school teachers disagreed, in that 66% reported that their own undergraduate preparation had not prepared them to assess students in a choral music performance classroom.

When asked about reasons for choosing certain assessment strategies, both the teachers and the professors overwhelmingly indicated that they used assessments based on personal choice rather than school, state, or national requirements. For all 12 assessment strategies, fewer than 33% of teachers chose a strategy because it was required of them; fewer than 20% of the professors included a strategy in their courses based upon a state requirement or national standard. This finding is particularly relevant in light of the current study's purpose and the increased emphasis on teacher accountability since 2005, which may influence current teachers to consider these requirements more dutifully.

Kotora reports that, when asked about the most frustrating aspect of assessing their choral students, respondents mainly cited inadequate amount of class time to conduct assessments. Lack of class time for assessment directly relates to the large number of students in their choral ensembles, and choral teachers noted difficulty balancing class time spent on preparation of an ensemble for a public performance with assessment of individual students. Kotora's findings may indicate the importance of research into the time-saving potential of technology-assisted assessment tools.

Similar to patterns seen in the broader examination of music education assessment literature, these three choral-specific assessment studies (Kotora, 2005; McClung, 1997; Tracy, 2002) reveal inconsistencies in both teachers' assessment practices and the factors that affect teachers' assessment decisions. Research suggests that choral music teachers lack preparation in assessment methods and make assessment decisions without considering national or state standards, or course content in their teacher preparation programs. Further, the inconsistent findings among researchers on the effect of instructional time or student enrollment indicates that

further research is needed to better determine the state of student assessment in secondary choral classrooms.

**Research on sight-singing.** Although research on music assessment in choral settings is sparse, a closely related area of research may be informative. Henry (2015) noted in her review of the choral assessment literature that vocal sight-reading has long been one of the most frequently researched areas of choral music education. The sight-singing literature contains a developmental span of integrated studies, and research findings in this area are more consistent than those of music assessment literature. Teaching sight-singing was one of the first forms of music education in the United States, growing from the need for individuals to be able to read music for worship (Keene, 1982). It continues to play a substantial role in choral instruction (Demorest, 2004; Kuehne, 2007) and is consistently a topic of discussion in both research and practitioner journals (Henry, 2015). Choral music educators teach sight-singing with great frequency, and assessment seems to be a primary reason (Kuehne, 2010). The following section includes a review of the sight-singing studies related to assessment in the secondary choral classroom, beginning with sight-singing in group settings and then of individual choral students.

Demorest (2004) surveyed 272 middle and high school choir directors in the United States and Canada and examined their sight-singing practices as well as the frequency of both sight-singing instruction and assessment. Participants responded to an online questionnaire containing open-ended and Likert-type questions. Results were divided by category: "time devoted to sight-singing" and "sight-singing assessment" are most relevant to the current study. Demorest found that 89% of teachers reported teaching sight-singing in their choral ensembles. Those teachers spent an average of 9.5 minutes on sight-singing either "almost every class period" (52%) or "every class period" (28%) over the entire school year. Eighty percent reported

assessing sight-singing, with 36% assessing students individually at least three times per year. The most commonly used assessment procedures involved students sight-singing alone for the teacher (34%), alone in the choral rehearsal (10%), and in quartets during rehearsal (10%). About half (53%) of individual assessments were informal and ungraded sight-singing tests, a finding that again shows that assessment takes place but is less formally measured in the choral classroom.

Researchers have also found that teachers most often taught and assessed sight-singing in states that require sight-singing evaluation as part of their state-sponsored organizational contest (Floyd & Bradley, 2006; Kuehne, 2007; Norris, 2004). According to Norris (2004), who conducted a nationwide overview of large-group choral festivals, 25 states required group sight-singing at their high school contest. Seventeen state middle school festivals required assessment of sight-singing. Floyd and Bradley (2006) found that choir teachers whose groups excel in sight-singing for state contests spend a great deal of instructional time on sight-singing. Floyd and Bradley's study focuses on the sight-singing instruction and evaluation practices of high school choral directors whose ensembles received a "distinguished" rating in sight-singing at the Kentucky state choral festival. The researchers conducted phone interviews with 24 of the teachers (52% response rate) whose schools received this highest rating from the Kentucky Music Educators Association (KMEA). A large majority of the teachers (80%) taught sight-singing the entire school year and devoted an average of 18% of their rehearsal time to sight-singing activities. Seventy-nine percent also indicated that they administered individual sight-singing assessments, and 74% of those teachers gave individual tests more than twice a year. Floyd and Bradley found that 54% of the choral educators in the study said that they taught sight-singing in their classes before the KMEA made sight-singing a required part of the state

contest. All felt that preparing their students for the state evaluation improved their students' music reading skills.

Kuehne (2007) found similar results in a survey of 152 middle school choral teachers in the Florida Vocal Association (40% response rate). She examined sight-singing practices used in middle school choirs and found that 83% of respondents involved their choirs in choral contests where sight-singing was assessed. As a result, sight-singing assessment in those choirs received greater emphasis. Ninety-three percent of teachers reported teaching sight-singing in all of their choirs and half of those teachers taught it every day.

***Individual sight-singing assessment.*** Researchers have found that individual sight-singing assessment is most effective for determining student growth in reading music notation at sight (Demorest, 1998; Demorest & May, 1995; Henry, 2001, 2011). Demorest (1998) examined the effect of individual sight-singing assessment on students' sight-singing achievement. The study employed a quasi-experimental design involving 306 high school singers from pairs of intact choirs within six schools in the state of Washington. Two choirs at each school were randomly assigned either to a control group or an experimental group and given pretests. For the pretest, the students sang one major and one minor melody that they had never seen. During the 16-week treatment period, both choirs received identical group instruction in sight-singing; however, members of the experimental group also received systematic individual sight-singing testing. All students took a parallel-forms posttest identical to the pretest. Results indicated a significant gain in the mean score of the experimental group (0.73, $p = .03$), which led Demorest to conclude that individual testing can be an effective method for singers to transfer the sight-singing skills they learn in the ensemble setting to individual performance.

Henry (2001) recognized that although testing individual choral students' sight-singing skills may be effective, choral music educators do not emphasis individual sight-singing assessment. She hypothesized that this may be due in part to the difficulty of assessing sight-singing at the individual level. Much of Henry's work revolves around the development of a sight-singing instrument to assist choral music educators, the Vocal Sight-Reading Inventory (VSRI). The VSRI has undergone multiple revisions and additions (Henry, 2004, 2011) and now contains 28 specific melodic patterns and 15 rhythmic patterns that test singers on seven skill categories. It has been used in studies to determine the effectiveness of different approaches to teaching and assessing sight-reading, one of which will be discussed next.

Killian and Henry (2005) studied the effect of a 30-second study period on the accuracy of high school singers in a Texas all-state choir camp. Student volunteers ($n$ = 198) from 600 singers at the camp were tested using the VSRI. Participants completed a written survey regarding their experience in sight-singing. Of particular importance to the current study is the finding that 83% of high-accuracy sight-singers practiced sight-singing individually and 62% were assessed individually by their choir directors. These studies make a strong case for additional research into methods or approaches that could encourage and support individualized sight-singing education and assessment in secondary choral music education. Additional studies by Henry will be discussed later in the section specifically regarding technology use for sight-singing assessment.

**Summary of Secondary Music Education Assessment Studies**

The preceding review of the secondary music education assessment literature ranged from very broad studies showing that nearly all secondary music teachers administer some form of formal assessment (Russell & Austin, 2010; United States Department of Education, 2011), to

more specific studies on individualized sight-singing assessment in the choral setting (Demorest, 1998, 2004; Henry, 2001). The more general studies encompass a wide range of teachers and may appear on the surface to suggest that music teachers collectively assess at a high level; however, these studies simply asked whether teachers do or do not assess and give little insight into more important issues, such as frequency of assessment, breadth and depth of assessment, and the efficacy of music teachers' assessment practices. Many of the reviewed studies highlight the common use of formative assessment though teacher observation, but the importance of documenting this vital type of assessment is missing.

The choral-specific assessment studies provide details about more content-specific aspects of assessment in secondary music, particularly the prevalence of performance assessment at both the group and individual levels. They still fail to address critical areas of assessment, such as assessment through listening and responding to music, self- and peer-assessment, and the role of technology-assisted assessment tools. An interesting comparison for the current study is the difference between Kotora's (2005) finding that local, state, or national guidelines did not heavily influence choral teachers' assessment practices and Floyd and Bradley's (2006) finding that teachers who bring their choirs to contests with sight-singing requirements do assess their students more often. The idea of the influence of educational policies, professional expectations, and/or school requirements is a key issue in the current study.

The relative age of the music education assessment literature is perhaps the most striking aspect about this review. Music educators have written articles for practitioners with numerous suggestions for best practices; however, no large-scale empirical studies have been conducted on secondary choral music teachers' assessment practices since 2005. Given the increased emphasis on teacher evaluation and accountability measures since these studies were conducted, there is a

very strong need to reassess the landscape of assessment in the choral classroom in this new era. Secondly, the role of technology is minor or nonexistent in most of these studies. Multiple researchers suggest that technology could assist secondary music teachers with their assessments; however, little has been done to investigate this possibility. This will be particularly crucial as technology use continues to become even more prevalent in modern schools.

## Music Teachers' Use of Technology

In the second section of this chapter, the literature informs a series of survey questions that are used in the current study to provide a profile of music teachers' (1) general use of technology, (2) use of technology for assessment of student learning in the choral music classroom specifically, (3) attitudes regarding use of technology, and (4) perceptions of the importance of technology education.

A fundamental problem inherent in citing research on technology is the speed with which studies can become dated, as modern technology changes at a very rapid pace. To develop a sense of music teachers' adoption of technology over the past decade, older studies are examined to add to a general understanding of technology integration in music education. Though not on assessment specifically, these studies are important to review because integration of technology in music generally may indicate potential for similar use for assessment purposes. More recent studies conclude each subsection of the review to show more current instances of technology use in music classrooms and its relevance to assessment of student learning.

Dorfman (2008) examined the frequency with which K-12 music teachers (band, choir, orchestra, and general) use technology in their teaching. Of the 552 teachers who responded to the survey (37% response rate), most consistently reported that they use technology less than

once a month in each of the predesignated technology categories (writing or arranging music with notation software, creating music with a sequencer, recording live performances, burning CDs, creating accompaniments, making multimedia presentations, and using computer-assisted instruction applications). For example, 68% of teachers said that they use technology to make multimedia presentations for their classes less than once per month and 45% said they use notation software to write or arrange music with the same level of infrequency. To determine the types of technology most frequently used, Dorfman calculated a "regular use subtotal." Computer-assisted instruction applications were used in music classes most often, but only on a regular basis by 7% of teachers. Dorfman concluded that teachers use technological tools for pedagogical purposes infrequently. Interestingly, participants indicated a relatively high level of expertise in using technology for non-musical tasks. The major obstacles to technology integration were found to be lack of equipment (31%) and budget issues (36%).

Wise, Greenwood, and Davis (2011) studied teachers' use of digital technology to teach and assess music composition in the secondary classroom. Using a mixed-methods approach, the researchers asked nine music teachers from four secondary schools in New Zealand to complete a questionnaire as well as a semi-structured interview. Data also included classroom observations at least once over a one-month period. They selected the schools based upon their reputations for successful incorporation of digital technology, socioeconomic student backgrounds, and variety of music styles taught. Three themes emerged: (1) teachers' access to and use of digital technology, (2) classroom resources and how they were used, and (3) pedagogical change. Each participating teacher used digital technology in composition activities and reported using technology for preparing resources and arranging music. All observed teaching spaces contained computers and music keyboards used on a regular basis for musical purposes. With respect to

pedagogical change, the researchers found that classes became more student-centered with increased use of technology and noted a "discernable shift from instructivist to a more constructivist pedagogical philosophy" (p. 130). Though these courses were specifically devoted to composition, the application of a student-centered approach though technology use could be applied in other contexts.

Dorfman and Dammers (2015) examined factors to help predict music teachers' potential success in integrating technology. In a survey of 116 music teachers drawn from a random sample of U.S. schools from 12 states ($N = 665$, response rate 17.44%), the researchers asked about teachers' experience with, attitudes towards, and perceived efficacy of music technology and compared these against school demographic information. Interestingly, findings indicated no significant relationship between successful technology integration and demographic data such as geographic region ($p = .077$), community type (rural, suburb, city; $p = .116$), or school socioeconomic status ($p = .132$). Technology education showed the strongest relationship with successful technology integration, particularly state conferences ($r = .267$, $p = .008$), external courses ($r = .325$, $p = .005$), and self-study ($r = .375$, $p < .001$).

In one of only a few qualitative studies on music technology, Dorfman (2016b) studied a common current trend in education: the one-to-one computing model, where every student is issued a laptop or tablet to use in all classes. This study involved four purposefully-selected band, choir, strings, and general music teachers from the northeastern United States who had recently adopted the one-to-one model. He used a multiple case study model, observing the teachers in their classrooms three to four times and also conducting semi-structured interviews over a six-month period. Technology implementation varied among Dorfman's participants, however, often the teachers had students use their devices more for logistical purposes than

musical objectives or goals. For example, Jessica, a choral director, replaced sheet music with scanned electronic documents that her students viewed on their iPads. Though this might be a convenient way to distribute materials, Dorfman notes that it represents a substitution for traditional means rather than an augmentation of learning possibilities made possible by technology. Overall, Dorfman concluded that music teachers in a one-to-one environment may need specialized preparation in order to implement the technology in meaningful and authentic musical ways.

**Music Teachers' Use of Technology for Assessment**

Nielsen (2011) investigated music teachers' use of technology specifically for music student assessment. Although researchers have highlighted the potential of technology's role in assessing music student learning (Buck, 2008; Colwell, 2002; LaCognata, 2010, 2013), Nielsen found that music teachers employ technology more for instruction than for assessment. Of the 464 K-12 music teachers who responded (22% response rate) to an online survey, 28% stated that they regularly include technology for instruction while only 9% regularly use it for performance assessments. Fewer teachers (8%) assess students' content knowledge by technological means on a regular basis. Indeed, 23% never incorporate technology for performance assessments and 30% never use it for content knowledge assessments.

Of the participating music teachers who did conduct assessments with digital tools, they most commonly incorporate music notation software (71%) and digital recording devices (52%). Notation software makes it easier for teachers to create worksheets or quizzes for knowledge assessments, but students tend not to interact with this software directly. Handheld digital recorders audio-record students' playing or singing for performance-based assessments. Additionally, 39% of teachers reported using GarageBand and 32% assessed students via

SmartMusic, two commercially popular music software applications. Other tools such as interactive whiteboards, digital portfolios, or web-based tools were rare.

More recently, Hawkins's (2016) qualitative case study examined the practices of an exemplary teacher in choral music education who makes innovative use of technology for student assessment. Data included sixteen class observations over eight weeks and two semi-structured interviews that describe the practices of a U.S. high school choir director who administers multiple "technology-enhanced" assessments. Where Nielsen observed that music teachers used technology more for instruction than assessment, Hawkins found that, in this case, the choir director incorporated technology as much or more in assessment than in instruction. For example, instead of a traditional individual jury-style performance assessment where each singer performs their part alone for the teacher, the choir performed as a whole while individual singers sang into their own teacher-provided digital handheld recorder. The technology allowed the singers to remain in an authentic choral setting, but also provided the teacher with a recording from each individual student to assess.

**Performance assessment software.** The following section contains research related to music performance assessment software in anticipation of the current study. Although several performance-assessment software applications are currently available (e.g., Music Prodigy, PracticeFirst), SmartMusic has seen the widest adoption by music educators (Buck, 2008; Criswell, 2017) and is the only commercially available computer-based performance assessment tool that has been studied empirically by researchers. SmartMusic is an interactive software application that allows students to use a computer or iPad to build individual musical performance skills through computer-based lessons, a music-minus-one practice environment, and teacher-assigned playing or singing assessments. The software has been used in U.S. band

programs (Flanigan, 2008) and, with the 2012 software update, added numerous choral/vocal tools and resources to expand applicability to the choral setting (Henry, 2014). Although SmartMusic has been used mostly as a practice and instructional tool, recent additions to the software have made it more likely to be used by teachers for student assessment (Henry, 2014). Particularly, the capability to assess sight-singing performance using multiple popular sight-singing methods integrated into the program may prove to be of interest to current choir directors (Henry, 2014).

Buck (2008) studied SmartMusic's assessment feature to determine its efficacy as a tool for assessing students' musical performance ability. In an action research study, Buck gave all students in his large Midwestern band program ($N = 231$) an opportunity to participate. Over a period of three weeks, 46 high school band students received five 15-minute teacher-led lessons. Students were randomly assigned to one of two groups: (1) a control group given traditional teacher-led instruction, or (2) an experimental group given teacher-led instruction using SmartMusic assessment. Students completed pretest and posttest performances of one technical and one lyrical etude. Three expert judges scored recordings of the performances independently. Detailed scoring rubrics and a statistical analysis of inter-rater reliability ($r = .807$-$.894$, $p < .001$) helped limit threats to validity. Both groups' mean scores improved from pretest to posttest. The SmartMusic group showed a larger composite gain ($F(1, 43) = 4.29$, $p = .044$) on the technical etude. Buck concluded that SmartMusic is an appropriate and effective tool for assessment of musical performance skills.

Walls, Erwin, and Kuehne (2013) investigated how SmartMusic might increase instructional time in a large ensemble setting by enabling students to complete performance assessments outside of the ensemble rehearsal time. In this study, 59 high school band students

from a large suburban school in Georgia played an excerpt from their current band literature for individual assessment on two occasions. One week of assessments involved the more traditional method of live, in-class playing tests. Two weeks later, the students completed a second, individual assessment in one of four computer-equipped practice rooms or at home, if they personally owned the software. The researchers trained all students how to use the SmartMusic software in class for the study. Walls, Erwin, and Kuehne report that the SmartMusic treatment resulted in increased in-class instructional time during the SmartMusic assessment week. During the in-class playing test assessment week, an average of 62% of class time was devoted to instruction, compared with 75% during the SmartMusic assessment week. The out-of-class SmartMusic assessments resulted in an average daily gain of 12.7 minutes of teaching time. Data from a follow-up questionnaire about students' perceptions of the assessment experiences reveal that the majority of students (80%) preferred the SmartMusic assessment over playing in front of their peers in class. About half of the students (52%) said that they liked the SmartMusic assessment better because they get nervous when performing live in class. Additionally, 77% of respondents said they felt their musicianship improved as a result of using computer-based assessment tools.

Henry (2014) investigated choral singers' experiences with computer technology for sight-singing assessment with SmartMusic. High school choral students at a Texas summer choral camp ($N = 138$) completed a survey before and after an individual sight-reading assessment involving three never-before-seen melodies. Both SmartMusic and a choral music educator scored the performances. The surveys asked students about their backgrounds, previous experiences with computer-assisted assessment, as well as their perceptions of the technology-assisted assessment experience during the study. Henry found that only one student had

previously been assessed though performance assessment software. Most students (69%) had favorable or neutral opinions about SmartMusic before the sight-reading assessment. Posttest survey data showed a complete reversal, however, revealing that 69% had a negative perception following interaction with the program. This finding sharply contrasts with that of Walls, Erwin, and Kuehne (2013), who found that band students preferred being assessed through SmartMusic. The choral students in Henry's study cited the inability to set their own tempo as the main reason for their dislike of the computer-assisted assessment procedure. In a second, voluntary phase of the study conducted in response to the original study, researchers taught the students how to adjust parameters such as tempo. Following a second poll, 46 out of 47 of the second-phase students (98%) had favorable opinions of SmartMusic.

Petty and Henry (2014) also studied the effects of SmartMusic assessment on sight-reading ability in the choral classroom. Sixth-grade choir students from a suburban Texas middle school were randomly divided into four classes by gender: two technology classes ($N = 47$) and two non-technology classes ($N = 36$). Over a period of eight weeks, all groups received daily sight-reading instruction and weekly assessment. The technology groups used SmartMusic and the non-technology groups used paper notation. Pretest-posttest data showed significant gains in overall sight-singing ability for all groups ($t = 9.77$, 46 *df*, $p < .0001$ for the technology group and $t = 8.24$, 35 *df*, $p < .0001$ for the non-technology group); however, no significant difference between the groups' gains was found ($t = -0.32$, 81 *df*, $p = .75$). This suggests that the treatment was effective (a 143% increase) regardless of medium and that SmartMusic may be as effective with beginning choirs as traditional sight-singing instruction and assessment methods.

Research on music teachers' use of technology indicates that music teachers generally have not integrated technology in their classes at high levels or with great frequency. Lack of

equipment, cost of technology tools, and lack of education in music technology all present barriers to successful technology integration. Even though the literature suggests that teachers have had greater access to technology in the music classroom as time has progressed, teachers still report using technology infrequently for pedagogical reasons. Technology-assisted assessment tools are less prevalent than instructional tools in music teachers' practices, but computer-based performance assessment software, such as SmartMusic, has potential for successful integration in the secondary choral music classroom. Though a few cases of meaningful technology integration for assessment have been found, they are limited. Additional research is needed to further understand why choral music teachers may or may not be using technology-assisted assessment tools.

**Music Teachers' Attitudes Toward Technology**

Several studies have examined music teachers' attitudes towards technology integration and found relationships between teachers' personal comfort level with technology and the frequency or depth of their technology use (Dorfman, 2008; Dorfman & Dammers, 2015; Nielsen, 2011). Anxiety has been a common response among teachers looking to begin or expand their use of technology in their classrooms (Dorfman & Dammers, 2015), and an examination of the factors that contribute to this feeling, among others, is important for understanding music teachers' use of technology-assisted assessment tools. The literature in this section was used to formulate survey questions about how music teachers' attitudes about technology and technology-assisted assessment tools might affect their technology integration in the classroom.

Dorfman (2008) examined music teachers' attitudes toward technology and their perceived obstacles to successful integration. Five hundred fifty-two teachers of varying music

teaching specialties and experience levels (37% response rate) answered questions in a web-based survey about their technological experience, their comfort with technology, as well as their thoughts about the types of future technology education they would find valuable. Dorfman found that, though the respondents reported a relatively high level of comfort with computers for non-musical tasks (4.90 on a 6-point scale; *SD* = 0.89), the mean score for their comfort with music-related computer technology was lower (3.29 on a 6-point scale; *SD* = 1.392). Forty percent of respondents indicated that they were very interested in music technology integration; four percent indicated that they had no interest. Teachers indicated that their education in technology came mostly from personal exploration (83%), or in-service workshops provided by their school (73%). Sixty-two percent reported that they desire more technology education in the form of school-sponsored in-service workshops. Dorfman's finding is informative in that the desire for education may indicate teachers' positive attitudes toward music technology.

Nielsen (2011) studied music teachers' attitudes towards technology use in assessment of student learning. Four hundred sixty-four teachers (22% response rate) responded to a web-based questionnaire containing belief statements based on five attitudinal constructs: (1) technology ease of use, (2) beliefs about assessment, (3) beliefs about technology, (4) familiarity, and (5) endorsement by the experts. Nielsen found that respondents generally held positive attitudes towards technology-assisted assessment, with a mean score of 3.79 on a 5-point Likert scale (*SD* = 0.387). Nielsen's analysis determined that there was a significant difference between the teachers' positive attitudes toward technology use and their realized usage. This is an important finding as it identifies an area in need of further study, an investigation of why teachers may use or not use technology.

Bauer (2012) explored music teachers' perceptions of their personal knowledge of music technology using a framework developed by Mishra and Koehler (2006) based upon Shulman's (1986) well-known construct, "pedagogical content knowledge (PCK)." The main principle of PCK is that effective teachers possess not only a deep understanding of the content matter, but also the ability to use appropriate pedagogy to teach within that discipline. By adding a technological underpinning to Shulman's framework, they created "technological pedagogical and content knowledge" (TPACK). This model considers not only teachers' knowledge of technology, but also how they feel they are able to use it within a specific discipline. Technology intersects and overlaps with a teacher's knowledge of the content area and their general knowledge about teaching—the pedagogical knowledge. The three-part overlap represented by TPACK describes this infused and integrated tech-savvy employment of teachers' knowledge. Though it may seem that after teachers learn about a certain technology they would naturally transfer that skill to their content area, Bauer (2012) stresses the importance of the intersection of technological, pedagogical, and content knowledge.

Bauer surveyed 284 K-12 music teachers with a variety of specialties who were enrolled in one-week music technology workshops in 17 locations nationwide. The teachers completed an online questionnaire, which measured what they perceived to be their level in each of the TPACK domains as well as how they acquired those skills. Bauer found that teachers felt least confident in the technology areas of the model and lacked structured ways to improve their confidence. Teachers rated themselves lowest in the area of technology knowledge (TK) with a percentile score of 71% and second lowest in combined TPACK (73%). Teachers felt that they were strongest in pedagogical knowledge (PK) at 86% and content knowledge (CK) at 85%. When asked about the ways they learned to use technology to augment learning in their music

classes, respondents listed self-study (57%) and music education conferences (54%) as the top methods. Bauer concluded that the results may indicate that music teachers need quality preparation specifically on the integration of technology in order to feel confident enough to implement it. He offered the TPACK framework as a possible model for professional development experiences.

**Music Technology Professional Development**

Many of the studies exploring music teachers' technology integration also include an examination of the importance of specific music technology professional development (Bauer, 2012; Dorfman, 2008, 2016b; Dorfman & Dammers, 2015; Nielsen, 2011). Though an explanation of each researcher's suggestions regarding music technology preparation were included within the review of each study in the preceding sections, two studies specifically focused on the effect of professional development on music teachers' technology integration.

First, Bauer, Reese, and McAllister (2003) recognized the lack of technology use among music teachers and studied the efficacy of professional development in music technology as a possible solution. They surveyed 203 K-12 music teachers about their use of music technology such as recording software, MIDI, and digital media before and after the teachers participated in a one-week summer music technology workshop. The technology workshops were held at 19 universities in the Eastern and Midwestern United States and included participants teaching at various grade levels, music teaching areas, and experience levels. A web-based questionnaire asked teachers about their knowledge of music technology, comfort with music technology, and frequency of music technology use. Participants completed the questionnaire before and immediately following the workshop, and then also responded to a follow-up questionnaire nine months after.

Bauer, Reese, and McAllister determined that the one-week workshops were effective in all three areas. Significant differences were found between the pretest and posttest questionnaires in terms of technological knowledge (Pre $M = 63.65$, Post $M = 81.43$, $p < .001$), comfort with music technology (Pre $M = 49.27$, Post $M = 81.68$, $p < .001$), and frequency of technology usage (Pre $M = 38.49$, Post $M = 69.19$, $p < .001$). The knowledge and comfort scores remained high in the follow-up survey nine months later ($M = 75.08$ and 70.30, respectively); however, the frequency of use score fell to a mean of 49.63, indicating a need for more regular music technology professional development. The researchers also found a moderate correlation ($r = .43$, $p < .001$) between the frequency with which respondents used technology and their reported access to technological resources, meaning that increased access may lead to increased use. Bauer, Reese, and McAllister concluded that professional development is an effective way to assist teachers in making good use of technology in the music classroom.

Zelenak (2015) also investigated the effect of a summer professional development program on K-12 music teachers' technology integration and attitudes toward technology. In a large southeastern U.S. school district, 75 music teachers of various teaching levels and specializations completed an 8-day professional development program where they spent six hours each day receiving instruction in technology pedagogy, music-related computer hardware, MIDI, notation software, sequencing applications, and electronic keyboards. With the assistance of representatives from the Technology Institute for Music Educators (TI:ME), the teachers followed a curriculum equivalent to TI:ME's level 1A training. At the end of the school year following the summer program, 52 participants and 57 non-participants completed online surveys asking about technology use in their music classrooms. Also, five participants completed in-person interviews to provide qualitative data.

Results of the study included that the in-district professional development program was effective. Program participants reported they used technology in their music classes more frequently than non-participants ($\beta = 0.80$, $p < .001$). An additional interesting finding pertinent to the current study was that secondary music teachers used technology more than elementary music teachers ($p < .008$). Results from the interviews found that the teachers overall felt that they experienced a positive change in the quality of technology integration in their music classes, specifically an increase in the use of visual presentations. Finally, teachers also reported that their general attitudes towards technology integration had improved along with the frequency with which they used it.

In the preceding section, studies were reviewed that found music teachers have a positive attitude about technology in general, but are less confident incorporating technology in their music classes. Overall, researchers have argued that music teachers' increased comfort with music technology may lead to increased successful integration in the classroom (Dorfman, 2008; Dorfman & Dammers, 2015); however, teachers feel less comfortable within the area of TPACK. A high percentage of music teachers report a desire for more preparation in music technology, and multiple researchers suggest that more technology education offerings could increase teachers' confidence and comfort, thus increasing the potential for successful technology integration. No research has been published specifically examining secondary choral music teachers' attitudes towards technology and the influence those attitudes may have on technology integration in the choral classroom, which leaves a research gap.

## Summary and Synthesis

In summary, chapter two examined two main areas of literature that informed the current study. First, the extant research on assessment in secondary music ensembles suggests that a variety of assessment formats can be used in ensemble settings for a variety of purposes. These could range from written tests intended to measure students' knowledge of musical terms to teachers' informal observations during rehearsals to assess vocal tone. Quantitative survey studies from both the secondary instrumental and choral areas indicate that secondary music teachers have been inconsistent with their assessment practices, often lacking documentation or administering them infrequently. This inconsistency, combined with an overreliance on non-achievement criteria, has contributed to a state of uncertainty in the field regarding assessment, especially among secondary choral music educators.

Choral-specific assessment studies show a disconnect between secondary choral music educators' assessment practices and national, state, or school standards, as well as a lack of preparation in assessment methods through teacher preparation programs. These findings are especially revealing, given the educational reform climate described in chapter one, and have an important role in the current study. Key ideas regarding individual assessment of sight-singing highlight a positive move among choral practitioners to focus on individual assessment of musical skills. There is still work to be done in the area of individual musical assessment measures, but it represents a bridge between the inconsistency seen in earlier assessment studies and the current study's investigation of technology-assisted tools to help choral music educators employ assessments that are more effective, efficient, and based upon musical achievement.

Secondly, teachers' use of technology in the secondary music classroom was examined. Though literature is lacking on secondary music teachers' technology integration, both

quantitative and qualitative studies were reviewed to examine the ways music teachers have used technology to assess student learning. These studies suggest that music teachers have difficulty bridging their use of technology in daily life to its pedagogical integration in the classroom. Research shows that music teachers use technology more for instruction than for assessment, but examples of technology-assisted assessment tool use may be emerging.

The few existing studies involving technology-assisted assessment in the choral classroom provide evidence of choral teachers using technology to enhance student assessment. The performance assessment software SmartMusic was specifically discussed, which has the potential to increase technological integration in the choral setting. Studies exploring teachers' attitudes towards using technology reveal that, though music teachers have positive perceptions of technology, many lack the preparation and/or resources to successfully implement it. Multiple researchers suggest further study into professional development on music technology, and it is clear that exploration of these factors in the current study is timely from both research and practical viewpoints.

# CHAPTER 3

# METHODOLOGY

This study was designed to investigate music educators' use of technology-assisted assessment tools in the secondary choral setting. To address this research problem, a survey of current U.S. secondary-school choral music educators was conducted. Since the aim of this study was to gauge the trends and perceptions of a population of teachers, it was prudent to employ a survey research design (Creswell, 2009; Dillman, Smyth, & Christian, 2009) as completed by studies of similar purpose described in chapter two (such as Kotora, 2005; LaCognata, 2010, 2013; Nielsen, 2011; Russell & Austin, 2010; Tracy, 2002). For this study, a cross-sectional survey design (Levy & Lemeshow, 2013) was used for the purpose of describing the prevalence and nature of secondary choral music educators' use of technology in their assessment of student learning at a particular time. Through a self-administered questionnaire for data collection, a large number of choral directors in a variety of school settings were surveyed to gain a broad understanding of their assessment practices and the implications of technology use across the population. An online questionnaire survey format offered the advantage of efficiency in terms of time, cost, and convenience of data availability.

This chapter begins with details about the survey research methodology, including the development of the survey instrument, sampling procedures, and data collection. Information about the predictor and outcome variables employed in the study with citations to prior research follow. Next, data-cleaning procedures, the creation of composite variable scales, and data transformations are explained. Finally, the descriptive and inferential data analysis plans used to answer the research questions are described, including details about the regression models.

## Survey Design

### Survey Instrument Development

The Survey of Technology Use in Choral Assessment (STUCA) instrument (see Appendix A) was developed by the researcher for this study. Development of the survey began with an extensive review of questionnaires from key survey studies discussed in the review of literature (Kotora, 2005; LaCognata, 2010; Nielsen, 2011; Russell & Austin, 2010). During the development of the survey, multiple approaches were used to address validity and reliability.

A cognitive interview protocol (see Appendix B) was conducted with an experienced high school choir director as an initial assessment of the completed survey instrument. According to Ryan, Gannon-Slater, and Culbertson (2012), cognitive interviewing is currently one of the most widely used methods of questionnaire testing in survey development practices and is used routinely in well-funded, large-scale national surveys. The main approach includes a "think-aloud" protocol (Ryan, Gannon-Slater, & Culbertson, 2012), where interviewees report what they are thinking as they complete the questionnaire in real time. The interviewer is primarily an observer and merely provides instruction where needed. This stream-of-consciousness method allows the survey designer to observe and locate potentially confusing items and misinterpretation of questions. This technique has been shown to increase validity and reliability of surveys, improving the quality of survey evidence (Ryan, Gannon-Slater, & Culbertson, 2012).

Adjustments were made to the STUCA based on the results of the cognitive interview. Multiple survey questions were reworded to improve clarity. Definitions of key terms were created and included in the survey instructions for the appropriate sections. Response scales were changed for frequency-based questions to give respondents the option to report the number of

times they administered assessments per week, per month, or per grading period, rather than asking them to report in hours per month. All of these adjustments improved the readability of the survey in an effort to increase the accuracy of the responses.

As a second form of verification, a pilot study was conducted with a group of high school choir directors from one large, Midwestern school district. Though this was a small sample size ($n$ = 5) in a one-time administration, piloting the survey provided valuable insight for the final administration and was used to assess the feasibility of the STUCA. Slight adjustments were made based on the results of the pilot study, including wording of items and reordering of questions.

**Survey Instrument Design**

The STUCA consists of 38 questions, including: five-point scaled Likert-type questions (e.g., 1 = *strongly disagree* to 5 = *strongly agree*), questions where respondents input specific numerical data directly (e.g., selecting the number of times they administer a certain assessment per week, month, or grading period), open-ended response questions, and demographic questions. Responses choices for survey items were also randomized to reduce response bias. All questions were designed to measure the use of, rationale for, and perceived efficacy of integrating technology-assisted assessment tools in choral music education. These terms are defined as (1) *use*: the frequency with which choral music educators integrate technology-assisted assessment tools and/or the variety of tools they employ, (2) *rationale*: the reasons choral music educators use technology-assisted assessment tools, and (3) *perceived efficacy:* how effective or ineffective choral music teachers feel technology-assisted assessment tools are for assessing their students.

**Qualifying Questions.** The STUCA begins with two qualifying questions to determine whether the respondents were eligible to complete the survey (see the "sampling procedures" section later in this chapter for specific sample requirements). Although the NAfME membership list was used and members have the option to update their demographic data during the annual NAfME membership renewal process, those data are self-reported. Thus, qualifying questions were needed to verify the accuracy of the sample. Respondents who were qualified were able to continue taking the survey, and those who were not were excluded from the survey data collection.

**Research Question One.** To help answer the first research question, the STUCA contains questions that examine the ways in which choral music educators use technology-assisted assessment tools in their classrooms. This includes survey items documenting teachers' assessment practices, the frequency with which they use technology to assist with student assessment, and their purposes for integrating it. Based upon the review of literature, multiple potential purposes were presented to which respondents indicated their level of agreement or the frequency with which they used a certain practice.

**Research Question Two.** Items related to the second research question were developed to identify factors that may enable or constrain choral music educators' integration of technology-assisted assessment tools. Survey questions for this section were drawn in part from Nielsen's (2011) Perceptions of Music Assessment and Technology (PMAT) survey instrument. Respondents were asked to what extent they believe potential incentives (e.g., clarity of presentation, ease of data storage) and barriers (e.g., cost, time for setup) factored into their decision to use or not use technology-assisted assessment tools.

**Research Question Three.** The STUCA contains questions designed to gauge choral music educators' perceptions of technology-assisted assessment tools. This includes survey items investigating the perceived efficacy of gathering data through technological means to accurately assess student achievement, how these data inform their instructional decisions, and how the data are used to assign grades. Further, the teachers reported their views regarding the validity of assessment data obtained through technological tools.

**Research Question Four.** In order to determine potential predictor variables regarding the amount of time choral music educators spend integrating technology-assisted assessment tools as well as the variety of technologies they use for the assessment of student learning, the STUCA gathered personal, professional, and employment demographic information including: teachers' ages, self-reported gender identities, years of teaching experience, levels and specializations of education, primary teaching areas, school settings, and school types.

## Sampling Procedures

As discussed in chapter one, a relatively new requirement to formally document and report student assessment data has become prevalent in most states and may impact teachers' assessment decisions. Therefore, the sampling frame selected for this study included all U.S. secondary school choir directors who were members of the National Association for Music Education (NAfME) in 2017 and taught in states that require documentation of student growth as part of their formal teacher evaluation processes. According to the National Council on Teacher Quality (NCTQ, 2015), all states except eight (Alabama, California, Iowa, Montana, Nebraska, New Hampshire, Texas, and Vermont) have this requirement.

Selection of the sampling frame for the proposed study was determined as recommended by Fowler (2014), who suggests that a researcher should evaluate a sampling frame according to its comprehensiveness, probability of selection, and efficiency. With over 50,000 actively teaching members, NAfME is among the world's largest arts education organizations (NAfME, 2017) and has the most comprehensive list of actively teaching secondary choral music educators available ($N$ = 18,051). Specifically, those individuals who selected High School or Junior High/Middle School as their teaching levels and Choral/Voice as one of their teaching areas during their NAfME membership registration were included. The American Choral Directors Association (ACDA) membership list was considered as an option for the sampling frame, but only 30-40% of its approximately 19,000 members are K-12 teachers (Sundra Flansburg, ACDA Director of Membership, personal communication, December 19, 2017). Another reason for using NAfME rather than ACDA was that ACDA's membership list may have excluded any educators teaching choir who were primarily band or orchestra directors and thus more likely to be members of NAfME than ACDA.

As part of NAfME's Research Assistance Program, a stratified random sample of 5,000 secondary choral music educators was selected. In order to ensure proportional representation from all states in the U.S. that require documentation of student growth as identified by the NCTQ (2015), the sample was stratified by state. NAfME provided a list of how many secondary choir teachers were members from each state, and the percentage was applied proportionally to create a sample of 5,000 (see Appendix C). A NAfME staff member sent an email message related to participation in the study on behalf of the researcher to the email address provided by each NAfME member. These sampling procedures ensured that the probability of selection could

be accurately determined, and the assistance of the NAfME office also made the process more efficient.

## Data Collection Procedures

The timeline for data collection and dissertation completion can be seen in Table 3.1. The proposed study was approved by the University of Illinois's Institutional Review Board (Appendix D) prior to data collection. In an effort to obtain the greatest number of respondents and highest response rate, the STUCA was administered in two waves to two separate samples without replacement. Both waves were identical in format and sampling procedures and lasted three weeks each. Wave 1 was administered in May 2017, at the end of the typical school year. After receiving a low response rate, it was administered a second time. Wave 2 was administered in September 2017, at the beginning of the typical school year.

*Table 3.1. Timeline for Data Collection and Dissertation Completion*

| Date | Event |
|---|---|
| April 2017 | Cognitive interviews |
| April 2017 | Pilot Test of STUCA |
| May 2017 | STUCA Wave 1 |
| September 2017 | STUCA Wave 2 |
| October 2017 | Data collection closes; analysis begins |
| March 2018 | Dissertation Defense |

For each wave, a formal invitation was sent via email to the sample as described above. A reminder email was sent one week after the first invitation, and a final request was sent to those who still had not completed the survey within two weeks. In an attempt to ensure a higher response rate, an incentive of a random drawing for a $50 Amazon gift card was included in the invitation. The survey was anonymous, and those who were interested in participating in the

drawing had the option to report their email addresses. Postpaid incentives such as this are commonly used in web-based surveys, and research indicates that incentives increase the likelihood people will respond by 19% and complete the survey by 27% (Manzo & Burke, 2012).

The survey invitation and two subsequent reminders contained a link to the STUCA for participants who wished to complete the survey. Participants were informed that the survey was anonymous and confidential and that participation was voluntary via a consent letter on the first page of the survey. After acknowledging their consent, respondents completed the instrument via a web-based online questionnaire using SurveyMonkey. According to Manzo and Burke (2012), experts recommend that web-based surveys have an average completion time of 10 minutes, so the STUCA was tailored to meet that time frame by using an efficient paged format, a clear graphic interface, and a progress meter. The average time respondents took to complete the survey was 12 minutes. All responses were reported to the researcher through SurveyMonkey's secure web interface and uploaded into IMB's Statistical Package for the Social Sciences (SPSS) software format for data analysis.

## Survey Response

Wave 1 of the STUCA was sent to 5,001 NAfME members via email. Of these emails, 125 were returned as undeliverable and 2,965 were not opened by the recipients. After two reminder emails, a total of 541 teachers responded (11% initial response rate). A further 227 respondents were disqualified after answering the qualifying questions or failing to complete the entire survey, leaving 317 usable responses (7% overall response rate). Wave 2 was sent to 4,998 NAfME members via email without replacement of respondents in the first wave. Of these

emails, 201 were returned as undeliverable and 2,883 were not opened by the recipients. After two reminder emails, a total of 621 teachers responded (13% initial response rate). A further 280 respondents were disqualified after answering the qualifying questions or failing to complete the entire survey, leaving 341 usable responses (7% overall response rate). The two waves of the STUCA were then combined for analysis with a final sample of $N = 658$.

Survey response by state was proportional to the desired sampling frame of NAfME choral music educators described above with a few exceptions (See Appendix C). The percentage of STUCA completers from each state was within a percentage point of the desired percentages according to the stratified state list of NAfME members in most cases. Exceptions included Alaska, Delaware, New Jersey, New Mexico, and Tennessee, which returned no usable survey responses. Non-response bias resulting from the lack of respondents from these states will be discussed in the study limitations section of chapter five.

## Selection Bias

A certain degree of selection bias resulting from the sampling procedures and survey response can be expected in this study. Selection bias in survey research is described as the potential for a sample to be unrepresentative of the population intended to be generalized due in part to a disproportionate representation of specific groups in the sample. In the current study, 51% of respondents were suburban music educators who were members of a voluntary professional organization (NAfME), those who could afford to pay the yearly NAfME membership dues, and presumably teachers who may have greater access to technology resources than the overall population. These teachers may also work with a student population that uses this technology more often. Choir teachers who are NAfME members might tend to

come from more suburban areas and might be underrepresented in urban areas. Teachers from urban schools were underrepresented in the study, although urban educators may presumably also be underrepresented in the NAfME membership.

Though urban teachers were underrepresented in the study (14%), the coefficient for urban educators was non-significant. For the urban educators who did respond, it does not seem that ubanicity was a significant predictor of technology use. Thus, it was not found that suburban teachers' technology use was significantly different from urban or rural teachers' use. However, the large standard errors for urban educators is a plausible reason for the lack of statistical significance, which also could mean that urban teachers' technology use may be highly varied with extremes in use. Still, had the sample included more urban or rural teachers, the results may have been different. This is something to consider since technology accessibility may be different among urban and suburban educators. Since NAfME does not provide access to their members' demographic data, the true proportions are unknown, which is a weakness of using this population and a weakness of the study.

Other populations of choral music educators may have also been underrepresented in the sample. Due to an apparent error with the set-up of the qualifying questions in SurveyMonkey, teachers from New Jersey were inadvertently disqualified. Since New Jersey is a state with a sizable number of choral music educators, its omission likely resulted in a degree of non-response bias. Young teachers also were low in number in this study, with only 3% younger than 25 years old. Larger representation of these younger teachers may have revealed different patterns of use related to recent changes in the technology offerings of music teacher education programs. Additionally, the low survey response rate may indicate that teachers who chose to

respond to the survey may have a strong interest in technology or already be comfortable using technology-assisted assessment tools.

## Variables Employed to Answer Research Questions

### Research Question One

The first research question was concerned with choral music educators' purposes and methods for integrating technology-assisted assessment tools. The variables used to answer research question one are provided with citations of past research in Table 3.2. As discussed in the review of literature, previous researchers have suggested that the following factors may be reasons why music teachers use technology: time savings during assessment administration, gains in instructional time, more objectivity in assessment administration, clarity of assessment administration, quicker turnaround time for feedback to students, as well as increased ability to organize, store, and disseminate assessment data. Researchers have also investigated the ways in which music educators use technology-assisted assessment tools and found that they use tools such as digital recorders for performance assessments, music notation software to create assessments and assess music composition, and online applications such as musictheory.net as a supplement to music theory assessment.

*Table 3.2. Research Question One Variables and Citations to Past Research*

| Domain/Variable | | Citation to Past Research |
|---|---|---|
| Reasons music educators use technology-assisted assessment tools | | |
| | Time savings (assessment administration and instructional time) | Dorfman, 2016; Nielsen, 2011; Petty & Henry, 2014 |
| | Objectivity of assessment tool | Henry, 2014; Pellegrino, Conway, & Russell, 2015; Petty & Henry, 2014 |
| | Clarity of assessment presentation/administration | Henry, 2014 |
| | Provide timely assessment feedback to students | Henry, 2014 |
| | Organization, storage, and communication of assessment data | Dorfman, 2016; Pellegrino, Conway, & Russell, 2015 |
| Ways music educators use technology-assisted assessment tools | | |
| | Types of tools | Criswell, 2012; Dorfman, 2008, 2010; Nielsen, 2011; Petty and Henry, 2014 |
| | Types of assessments | Dorfman, 2008, 2010; Nielsen, 2011 |

**Research Question Two**

Research question two investigated factors that may enable or constrain choral music educators' integration of technology-assisted assessment tools. Variables used to analyze research question two are provided with citations of past research in Table 3.3.

*Table 3.3. Research Question Two Variables and Citations to Past Research*

| Domain/Variable | Citation to Past Research |
|---|---|
| Amount of technology training | Bauer, 2012; Bauer, Reese, & McAllister, 2003; Dorfman, 2008; Dorfman, 2016; Dorfman & Dammers, 2015; Kotora, 2005; Nielsen, 2011 |
| Attitude towards technology | Dorfman, 2008; Dorfman, 2010; Dorfman, 2016; Dorfman & Dammers, 2015; Nielsen, 2011 |
| Comfort with technology | Bauer, 2012; Bauer, Reese, & McAllister, 2003; Dorfman, 2008; Dorfman, 2016; Dorfman & Dammers, 2015; Nielsen, 2011; Petty & Henry, 2014 |
| Assessment philosophy | Dorfman, 2010; Dorfman & Dammers, 2015; Henry, 2015; McClung, 1997; McCoy, 1991; Pellegrino, Conway, & Russell, 2015; Russell & Austin, 2010; Tracy, 2002 |
| Amount of instructional time | Nielsen, 2011; Tracy, 2002 |
| Number of students and class size | Kotora, 2005; Tracy, 2002 |
| Time it takes to implement technology tools | Dorfman, 2016; Nielsen, 2011 |
| Amount or quality of technology resources and IT support | Bauer, Reese, & McAllister, 2003; Dorfman, 2008; Dorfman, 2016; Nielsen, 2011; Pellegrino, Conway, & Russell, 2015 |
| Cost of technology | Dorfman, 2008; Nielsen, 2011; Pellegrino, Conway, & Russell, 2015 |
| School district requirements for documentation of student assessment data | Hawkins, 2016; Pellegrino, Conway, & Russell, 2015 |

The incentives and barriers to both technology integration and assessment administration are perhaps the most well-developed portion of the existing literature base. Based upon the findings and methodology of multiple empirical studies discussed in chapter two, the predictor variables

related to this research question include: amount of technology training, attitude toward technology, comfort with technology, assessment philosophy, amount of instructional time, number of students and class sizes, time it takes to set up/implement technology tools, amount or quality of technology resources and IT support, cost of technology, and school district requirements for documentation of student assessment data.

**Research Question Three**

Research question three asked about the perceived efficacy of using technology-assisted assessment tools in the choral classroom. The variables used to analyze research question three are provided with citations of past research in Table 3.4. Unfortunately, there is not a well-established body of literature in music education regarding the effectiveness of using technology in the choral classroom from which to draw empirically suggested predictor variables. Henry (2014, 2015) and Petty and Henry (2014) discuss the potential effectiveness of performance assessment tools such as SmartMusic when used with vocalists. Buck (2008) studies the efficacy of SmartMusic in high school band students. Dorfman (2016b) and Bauer (2010) study the efficacy of technology used for music instruction. Based on the findings of these related studies, predictor variables for research question three were developed to include: effectiveness of music performance assessment technology, effectiveness of music creativity assessment technology, teachers' perceptions of the accuracy of technology-assisted assessment tools, and students' perceptions of the accuracy of technology-assisted assessment tools.

*Table 3.4. Research Question Three Variables and Citations to Past Research*

| Domain/Variable | Citation to Past Research |
|---|---|
| Effectiveness of technology-based music performance assessment | Buck, 2008; Henry, 2014; Henry & Petty, 2014 |
| Effectiveness of technology-based music creativity assessment | Bauer, 2010; Dorfman, 2016 |
| Teachers' perceptions of technology accuracy | Pellegrino, Conway, & Russell, 2015 |
| Students' perceptions of technology accuracy | Henry, 2014 |

**Research Question Four**

Research question four investigated to what extent choral educators' demographics, professional backgrounds, comfort with technology, and levels of school support for technology predict the amount of time they spend integrating technology-assisted assessment tools or the variety of technologies they use for assessment of student learning. The examination of the variables used in research question is divided into two main sections. First, two outcome variables will be explained with citations to prior research. Second, predictor variables used in analyses of the outcome variables will be discussed.

**Outcome Variables.** Okojie, Olinzock, and Okojie-Boulder (2006) define teachers' technology integration as such:

> In a broad sense, technology integration can be described as a process of using existing tools, equipment and materials, including the use of electronic media, for the purpose of enhancing learning. It involves managing and coordinating available instructional aids and resources in order to facilitate learning. It also involves the selection of suitable technology based on the learning needs of students as well as the ability of teachers to

adapt such technology to fit specific learning activities. (Okojie, Olinzock, & Okojie-Boulder, 2006, p. 67)

This definition from the general education literature includes two basic components: realized technology usage and types of technology used. Based on this definition and the work of music education researchers who have studied technology integration in the music classroom (e.g., Dorfman, 2008, Dorfman & Dammers, 2015), two outcome variables were developed to explore research question four: (1) the frequency with which choral music educators use technology-assisted assessment tools, and (2) the variety of technology-assisted assessment tools teachers use for assessment of choral students (See Table 3.5). Multiple regression analyses were used to examine relationships among variables related to these two outcome variables. The following subsections discuss these outcome variables and the rationale for their inclusion.

*Table 3.5. Research Question Four Outcome Variables and Citations to Past Research*

| Domain/Variable | Citation to Past Research |
|---|---|
| Frequency of technology use for student assessment | Bauer, 2012; Bauer, Reese, & McAllister, 2003; Dorfman, 2008, 2010, 2016; Dorfman & Dammers, 2015; Nielsen, 2011 |
| Variety of technologies used for assessment of student learning | Bauer, 2012; Dorfman, 2008, 2010; Nielsen, 2011 |

***Frequency of technology use for student assessment.*** Dorfman and Dammers (2015) posit that one important aspect of technology integration is measured in terms of quantity: the frequency with which teachers use technology in the classroom. How often music teachers use technology, both in general and specifically for instruction or assessment purposes, seems to be one of the first indicators that researchers consider when determining teachers' levels of technology integration. Multiple music technology researchers have included frequency as a

variable in their research questions or surveys (see Bauer, Resse, & McAllister, 2003; Dorfman, 2008; Dorfman & Dammers, 2015; Nielsen, 2011). Though using technology more often to assist with assessments may not always necessarily correlate with effectiveness in the classroom, it is logical to surmise that teachers who use technology more frequently experience success with the technological tools they use. Therefore, it is a goal of the current study to investigate what factors lead to increased frequency of technology-assisted assessment tool use.

***Variety of technologies used for assessment of student learning.*** Prior research has also investigated music teachers' integration of technology in terms of depth in addition to frequency, which includes the variety of technology tools music teachers use (Bauer, 2010, 2012; Dorfman, 2008, 2016; Nielsen, 2011). Part of this research involves the application of the technological pedagogical and content knowledge (TPACK) model (Koehler & Mishra, 2008; Mishra & Koehler, 2006). This model suggests that for teachers to be successful integrating technology into their teaching, they must understand not only how to use the technology but also the pedagogical principles for teaching with it. One of the leading professional organizations for technology in music education, TI:ME, developed a set of standards that describe areas of technological pedagogical skill and understanding based upon the principles of TPACK (Technology Institute for Music Education: Areas of Pedagogical Skill and Understanding, n.d.). According to these technology standards, teachers should obtain skills and understanding in six areas to make competent use of technology in the music classroom: (1) music instruction software, (2) computer music notation, (3) multimedia development, (4) electronic musical instruments, (5) productivity tools as well as classroom and lab resources, and (6) live sound reinforcement. The authors of the standards make it clear that not all of these areas may be applicable to all music classes; however, it is evident that they purport the use of a wide variety

of technology tools. Considering these recommendations and previous research, it is a goal of the current study to investigate what factors lead to increased variety in technology-assisted assessment.

**Predictor Variables.** The following subsections describe the predictor variables used in the multiple regressions for research question four. The variables used in the analyses are provided with citations of past research in Table 3.6. Most of the studies from the review of literature included a section discussing their participants' demographic and school characteristics. Some (Dorfman & Dammers, 2015; Nielsen, 2011) explored these variables specifically using correlational analysis or other analytical statistics; however, the analyses varied in degree of sophistication and conclusiveness of the findings. Based on the methodologies of these prior researchers, the predictor variables related to research question four of the current study included: age, gender, years taught, education, school setting, and primary teaching assignment.

*Table 3.6. Research Question Four Variables and Citations to Past Research*

| Domain/Variable | Citation to Past Research |
|---|---|
| Age | Bauer, Reese, & McAllister, 2003; Dorfman & Dammers, 2015 |
| Gender | Bauer, Reese, & McAllister, 2003; Dorfman & Dammers, 2015; Nielsen, 2011 |
| Years taught | Bauer, Reese, & McAllister, 2003; Dorfman & Dammers, 2015; Nielsen, 2011 |
| Education | Bauer, Reese, & McAllister, 2003; Nielsen, 2011 |
| School setting | Dorfman & Dammers, 2015; Nielsen, 2011 |
| Primary Teaching Assignment (Choir/Band/Orchestra/General) | Bauer, Reese, & McAllister, 2003; Dorfman & Dammers, 2015; Nielsen, 2011 |

Given on the research cited above, there is reason to believe that these predictor variables are related to the outcome variables of (1) frequency of technology use, and (2) variety of technology used. The predictor variables were organized into five categories, which served as the models within the regressions for both outcome variables. They are presented here in the order in which they were run in regression analysis.

***Teachers' Comfort with Technology.*** Past research has suggested that music teachers' comfort with technology (Bauer, 2012; Dorfman, 2008) and attitudes towards technology (Nielsen, 2011) may have an impact on their integration of technology-assisted assessment tools. Thus, model one investigated teachers' comfort with technology using the following variables: teachers' comfort using technology in their personal lives and teachers' comfort using technology in assessment of choral students. These variables were placed first in the regression because Nielsen's (2011) study is most closely related to the current study, and these attitudinal variables are thought to be closely related to actual technology usage.

***Teacher Characteristics.*** Model two included teacher demographic characteristics as predictor variables, including age, teaching experience, highest degree earned, and gender. Multiple researchers have indicated the need to study the effect of teacher demographics more deeply. Bauer, Reese, and McAllister (2003) studied the effects of years of teaching experience, education, and teaching assignment on technology integration and found only slight differences in the gender variable. Nielsen (2011) finds that gender and age were significant variables related to teachers' attitudes towards technology-assisted assessment tools; specifically, females in the study who had taught the longest had the lowest technology attitude scores on the Perceptions on Music Assessment and Technology survey tool. In his review of the research related to the use of technology in music teaching, Webster (2011) expresses that there is a common belief that males

are more interested in technology and use it more frequently, but concludes that more research is needed on issues of gender and technology. Since prior research has been mixed and further investigation has been advised by past researchers, these variables were included in the regression analyses.

***School Demographics.*** Model three used the predictor variables school setting (rural, suburban, urban) and school type (public, charter, private). The availability of technological resources in schools has been shown to impact teachers' use of technology (Bauer, Reese, & McAllister, 2003). Though Nielsen (2011) found that school setting had little impact on teachers' attitudes towards technology-assisted assessment tools, school demography may play a part in the quantity and quality of technological resources available for teachers to use, so it was included in the regression model.

***Training in Technology.*** Model four included the predictor variables: training in technology through professional development, and training in technology during teacher preparation (i.e., undergraduate studies). Prior research has provided evidence that training experiences may impact teachers' technology integration in the classroom (Bauer, Reese, & McAllister, 2003; Dorfman, 2008; Dorfman & Dammers, 2015). Although studies have indicated that preparation in technology-assisted assessment tools at the undergraduate level has been rare, music teachers more commonly participate in professional development sessions that include training in technology (e.g., summer workshops, state music education conferences). Especially given the fast-paced technological advancements over the past decade, there is reason to believe that teachers who receive this training may use technology more often and/or use a wider variety of technology tools. Therefore, these predictor variables were deemed appropriate for use in the current study.

***School Technology Factors.*** Finally, model five contained variables related to the technology resources at teachers' schools. These included teachers' responses to survey questions asking about three potential barriers to using technology-assisted assessment tools (lack of resources, cost of technology, and technical problems beyond the teachers' control) as well as the presence of technology support professionals in the school. As described above in the discussion of variables related to research question two, the barriers teachers have reported when integrating technology in the music classroom have been documented by multiple studies (Bauer, Reese, & McAllister, 2003; Dorfman, 2008, 2016; Nielsen, 2011; Pellegrino, Conway, & Russell, 2015). Whether these barriers correlate with decreased technology use, however, has yet to be explored conclusively. The effect of technology support personal has not been researched in previous studies, but is considered prudent for the current study as assistance from these professionals may enable teachers to integrate technology more easily.

## Data Analysis

### Data Cleaning and Preparation

Since the STUCA was self-administered and data was exported from SurveyMonkey into SPSS, data cleaning was required. This subsection describes these procedures. The coding of survey items following the SurveyMonkey export was not consistent, and multiple response scales were reversed (i.e., 1 = *strongly agree* instead of 1 = *strongly disagree*). A case-by-case verification of respondents' answers was conducted to identify and correct the coding. Data were also transferred to the statistical analysis program Stata (Statcorp, 2017) to make use of specific features unique to that software (e.g., robust standard error analyses for multiple regression), so

recoding was required after that export as well. All survey items were required, so there were no missing data.

**Data Transformation.** Most of the survey items in the STUCA use Likert-type response choices that produce ordinal data; however, continuous data was desired for certain frequency-based questions (survey items 10, 12, 13, 14, 15) because it allows for linear regression, which is easier to interpret. Prior research has suggested that the frequency with which music educators administer assessments varies (Nielsen, 2011), and most music teachers integrate technology in the classroom less than once a month (Dorfman, 2008). But, teachers most likely could not accurately recall the number of times they use a particular assessment format over an entire school year. In order to afford respondents the most flexibility, they were given the choice to answer frequency-related questions in number of times per week, per month, or per grading period. Respondents were also asked how many weeks long their grading periods were so that the data could be transformed into a continuous variable in the common time frame of nine weeks, which was the most frequently indicated time frame (60%). The nine-week transformation was calculated by multiplying respondents' selected grading periods by the fraction required to convert it to one week, then multiplying it by the number of times they indicated using a technology tool, and finally multiplying that number by nine.

**Composite Variables.** The transformed, continuous data from survey item 12 were combined into a composite "frequency of technology use" index indicating how many times each respondent used technology to assist with a given assessment format (e.g., written tests, listening responses, individual sight-singing tests) over a nine-week grading period. Composite scores ranged from 0.31-2.49 times per grading period. See Table 4.2 for a full list of variables with means and standard deviations. This composite serves as the first outcome variable for research

question four. Internal consistency analysis was conducted on the nine variables within the composite using a Cronbach's alpha test. The frequency of technology use composite measure was found to be moderately reliable (9 items; $\alpha = .75$).

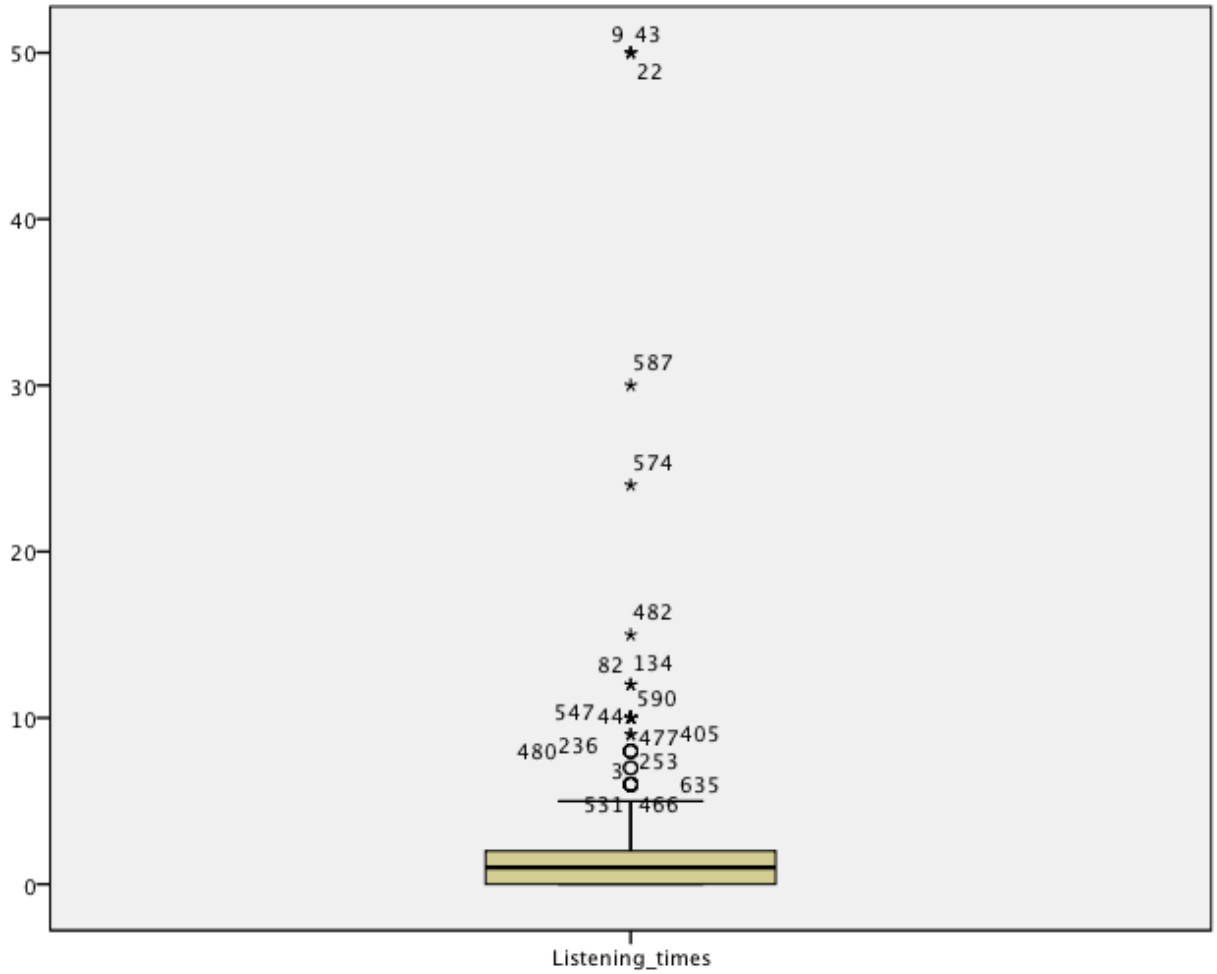
A composite "variety of technologies used for assessment" index was created by adding the total number of unique technology-assisted assessment tools respondents selected in survey items 13, 14, and 15 (e.g., laptops, handheld recorders, SmartMusic). Composite scores ranged from 0.13-11.04 times per grading period. See Table 4.4 for a full list of variables with means and standard deviations. This served as a second outcome variable for research question four. Internal consistency analysis was conducted on the 16 variables within the composite using a Cronbach's alpha test. The variety of technology tools composite was found to be moderately reliable (16 items; $\alpha = .74$).

**Outliers.** In survey questions 10, 12, 13, 14, and 15, respondents were asked to indicate the times they used an assessment format or a specific type of technology-assisted assessment tool. Extreme outliers were detected in the data for this section of the survey. For example, one respondent claimed they administered listening response assessments 50 times per week. Since it is unlikely that a choral music educator would administer so many of the same assessment every week, this was most likely an input error. Outliers like this could lead to a misleading interpretation of the spread of the data.

After first examining the frequency and summary statistics to identify cases well outside the bulk of other observations, the interquartile range rule (Cook & Upton, 1996) and boxplots were used in SPSS to determine outliers at the 1.5 multiplier (see Figure 3.1). As suggested in Heeringa, West, and Berglund (2010), regressions were run with and without outliers to investigate the impact of these influential points on the fit of the model. Since the median of the

responses to many of the frequency-related questions was 0 (i.e., most respondents indicated they did not assess improvisation), the outliers did have an impact on the results of the regression models. Extreme outliers were then winsorized as suggested by Salkind (2010 ) to address the heavy-tailed distribution. Data were winsorized by recoding data points at the ends of the tails of the distribution to the next highest/lowest value within the distribution that were not suspected to be outliers.

*Figure 3.1. Outliers Identified in SPSS for the Listening Times Variable*




o = Outlier (IQR 1.5 multiplier). * = Extreme outlier (IQR 3.0 multiplier)

**Descriptive Analysis Plan**

Descriptive statistics (i.e., frequencies, means, standard deviations) were used to describe research question one ("For what purposes are choral music educators using technology-assisted assessment tools?"), research question two ("What factors enable or constrain choral music educators' integration of technology-assisted assessment tools?"), and research question three ("What is the perceived efficacy of using technology-assisted assessment tools in the choral classroom?"). Responses to open-ended questions were coded, analyzed by frequency of themes, and used in a descriptive and interpretive manner.

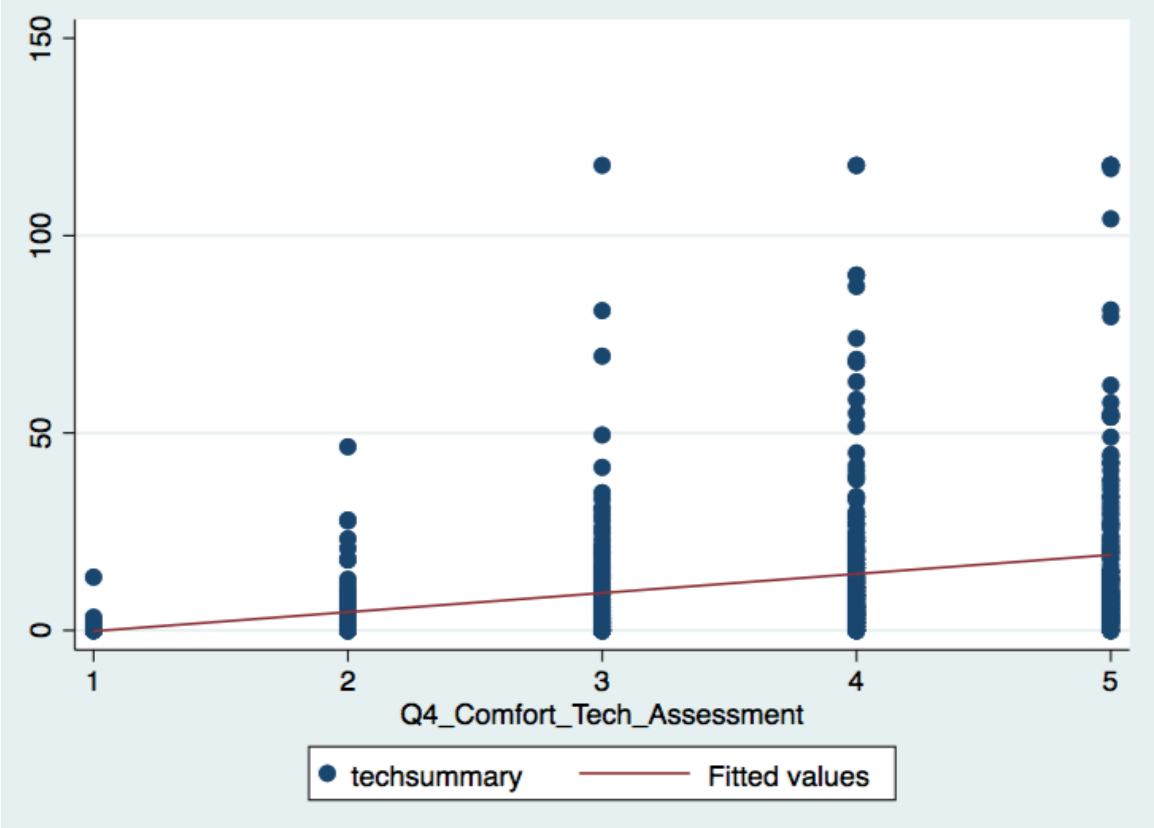
**Inferential Analysis Plan**

Multiple linear regression analyses were conducted to determine whether the frequency with which choral music educators use technology-assisted assessment tools (outcome variable one) or the variety of technology tools they use (outcome variable two) were related to the potential predictor variables described above. Following the aforementioned data cleaning and preparation steps, the data were screened for violation of the assumptions of multiple regression prior to analysis. The subsections below describe the steps taken to test each assumption as described by Allison (1999). A concluding paragraph follows explaining the actions employed to address any violations.

**Linearity.** A review of scatterplots of the predictor and outcome variables indicated that linearity was a reasonable assumption. As seen in Figure 3.2, the line of best fit placed on the scatterplot of outcome variable one, frequency of technology use, and a significant predictor variable, comfort with technology-assisted assessment tools, shows a steady increase suggesting linearity. Multiple scatterplots were inspected to represent the potential predictors relationship

with the two outcome measures with careful consideration of possible *U*- or inverted *U*-shaped distributions, which might suggest nonlinear relationships.

*Figure 3.2. Scatterplot of Outcome Variable One (Frequency of Technology Use) and the Predictor Variable Comfort with Technology-Assisted Assessment Tools*




**Normality.** The assumption of normality was tested using graphical examination of the data via histograms and boxplots in SPSS (See Figure 3.1). Review of the residuals as well as skewness and kurtosis statistics revealed that the outcome variables were not normally distributed, but rather positively skewed, suggesting that the assumption of normality was violated. Though winsorizing outliers as describe above in the "outliers" section helped reduce large standard errors, the high percentage of teachers who did not use certain assessments (e.g.,

81% of teachers reported that they never use improvisation) resulted in a non-normal distribution.

**Homoscedasticity.** A visual inspection of residuals plotted against the fitted values was used to test for a violation of the assumption of homogeneity of variance. For outcome variable one, the plot produced a clustered and skewed distribution with a lower shelf, suggesting that heteroscedasticity may be an issue (see Figure 3.3). However, a relatively dispersed display of points on the scatterplot for outcome variable two (see Figure 3.4) suggested that the second regression may meet the assumption.

*Figure 3.3. Plot of Residuals Against Fitted Values for Outcome Variable One*

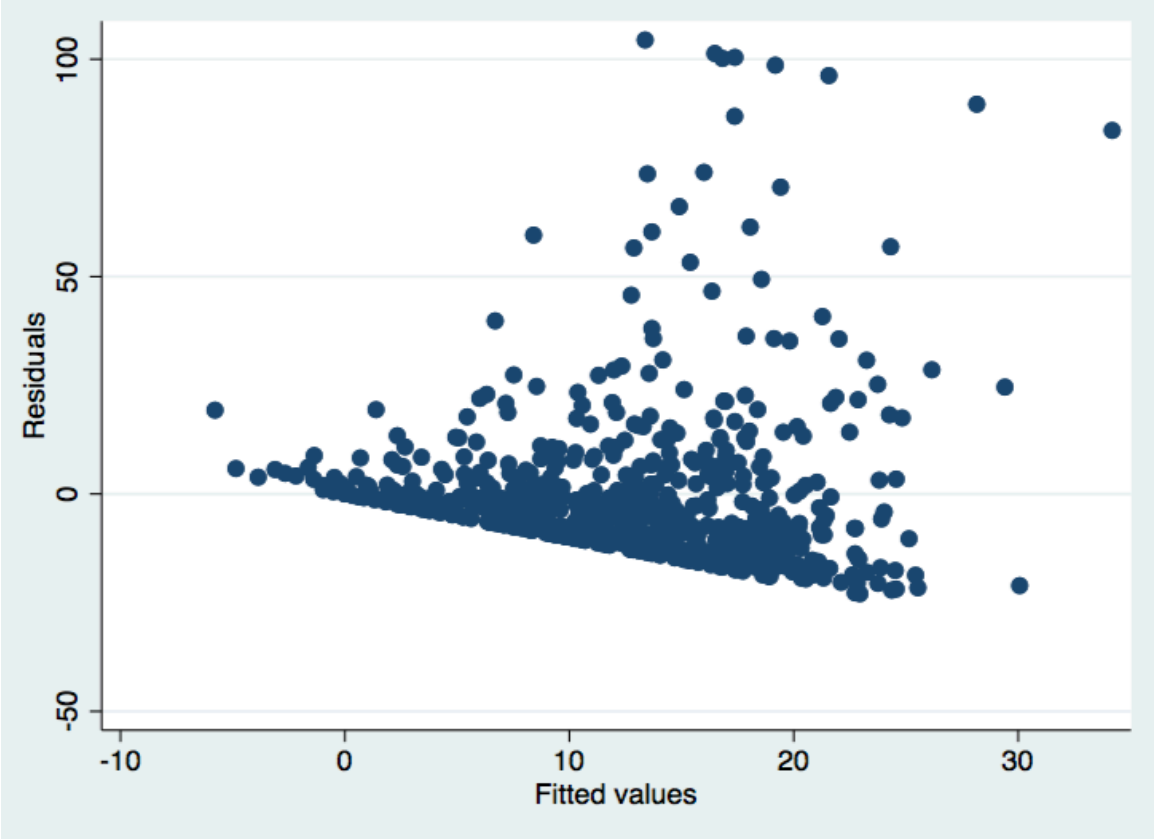
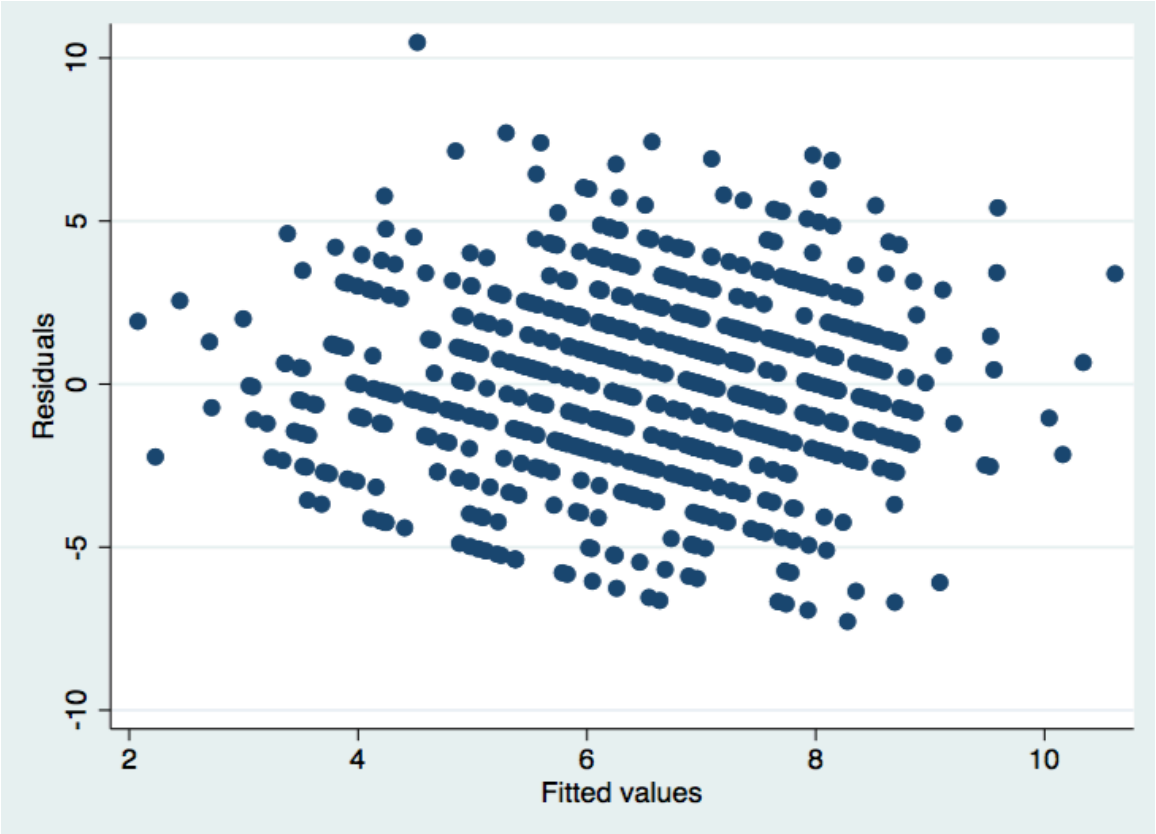


*Figure 3.4. Plot of Residuals Against Fitted Values for Outcome Variable Two*




**Multicollinearity.** The assumption that predictor variables are not related to one another was tested by running correlations between suspected variables: age, years taught, and highest degree earned. Pearson's product-moment correlation coefficients were calculated, and these variables were found to be moderately correlated ($r$ = .30 - .60, $p \leq .001$). This suggests the assumption for multicollinearity may be violated.

Though not all assumptions were met, regression analyses were appropriate for these data because both the frequency and variety outcome variables were continuous, and the potential predictor variables varied as categorical or ordinal variables. Allison (1999) posits that normality assumptions can be violated with larger populations (above 200), and the large sample size in the current study ($N$ = 658) allowed the analyses to retain statistical power. Robust standard error

techniques were also used as suggested by Allison to obtain less-biased estimates due to potential problems with heteroscedasticity in the data. Finally, careful inspection of the coefficients across sequential models where additional predictors were included in the analysis was used to detect any impact multicollinearity could have on the analytic results and construct the regression model of best fit. To accommodate for the potential violation of the multicollinearity assumption, the age variable was removed from the models.

## Summary

This chapter provided details about the survey research methodology, including development of the survey instrument, sampling procedures, and data collection. Information about data cleaning procedures, creation of composite variable scales, and data transformation followed. Descriptive and inferential data analysis plans used to answer the research questions were described, including details about the regression models. The results of these analyses are presented next in chapter four.

# CHAPTER 4

# RESULTS

This chapter contains the results for all research questions: research question one, for what purposes and in what ways are choral music educators using technology-assisted assessment tools?; research question two, what factors enable or constrain choral music educators' integration of technology-assisted assessment tools?; research question three, what is the perceived efficacy of using technology-assisted assessment tools in the choral classroom?; and research question four, to what extent do choral educators' demographics, professional backgrounds, comfort with technology, and levels of school support for technology predict (a) the amount of time they spend integrating technology-assisted assessment tools and (b) the variety of technologies used for assessment of student learning? The chapter begins with the demographic results for the sample. The results of the descriptive statistical analyses for research questions one, two, and three follow. Finally, the results of the multiple regressions described in chapter three are presented to address research question four.

## Demographic Analysis

Teacher and school demographic variables included: age, years of choral teaching experience, gender, primary teaching assignment, school setting, school type, and highest level of education. Half of the teachers were between the ages of 25 and 44 and had been teaching at least 11 years. Sixty-four percent of teachers held a master's degree or higher. The majority of the sample was female (70%) and taught in public schools (86%). Over half of the educators reported working in suburban schools (51%) and most of the teachers' primary assignments were choir (79%). Full teacher and school demographic results are presented in Table 4.1.

*Table 4.1. Demographic Characteristics of Participants*

| Characteristics of the Sample | *N* | Percent of Sample |
|---|---|---|
| Years teaching secondary choir | | |
| 1-5 school years | 185 | 28% |
| 6-10 school years | 128 | 19% |
| 11-20 school years | 181 | 28% |
| 21-30 school years | 120 | 18% |
| 31+ school years | 44 | 7% |
| Age | | |
| 18-24 | 22 | 3% |
| 25-44 | 384 | 51% |
| 45-64 | 240 | 37% |
| 65+ | 12 | 2% |
| School setting | | |
| Rural | 235 | 36% |
| Suburban | 332 | 51% |
| Urban | 91 | 14% |
| School type | | |
| Public | 536 | 82% |
| Charter | 25 | 4% |
| Private | 97 | 15% |
| Primary teaching assignment | | |
| Choir | 521 | 79% |
| General Music | 81 | 12% |
| Band | 51 | 8% |
| Orchestra | 5 | 1% |

*Table 4.1. (Cont.)*

| | | |
|---|---|---|
| Highest level of education | | |
| Bachelor's Degree | 134 | 20% |
| Some Graduate Study | 107 | 16% |
| Master's Degree | 355 | 54% |
| Some Doctoral Study | 37 | 6% |
| Doctorate Degree | 24 | 4% |
| Major field/s of study (could select multiple) | | |
| Choral Music Education | 520 | 79% |
| General Music Education | 274 | 42% |
| Vocal Performance | 220 | 33% |
| Instrumental (Wind/Percussion) Music Education | 168 | 26% |
| Piano Performance and/or Pedagogy | 88 | 13% |
| Education, Non-Music | 62 | 9% |
| Instrumental (Strings) Music Education | 49 | 7% |
| Instrumental Performance | 46 | 7% |
| Gender identity | | |
| Female | 461 | 70% |
| Male | 189 | 29% |
| Prefer not to answer | 6 | 1% |

*Note:* $N = 658$

**Research Question One**

Multiple survey questions were developed to answer research question one: For what purposes and in what ways are choral music educators using technology-assisted assessment tools? Choir teachers responded to indicate how many times they administered certain types of

assessments in the choral setting and also how often technology was used with those assessments. Since prior research has suggested that the frequency with which music educators administer assessments varies (Kotora, 2005; Tracy, 2002) and teachers most likely could not accurately recall the number of times they use a particular assessment format over an entire school year, respondents were given the choice to answer in number of times per week, per month, or per grading period. They were also asked to indicate how long their grading periods were, with 60% of teachers indicating their schools held nine-week grading periods. To aid in data analysis and interpretation, all responses were converted to represent the number of times respondents administered a particular assessment over a nine-week period, the most common grading period indicated. A more detailed discussion of this nine-week transformation can be found in chapter three, but for the remainder of this chapter, "grading period" represents a nine-week period.

The assessment format that was most frequently administered was listening responses (i.e., students listen to music and respond to posed questions), employed by teachers 4.12 times per grading period on average. Listening responses were also the most frequently administered assessment format for which teachers incorporated technology ($M$ = 2.49 times per grading period). Though administered much less often, singing tests in quartets, trios, or other small group configurations were the second most frequently used assessment format overall, employed an average of 2.90 times per grading period; however, teachers did not use technology for this format as frequently ($M$ = 1.49 times). Other assessment formats from the list in which teachers used technology most often included: individual singing tests on choral literature ($M$ = 1.83), individual sight-singing tests ($M$ = 1.54), and reflective journals ($M$ = 1.48). Improvisation was the least frequently administered assessment format and also the least likely to incorporate

technology. The mean responses and standard deviations for all assessment formats are presented in Table 4.2.

*Table 4.2. Frequency of Assessments per Grading Period and Use of Technology for Assessments*

| Assessment Formats | Frequency of Assessments Administered *M* (*SD*) | Frequency of Technology Use for Assessments *M* (*SD*) | Percentage of Teachers Who Used this Assessment Format | Percentage of Teachers Who Used Technology for this Assessment Format |
|---|---|---|---|---|
| Listening responses | 4.12 (8.54) | 2.49 (5.53) | 66% | 53% |
| Individual singing tests on choral literature | 2.17 (3.13) | 1.83 (4.68) | 69% | 50% |
| Individual sight-singing tests | 2.34 (4.36) | 1.54 (3.09) | 66% | 46% |
| Singing tests in quartets, trios, or small group | 2.90 (4.53) | 1.49 (3.71) | 71% | 39% |
| Reflective journals | 2.42 (6.22) | 1.48 (4.34) | 52% | 32% |
| Written tests or quizzes | 2.43 (2.97) | 1.21 (2.10) | 78% | 45% |
| Written homework | 1.88 (3.38) | 1.06 (2.65) | 47% | 32% |
| Compositions or arrangements | 0.82 (2.57) | 0.69 (2.52) | 26% | 21% |
| Improvisations | 0.57 (1.74) | 0.31 (1.29) | 19% | 11% |

*Note: N* = 658. Respondents were given the choice to answer in times per week, per month, or per grading period. All responses were then converted to "times per grading period (nine weeks)" and winsorized for analysis.

It is interesting to note that, even for the most frequently administered assessment formats, a large percentage of respondents reported never using them (0 times) regardless of technology's role. For example, 222 teachers (34%) reported that they never administered listening responses and 204 (31%) never conducted individual singing tests on choral literature.

For the assessment formats with the lowest means, 563 (81%) reported that they never assessed their choral students using improvisation, and 486 (74%) never assessed their choral students' compositions. The large number of teachers who reported never assessing these musical processes, or never using technology to assess these, resulted in relatively large standard deviations and skewed distributions.

Since previous literature indicates that music teachers tend to use technology more for instruction than assessment (Nielsen, 2011), participants in this study were also asked how often they used technology to assist with choral instruction. The responses to these questions may provide insight into whether or not using technology for choral instruction predicts integration of technology for assessment. Respondents ranked how often they used technology for a given instructional goal on a 5-point Likert-type scale (1 = *never*, 5 = *very often*). Results are presented in Table 4.3. The teachers indicated that they used technology to display/project choral literature or sight-singing examples for in-class instruction most frequently, with 58% selecting "often" or "very often." More than half (52%) of the choral music educators reported they used technology as a way for students to practice choral repertoire alone. The use of technology for other instructional reasons in the choral classroom, such as accompanying rehearsals, playing parts during rehearsal, individual sight-singing, or individual technique practice was less common. Like Nielsen (2011), respondents reported using technology on average more often for purposes related to instruction more than assessment.

*Table 4.3. Teachers' Frequency of Technology Use for Given Choral Areas*

| Ways Teachers Use Technology in the Choral Setting | Frequency *M* (*SD*) |
|---|---|
| Display/project choral literature or sight-singing examples for in-class instruction | 3.58 (1.31) |
| Provide a way for students to practice choral repertoire alone | 3.48 (1.21) |
| Accompany choral ensemble rehearsals | 2.98 (1.41) |
| Play choral parts for ensemble rehearsals | 2.90 (1.37) |
| Provide a way for students to practice sight-singing alone | 2.64 (1.34) |
| Provide a way for students to practice technique (e.g., scales, triads, range) alone | 2.63 (1.26) |

*Note:* Respondents indicated frequency on a 5-point Likert-type scale (1 = *never*, 5 = *very often*).

To investigate how often specific tools were used in the choral classroom, teachers reported the number of times they used given types of hardware-, software-, or web-based technology for assessment of choir students. Laptops, iPads, or other tablets were the most frequently used technology tools, used for student assessment an average of 11.04 times per grading period. Other commonly reported technology-assisted assessment tools included teachers' personal smartphones, which were used 9.42 times; interactive whiteboards (e.g., SMARTboard), used 8.87 times; online collaborative platforms (e.g., Blackboard, Google Classroom, Schoology, Edmodo, blogs), used 8.25 times; and videos shared by posting on the web (e.g., YouTube, Vimeo), used 7.89 times. Teachers reported that they rarely used electronic portfolios or clickers (personal response systems), with most reporting that they were not applicable/available. Table 4.4 lists the average reported use of each technology-assisted assessment tool in the survey as well as the percentage of teachers who reported using them.

*Table 4.4. Frequency of Technology-Assisted Assessment Tool Use per Grading Period and Percentage of Teachers Who Used Them*

| Type of Technology-Assisted Assessment Tool | Times Used *M* (*SD*) | % of Teachers who used Tool |
|---|---|---|
| Hardware-based technology | | |
| Laptop computers, iPads, or other tablets | 11.04 (17.81) | 71% |
| Teachers' personal smartphone | 9.42 (19.56) | 57% |
| Interactive whiteboards (e.g., Smartboard) | 8.87 (17.83) | 35% |
| Students' smartphones | 4.18 (8.86) | 50% |
| Audio recorder built into your classroom sound system | 2.97 (9.29) | 21% |
| Handheld audio recorders | 1.95 (5.24) | 36% |
| Video recorders | 1.31 (2.56) | 50% |
| Clickers (personal response systems) | 0.13 (0.74) | 4% |
| Software-based technology | | |
| Music notation applications (e.g., Finale, Sibelius, NoteFlight) | 4.13 (9.99) | 42% |
| Music theory applications (e.g., Alfred's Essentials of Music Theory, Music Ace, Practica Musica) | 2.87 (7.93) | 28% |
| Digital audio applications (e.g, GarageBand, Audacity, Pro Tools) | 2.82 (7.76) | 37% |
| Computer-based performance assessment applications (e.g., SmartMusic, MusicProdigy, MusicFirst/PracticeFirst) | 2.18 (7.43) | 19% |
| Web-based technology | | |
| Online collaborative platform (e.g., Blackboard, Google Classroom, Schoology, Edmodo, blogs) | 8.25 (14.45) | 55% |
| Videos shared by posting on the web (e.g., YouTube, Vimeo) | 7.89 (13.09) | 66% |
| Music-based websites (e.g., musictheory.net) | 5.44 (10.88) | 56% |
| Electronic portfolios through school website / other platform | 2.52 (14.45) | 21% |

*Note:* Respondents were given the choice to answer in times per week, per month, or per grading period. All responses were then converted to times per grading period (nine weeks) and winsorized for analysis.

Teachers reported how they use the data that they obtained through technology-assisted assessment tools. Results are presented in Table 4.5. The most common ways in which teachers used the data were to inform instruction (78%) and assign grades (74%). A small percentage of teachers (29%) said that they report assessment data obtained through technology-assisted assessment tools to their administrators.

*Table 4.5. Teachers' Use of Student Assessment Data Collected through Technological Tools*

| Uses of Data | % of Teachers |
|---|---|
| I use it to inform my instruction | 78% |
| I use it to assign grades | 74% |
| I share it with the students to discuss their progress | 69% |
| I analyze it to show individual student growth | 68% |
| I use it informally to gauge class trends | 45% |
| I use it for ensemble placement (auditions) | 38% |
| I report it to my administrators | 29% |

*Note:* Respondents could select multiple answers.

It is interesting that such a small number of teachers reported sharing assessment data with their administrators given that the majority of teachers (65%) said that their schools or school districts require them to document student growth data as part of their formal teacher evaluation processes. Additionally, 83% of the teachers who were required to document student growth data indicated that technology helps them fulfill this requirement "a moderate amount," "a lot," or "a great deal" (3 or higher on a 5-point Likert-type scale).

An open-ended response question gave teachers the opportunity to write in other ways they used technology to assist with their assessment of choir students. A frequency count of the responses from the 97 teachers (15%) who provided comments was conducted, and some areas

were identified as additional ways teachers use technology for assessment. Teachers commented that websites or software such as sightreadingfactory.com ($n$ = 7), musictheory.net ($n$ = 2), and Musition/Auralia ($n$ = 2) were technology tools used in supplemental ways to prepare students for assessments. Five teachers reported that they used iPads or Chromebooks in a one-to-one model where students often use their devices as personal recording devices. Seven teachers reported using various recording technologies to create individual practice tracks to assist students prior to the assessment of choral literature. All other responses reiterated topics already discussed through prior survey questions or provided slight elaboration on their technology use.

## Research Question Two

To address research question two (what factors enable or constrain choral music educators' integration of technology-assisted assessment tools?), data were collected to obtain a numerical indication of respondents' overall comfort with technology in their personal lives, professional administrative tasks, choir instruction, and assessment of choir students. Respondents indicated their comfort using technology on a 5-point Likert-type scale (1 = *very uncomfortable*, 5 = *very comfortable*). Frequency of technology use in general was also reported on a Likert-type scale (1 = *never*, 5 = *very often*), and a Spearman rank correlation was calculated to determine the correlation between frequency of use and comfort with technology. Results are presented in Table 4.6.

Teachers reported that they used technology generally very often in their personal ($M$ = 4.82 on a 5-point Likert-type scale) and professional lives ($M$ = 4.70). They used technology less frequently in their choir instruction ($M$ = 3.60) and assessment ($M$ = 3.18). The mean scores of teachers' reported comfort with technology in these areas were similar to the means of the

reported frequencies, although the mean score for comfort using technology for choral instruction or assessment was higher than its reported frequency of use in the classroom. Overall, frequency of technology use and comfort with technology were moderately correlated in all four areas at a statistically significant level, which was likely due to the relatively large sample size ($\rho = .440 - .651$, $p = .01$).

*Table 4.6. Teachers' Frequency of Technology Use and Comfort with Technology*

| Area of Technology Use | Frequency of Tech Use *M* (*SD*) | Comfort with Tech *M* (*SD*) | Correlation Between Frequency and Comfort |
|---|---|---|---|
| Personal life | 4.82 (0.44) | 4.72 (0.52) | .513 ($p < .001$) |
| Professional administrative tasks | 4.70 (0.52) | 4.58 (0.59) | .440 ($p < .001$) |
| Choir instruction | 3.60 (0.91) | 3.97 (0.95) | .552 ($p < .001$) |
| Assessment of choir students | 3.18 (1.13) | 3.65 (1.07) | .651 ($p < .001$) |

*Note:* Respondents indicated their frequency of use on a 5-point Likert-type scale (1 = *never*, 5 = *very often*) and comfort (1 = *very uncomfortable*, 5 = *very comfortable*).

When teachers were asked about factors that influence their decision to use technology in the classroom, personal interest and professional development factors seemed to be the most influential (See Table 4.7). Teachers overwhelmingly reported that their personal interest/philosophy influenced them the most when deciding whether to use technology assessment tools with 64% responding "a lot" or "a great deal" (4 or higher on a 5-point Likert-type scale where 1 = *not at all* and 5 = *a great deal*). Professional development such as conferences or workshops was also highly rated, with 47% of teachers saying that it influenced their decision to use technology "a lot" or "a great deal."

Interestingly, other types of formal training, such as degree programs and courses/content in those programs, did not have the same level of influence. In fact, 57% of respondents said that

their teacher preparation program did not influence their decision to use technology at all, and 47% said that graduate classes had no influence on their use of technology-assisted assessment tools. Professional articles also had little to no influence on whether teachers used technology in student assessment, as reported by 48% of respondents.

School-related factors, such as other teachers' or administrators' suggestions, seemed to have a moderate influence. A colleague's suggestion to use technology was influential, with 44% of teachers saying that it influenced their decision "a lot" or "a great deal." Over half of the respondents said that a school administrator's suggestion to use technology had little or no influence. Almost two-thirds (63%) of teachers felt that the technology tools already used in the choral classroom at their schools prior to their appointments in their positions had little or no influence on their use of these tools.

*Table 4.7. Factors that Influence Teachers' Decision to Use Technology-Assisted Assessment Tools*

| Influencing Factor | Level of Influence *M* (*SD*) |
|---|---|
| Personal interest/philosophy | 3.78 (1.12) |
| Professional development such as conferences or workshops | 3.34 (1.20) |
| Colleague's suggestion | 3.17 (1.26) |
| Professional article(s) | 2.62 (1.22) |
| Administrator's suggestion | 2.53 (1.28) |
| Graduate courses | 2.26 (1.40) |
| Already in place prior to employment | 2.15 (1.39) |
| Teacher preparation program | 1.86 (1.18) |

*Note:* Respondents indicated level of influence on a 5-point Likert-type scale (1 = *not at all*, 5 = *a great deal*).

**Technology Instruction, Professional Development, and School Technology Support**

Prior research has suggested that training in technology may enable choral music educators' integration of technology-assisted assessment tools (Bauer, 2010, 2012; Bauer, Reese, & McAllister, 2003; Dorfman & Dammers, 2015; Nielsen, 2011). In addition to asking about the level of influence teacher preparation programs and professional development had in general, the STUCA also asked respondents specific questions about technology instruction, professional development, and school technology support.

Choral teachers were asked if they learned to use technology for assessing student learning as part of their teacher preparation program and, if so, how well they felt their teacher preparation program prepared them to use technology to assess music students. Results are presented in Table 4.8. The majority of teachers (83%) said their teacher preparation did not include training in technology-assisted assessment tools. Of the 17% of teachers who did receive some instruction in this area, 74% reported that this preparation helped "fairly well," "pretty well," or "very well" (3 or higher on a Likert-type scale from 1-5).

*Table 4.8. Teachers' Reports of Teacher Preparation and Technology for Choral Assessment*

| Preparation Level | Frequency | % of Teachers |
|---|---|---|
| Very well | 15 | 14% |
| Pretty well | 27 | 24% |
| Fairly well | 40 | 36% |
| A little | 23 | 21% |
| Not at all | 6 | 5% |

*Note: N* = 112; Respondents indicated level on a 5-point Likert-type scale (1 = *not at all*, 5 = *very well*).

Participants were also asked whether they had attended professional development training sessions on the use of music technology (e.g. state music education conventions, school-

sponsored in-service, ACDA conventions) and, if so, how much they felt the technology training sessions helped them use technology effectively in their choral classroom. Results are presented in Table 4.9. The majority of teachers (63%) reported attending music technology training sessions, and 72% of those teachers reported that these sessions helped "a moderate amount," "a lot," or "a great deal" (3 or higher on a Likert-type scale from 1-5).

*Table 4.9. Teachers' Reports of Professional Development and Technology Use*

| Amount of Help | Frequency | % of Teachers |
|---|---|---|
| A great deal | 33 | 8% |
| A lot | 99 | 24% |
| A moderate amount | 167 | 40% |
| A little | 96 | 23% |
| Not at all | 20 | 5% |

*Note: N* = 415; Respondents indicated level on a 5-point Likert-type scale (1 = *not at all*, 5 = *a great deal*).

Another potential enabling factor was access to technology assistance in the school building (Dorfman & Dammers, 2015). Respondents reported if they had access to Information Technology (IT) professionals or technology assistants at their school(s) and, if so, how much they felt the IT professionals helped them when they had problems with technology in the classroom. Results are presented in Table 4.10. The majority of teachers (92%) reported that they had IT support at their schools, and 76% of those teachers said their IT professionals helped "a moderate amount" or more (3 or higher on a Likert-type scale from 1-5 where 1 = *not at all*; 5 = *a great deal*).

*Table 4.10. Teachers' Responses to How Much School IT Professionals Help with the Implementation of Technology in the Choral Classroom*

| Amount of Help | Frequency | % of Teachers |
|---|---|---|
| A great deal | 145 | 24% |
| A lot | 136 | 23% |
| A moderate amount | 177 | 29% |
| A little | 130 | 22% |
| Not at all | 17 | 3% |

*Note: N* = 605; Respondents indicated level on a 5-point Likert-type scale (1 = *not at all*, 5 = *very well*).

**Incentives and Barriers for using Technology-Assisted Assessment Tools**

Respondents reported potential incentives for using assessment technology tools in the choral context by indicating how much technology helped them with assessment-related tasks. Results are presented in Table 4.11. A majority of teachers (64%) felt that technology assessment tools helped "a lot" or "a great deal" when assigning grades (4 or higher on a 5-point Likert-type scale where 1 = *not at all*, 5 = *a great deal*). Over half of the teachers reported that quick or efficient feedback to students was an incentive for using technology tools for assessment. Interestingly, two time-saving incentives ("save time when administering an assessment" and "conduct a group rehearsal while students complete assessments independently") ranked lower, even though they are often one of the biggest incentives for using technology listed in practitioner articles (see Criswell, 2012; Furby, 2013).

*Table 4.11. Incentives for Using Technology-Assisted Assessment Tools*

| Incentive | Level of Incentive *M* (*SD*) |
|---|---|
| Calculate and/or assign grades | 3.66 (1.51) |
| Provide assessment feedback for students quickly | 3.21 (1.60) |
| Organize data obtained from assessments | 3.14 (1.63) |
| Provide accurate and objective assessment feedback to students | 3.08 (1.57) |
| Present an assessment in a convenient, clear format | 3.03 (1.65) |
| Save time when administering an assessment | 2.98 (1.68) |
| Maintain an ongoing digital portfolio of student assessment data | 2.24 (1.82) |
| Conduct a group rehearsal while students complete assessments independently | 2.19 (1.73) |

*Note*: Respondents indicated how much technology helps them on a 5-point Likert-type scale (1 = *not at all*, 5 = *a great deal*).

Teachers were also asked to what extent given barriers impacted them when they considered using technology for assessment. Full results for all barriers are presented in Table 4.12. Respondents reported that multiple factors were "large" or "extreme" barriers (4 or higher on a 5-point Likert-type scale where 1 = *not at all a barrier*, 5 = *an extreme barrier*) to their implementation of technology-assisted assessment tools. More than half (53%) of respondents reported that both lack of time to research, set up, and/or implement technology as well as cost of implementation represented "large" or "extreme" barriers. An additional major barrier cited by the choral music teachers in the study was a lack of technology resources at their schools (39%).

Some factors were not seen as large barriers by the teachers in the study. Fifty-four percent reported that lack of trust in the accuracy of the technology was "not a barrier at all," and 66% felt that students' lack of trust in the accuracy of the technology was "not a barrier at all." Two potential barriers cited in previous research, lack of training with technology (Dorfman,

2008) and number of students (Tracy, 2002), were only found to be moderate barriers in the current study. Almost half (47%) of teachers reported lack of training was a "moderate" or "small barrier." The number of students they teach/assessments they have to grade received the same designation by 44% of respondents.

*Table 4.12. Barriers to Using Technology-Assisted Assessment Tools*

| Barrier | Level of Barrier *M* (*SD*) |
|---|---|
| Lack of time to research, set up, and/or implement technology | 3.45 (1.26) |
| Cost of implementation | 3.43 (1.35) |
| Lack of technology resources at my school | 2.98 (1.45) |
| Technical problems out of my control | 2.94 (1.31) |
| Lack of training with technology | 2.83 (1.31) |
| Number of students I teach/assessments I have to grade | 2.75 (1.37) |
| Personal discomfort with technology | 1.93 (1.15) |
| My lack of trust for accuracy of the technology | 1.77 (1.03) |
| My students lack of trust for accuracy of the technology | 1.50 (.837) |

*Note:* Respondents indicated the level of each barrier on a 5-point Likert-type scale (1 = *not at all a barrier*, 5 = *an extreme barrier*).

Two open-ended response questions gave respondents the opportunity to write in additional reasons they did or did not use technology to assist with their assessment of choir students. A frequency count of the responses from the 279 teachers (42%) that provided comments was conducted, and the following themes emerged as common additional reasons teachers use technology-assisted assessment tools: students enjoy using technology in the classroom ($n$ = 6), teachers desire to stay current with the students' interests ($n$ = 11), technology has the ability to augment the choral curriculum ($n$ = 12), technology allows students to work

independently ($n$ = 15), as well as general reasons for increased efficiency or convenience ($n$ = 22).

When asked to list additional reasons that they did not use technology, many teachers reiterated concerns already addressed in other questions of the STUCA regarding the cost of technology, the lack of technological resources at their school, the amount of time that it takes to implement technology when they have limited class time with a large number of students, as well as concerns regarding their own lack of training or experience in implementing technology in the choral classroom. Respondents also offered additional comments including: they value the "old fashioned way" of teaching and assessing with a focus on teacher-to-student interaction ($n$ = 31), they find technology is distracting for the students ($n$ = 6), and their choir ensembles are voluntary so they do not assess their students because it is not required by the school ($n$ = 9).

## Research Question Three

Research question three (what is the perceived efficacy of using technology-assisted assessment tools in the choral classroom?) was developed to investigate whether choral music educators feel that integrating technology is an effective way to improve their assessments. The researcher addressed question three by asking choir teachers how effective they felt technology was at helping them assess their choral students' abilities based on the National Core Arts Standards artistic processes (creating, performing, responding, connecting) (State Education Agency Directors of Arts Education, 2014). Respondents ranked the perceived level of effectiveness on a 5-point Likert-type scale (1 = *very ineffective*; 5 = *very effective*). Results are presented in Table 4.13. The highest percentage of teachers selected "neutral" for five of the eight categories. Teachers reported that technology was "effective" or "very effective" when assessing students' ability to respond to music by listening, analyzing, and/or writing (66%),

perform choral music repertoire effectively (61%) and sight-sing (59%). Technology's effectiveness when assessing improvisation ranked lowest with a mean of 2.9.

*Table 4.13. Perceived Effectiveness of Technology to Assist with Student Assessment*

| Student Knowledge or Skill | Level of Perceived Effect *M* (*SD*) |
|---|---|
| Respond to music by listening, analyzing, and/or writing | 3.79 (0.95) |
| Perform choral repertoire effectively | 3.67 (0.97) |
| Sight-sing using music notation | 3.66 (0.98) |
| Connect with music on a personal level | 3.48 (1.05) |
| Compose their own music | 3.34 (1.01) |
| Demonstrate appropriate vocal technique | 3.32 (1.07) |
| Understand how composers create music | 3.18 (0.95) |
| Improvise | 2.90 (8.98) |

*Note:* Respondents indicated the level of effectiveness on a 5-point Likert-type scale (1 = *very ineffective*, 5 = *very effective*).

In addition to technology's effectiveness for assessing student abilities based on the National Core Arts Standards, teachers were asked about two additional areas. First, teachers indicated how accurate they believe technology-based performance assessment tools like SmartMusic, Music Prodigy, or PracticeFirst are in assessing students' singing accuracy. Over half of the teachers (58%) said that they did not use this type of technology. The rest reported that these types of tools are "very accurate" (5%), "accurate" (22%), "neutral" (10%), "inaccurate" (4%), or "very inaccurate" (1%). Second, teachers were asked how much they feel technology helps them effectively meet the requirement to document student growth data. Though 35% of respondents reported that they are not required to document student growth for

their choir classes, 57% of the remaining teachers reported that technology helps "a lot" or "a great deal" (4 or higher on a 5-point Likert-type scale where 1 = *not at all*; 5 = *a great deal*).

Two final open-ended response questions gave respondents the option to write in other reasons why they felt technology-assisted assessment tools are effective or ineffective. Of the 123 teachers (19%) who responded, many reiterated points already discussed in the survey questions regarding why teachers decide to implement technology (e.g., cost, time). Additional relevant respondent insights regarding the efficacy of using technology-assisted assessment follow. Six respondents said the immediate feedback provided by technology-assisted assessment tools is effective for enhancing assessments and motivating students. Meanwhile, three felt the ability of technology-assisted assessment tools to digitally archive assessment results so teachers can go back to review them at any time improves the effectiveness of assessments. Two teachers reported using recording technology to decrease students' testing anxiety during performance-based singing tests, which makes the assessment more effective, while twenty-six were concerned that performance-based assessment tools could be ineffective because they pick up the human voice inaccurately or are "too accurate" for young vocalists (e.g., SmartMusic scores a pitch that is flat as incorrect where a teacher may consider it correct given the student's inexperience). Finally, 21 teachers felt performance-based assessment tools are ineffective because they cannot judge factors other than pitch and rhythm (e.g., tone, diction, musicality, posture).

## Research Question Four

While choral teachers' personal factors and professional development seemed to have the strongest impact on the frequency with which they used technological tools for assessment based on the descriptive statistical analysis, it is likely that multiple factors contribute to their time

spent integrating these tools and the variety of tools they use for assessment purposes. The goal of research question four was to investigate to what extent choral educators' demographics, professional backgrounds, comfort with technology, and levels of school support for technology predict (a) the amount of time they spend integrating technology-assisted assessment tools and (b) the variety of technologies used for assessment of student learning. Multiple regression analyses were conducted to examine the relationship between potential predictor variables and two outcome variables: (1) the frequency with which choral music educators use technology-assisted assessment tools, and (2) the variety of technology tools teachers used.

Both regressions included the 12 empirically supported predictor variables described in detail in chapter three as covariates and were run following the same sequential order. Entered in Model 1 were variables related to teachers' reported comfort with technology (i.e., comfort with technology in their personal lives, comfort with technology when assessing students); Model 2 contained teacher characteristics (e.g., years taught, education, and gender); Model 3 contained school demographic predictors (e.g., school setting and school type); Model 4 contained teacher training predictors (e.g., professional development, teacher preparation); and Model 5 contained school technology factors (e.g., presence of technology support, cost of technology, technical difficulties experienced). Reference groups for the factor variables included bachelor's degree for highest degree earned, female for gender, suburban for school setting, and public for school type. It should also be noted, that though the R-squared values for the regression were relatively low, these do not necessarily indicate a poor model fit. As Allison contends, "Although it is certainly true that high is better, there is no reason to reject a model if the R-squared is small" (1999, p. 31). The R-squared values for this study are similar to other education studies using

multiple regression. The following subsections describe the results of the analyses for the two outcome variables.

**Outcome Variable One: Frequency of Technology Used for Student Assessment**

Table 4.14 shows the full results of the multiple regression analysis for outcome variable one, frequency of technology used for student assessment. Model 1 accounted for a total of 7.4% of variance in frequency of use and was statistically significant, $F(2, 655) = 26.75$, $p < .001$. The primary source of explanatory power was comfort with choral assessment technology, which was associated with increased frequency the more comfortable respondents were using technology-assisted assessment tools. Specifically, for each 1-unit of endorsement of the comfort item, teachers use of technology-assisted assessment tools increased 4.79 times per grading period ($b = 4.79$, $SE = 0.61$, $p < .001$).

When the teacher characteristics variables were entered with Model 2, the model was significant, explaining 9.2% of the variance ($R^2 = .092$, $F(9, 645) = 8.47$, $p < .001$). The model showed that comfort was still a significant predictor ($b = 4.88$, $SE = 0.63$, $p < .001$). The unique amount of explained variance associated with the teacher characteristics was 1.8%, and the primary teacher characteristic associated with use of technology-assisted assessment tools was level of education. Those with higher degrees (relative to bachelor's degree) generally reported using technology-assisted assessment tools less often. The only significant coefficient for education level was if the teachers held a master's degree, for whom use of technology-assisted assessment tools was, on average, 6.10 units less than teachers with a bachelor's degree ($b = -6.10$, $SE = 2.17$, $p = .005$).

Model 3, school demography, accounted for an additional 1.2% increase in the explained variance in frequency of technology-assisted assessment tool use. The model was significant ($R^2$

=.104, $F(13, 641) = 6.10$, $p < .001$), with one variable, private schools, corresponding with a decrease in teachers' use of technology-assisted assessment tools. Choir teachers who worked in private schools reported, on average, that they used technology less for assessment of choral students. Compared with the public school reference group, teachers in private schools used technology-assisted assessment tools 5.09 units less ($b = -5.09$, $SE = 1.50$, $p = .001$).

When variables in Models 4 and 5 were entered as predictors of frequency of technology-assisted assessment tool use, both sets of potential predictors were non-significant. As such, no consistent pattern of relationships occurred for training with technology or school technology factors when it comes to how frequently choral music educators use technology-assisted assessment tools. It is important to note, however, that the overall regression analysis remained significant for both Models 4 and 5. Also important to note is that all predictors that were significant in Models 1, 2, and 3 remained significant after controlling for other variables.

*Table 4.14. Regression of Frequency Choir Teachers Use Technology-Assisted Assessment Tools*

| | Model 1 Initial Model *b/SE/p* | Model 2 + Teacher Characteristics *b/SE/p* | Model 3 + School Demographics *b/SE/p* | Model 4 + Technology Training *b/SE/p* | Model 5 + School Technology Factors *b/SE/p* |
|---|---|---|---|---|---|
| Comfort with Technology | | | | | |
| Personal Life | 0.296 | -0.044 | -0.167 | -0.175 | -0.050 |
| | (1.012) | (1.102) | (1.097) | (1.112) | (1.077) |
| | 0.770 | 0.968 | 0.879 | 0.875 | 0.963 |
| Choral Assessment | 4.794*** | 4.876*** | 4.787*** | 4.794*** | 4.679*** |
| | (0.608) | (0.631) | (0.609) | (0.637) | (0.687) |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Years Taught | | 0.286 | 0.267 | 0.235 | 0.163 |
| | | (0.569) | (0.572) | (0.622) | (0.645) |
| | | 0.616 | 0.641 | 0.705 | 0.800 |
| Highest Degree Earned (Bachelor's is Reference) | | | | | |
| Some Graduate Study | | -4.112 | -4.146 | -4.173 | -4.023 |
| | | (2.496) | (2.495) | (2.505) | (2.500) |
| | | 0.100 | 0.097 | 0.096 | 0.108 |
| Master's Degree | | -6.102** | -6.169** | -6.186** | -6.087** |
| | | (2.167) | (2.186) | (2.199) | (2.222) |
| | | 0.005 | 0.005 | 0.005 | 0.006 |
| Doctorate Study or Degree | | -3.523 | -3.652 | -3.680 | -3.715 |
| | | (3.206) | (3.315) | (3.323) | (3.352) |
| | | 0.272 | 0.271 | 0.269 | 0.268 |
| Gender (Female is Reference) | | | | | |
| Male | | 0.794 | 0.868 | 0.904 | 0.804 |
| | | (1.687) | (1.667) | (1.660) | (1.646) |
| | | 0.638 | 0.603 | 0.586 | 0.625 |
| Other | | 8.755 | 8.250 | 8.225 | 7.655 |
| | | (9.863) | (9.443) | (9.421) | (8.884) |
| | | 0.375 | 0.383 | 0.383 | 0.389 |
| School Setting (Suburban is Reference) | | | | | |
| Rural | | | -0.828 | -0.836 | -0.584 |
| | | | (1.584) | (1.597) | (1.579) |
| | | | 0.601 | 0.601 | 0.712 |
| Urban | | | 3.052 | 3.047 | 3.110 |
| | | | (2.515) | (2.518) | (2.551) |
| | | | 0.225 | 0.227 | 0.223 |

*Table 4.14. (Cont.)*

| | | | | | |
|---|---|---|---|---|---|
| School Type (Public is Reference) | | | | | |
| Charter | | | -1.644 | -1.639 | -1.278 |
| | | | (2.191) | (2.195) | (2.197) |
| | | | 0.453 | 0.456 | 0.561 |
| Private | | | -5.085*** | -5.070*** | -5.175*** |
| | | | (1.470) | (1.495) | (1.534) |
| | | | 0.001 | 0.001 | 0.001 |
| Training in Technology | | | | | |
| Attended Technology PD | | | | -0.102 | -0.357 |
| | | | | (1.538) | (1.546) |
| | | | | 0.947 | 0.817 |
| Had Tech Training in Teacher Prep | | | | 0.365 | 0.385 |
| | | | | (1.940) | (1.947) |
| | | | | 0.851 | 0.843 |
| School Technology Factors | | | | | |
| Had IT Professional in School | | | | | 2.212 |
| | | | | | (2.626) |
| | | | | | 0.400 |
| Barrier: Technical Problems | | | | | 0.693 |
| | | | | | (0.656) |
| | | | | | 0.291 |
| Barrier: Lack of Resources | | | | | -0.249 |
| | | | | | (0.748) |
| | | | | | 0.740 |
| Barrier: Technology Cost | | | | | -0.762 |
| | | | | | (0.616) |
| | | | | | 0.216 |
| *N* | 658 | 655 | 655 | 655 | 655 |
| $R^2$ | 0.074 | 0.092 | 0.104 | 0.104 | 0.108 |

*Note:* Robust standard errors in parentheses. Reference variables are bachelor's degree, female, suburban, and public school. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

**Outcome Variable Two: Variety of Technologies Used for Student Assessment**

Table 4.15 shows the full results of the multiple regression analysis for outcome variable two, the variety of technology tools teachers used for choral student assessment. Model 1 accounted for a total of 14.3% of variance in variety of technology tools used and was statistically significant, $F(2, 655) = 57.26$, $p < .001$. As with outcome variable one, the primary source of explanatory power was comfort with choral assessment technology, which was associated with increased variety of technology used the more comfortable respondents were with using technology-assisted assessment tools. Specifically, for each 1-unit increase of the comfort item, the variety of technology-assisted assessment tools teachers used increased 1.09 times ($b = 1.09$, $SE = 0.11$, $p < .001$).

Variables in Model 2 were statistically non-significant. No consistent pattern of relationships occurred for teacher characteristics based on the number of years a teacher had taught, their level of education, or gender.

Model 3, school demography, accounted for an additional 2.2% increase in the explained variance in variety of technology-assisted assessment tools used. The model was significant ($R^2 = .161$, $F(13, 641) = 11.32$, $p < .001$), with one variable, charter schools, corresponding with an increase in teachers' variety of technology-assisted assessment tools. Choir teachers who worked in charter schools reported, on average, that they used a wider variety of technology for assessment of choral students. Compared with the public school reference group, teachers in charter schools used technology-assisted assessment tools 1.61 units more ($b = 1.42$, $SE = 0.68$, $p = .035$).

Variables in Model 4 were statistically non-significant. No consistent pattern of relationships occurred for teachers' training with technology and the variety of technology-

assisted assessment tools they used, whether in the form of professional development or training obtained during teacher preparation.

When the final variables related to school technology factors were entered in Model 5, the model explained additional significant variance in the variety of technology-assisted assessment tools teachers used, overall $R^2 = .201$, $F(15, 639) = 10.11$, $p < .001$. The amount of explained variance associated with school technology factors (4%) was due to two significant predictor variables, technical problems experienced by the teachers, and a lack of resources at their schools. Teachers who reported experiencing technical problems out of their control when using technology for assessment generally reported using a greater variety of technology-assisted assessment tools. For each increase in the level of this barrier, the variety of tools used increased 0.42 times ($b = 0.415$, $SE = 0.09$, $p < .001$). The other significant predictor variable was a reported lack of school resources, for which variety of technology-assisted assessment tools used was, on average, 0.34 units less ($b = -0.34$, $SE = 0.10$, $p = .001$). All predictors that were significant in Models 1, 2, 3, and 4 remained significant after controlling for other variables.

*Table 4.15. Regression of Variety of Technology-Assisted Assessment Tools Used by Choir Teachers*

| | Model 1 Initial Model *b/SE/p* | Model 2 + Teacher Characteristics *b/SE/p* | Model 3 + School Demographics *b/SE/p* | Model 4 + Technology Training *b/SE/p* | Model 5 + School Technology Factors *b/SE/p* |
|---|---|---|---|---|---|
| Comfort with Technology | | | | | |
| Personal Life | 0.282 | 0.316 | 0.273 | 0.263 | 0.415 |
| | (0.226) | (0.235) | (0.233) | (0.232) | (0.229) |
| | 0.212 | 0.179 | 0.242 | 0.258 | 0.071 |
| Choral Assessment | 1.094*** | 1.088*** | 1.100*** | 1.053*** | 0.997*** |
| | (0.112) | (0.113) | (0.113) | (0.116) | (0.118) |
| | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Years Taught | | 0.159 | 0.153 | 0.178 | 0.144 |
| | | (0.107) | (0.107) | (0.113) | (0.112) |
| | | 0.138 | 0.153 | 0.115 | 0.200 |
| Highest Degree Earned (Bachelor's is Reference) | | | | | |
| Some Graduate Study | | -0.033 | -0.060 | -0.033 | -0.014 |
| | | (0.413) | (0.411) | (0.408) | (0.404) |
| | | 0.935 | 0.883 | 0.936 | 0.972 |
| Master's Degree | | -0.231 | -0.271 | -0.270 | -0.166 |
| | | (0.331) | (0.334) | (0.334) | (0.329) |
| | | 0.486 | 0.417 | 0.419 | 0.613 |
| Doctorate Study or Degree | | -0.071 | -0.131 | -0.147 | -0.069 |
| | | (0.507) | (0.513) | (0.511) | (0.508) |
| | | 0.889 | 0.798 | 0.774 | 0.892 |
| Gender (Female is Reference) | | | | | |
| Male | | -0.068 | -0.047 | -0.134 | -0.159 |
| | | (0.267) | (0.268) | (0.270) | (0.263) |
| | | 0.800 | 0.861 | 0.621 | 0.546 |
| Other | | 0.342 | 0.434 | 0.525 | 0.420 |
| | | (0.792) | (0.783) | (0.789) | (0.725) |
| | | 0.666 | 0.580 | 0.506 | 0.562 |
| School Setting (Suburban is Reference) | | | | | |
| Rural | | | -0.191 | -0.190 | -0.072 |
| | | | (0.271) | (0.271) | (0.264) |
| | | | 0.483 | 0.483 | 0.784 |
| Urban | | | -0.201 | -0.195 | -0.022 |
| | | | (0.343) | (0.342) | (0.333) |
| | | | 0.559 | 0.567 | 0.947 |

*Table 4.15. (Cont.)*

| | | | | | |
|---|---|---|---|---|---|
| School Type (Public is Reference) | | | | | |
| Charter | | | 1.417* | 1.451* | 1.373* |
| | | | (0.681) | (0.682) | (0.673) |
| | | | 0.038 | 0.034 | 0.042 |
| Private | | | -0.661 | -0.605 | -0.566 |
| | | | (0.353) | (0.350) | (0.340) |
| | | | 0.061 | 0.084 | 0.097 |
| Training in Technology | | | | | |
| Attended Technology PD | | | | -0.347 | -0.270 |
| | | | | (0.258) | (0.257) |
| | | | | 0.179 | 0.295 |
| Had Tech Training in Teacher Prep | | | | -0.585 | -0.630 |
| | | | | (0.343) | (0.335) |
| | | | | 0.088 | 0.061 |
| School Technology Factors | | | | | |
| Had IT Professional in School | | | | | -0.469 |
| | | | | | (0.445) |
| | | | | | 0.292 |
| Barrier: Technical Problems | | | | | 0.415*** |
| | | | | | (0.095) |
| | | | | | 0.000 |
| Barrier: Lack of Resources | | | | | -0.343*** |
| | | | | | (0.102) |
| | | | | | 0.001 |
| Barrier: Technology Cost | | | | | 0.159 |
| | | | | | (0.101) |
| | | | | | 0.118 |
| *N* | 658 | 655 | 655 | 655 | 655 |
| $R^2$ | 0.143 | 0.148 | 0.161 | 0.168 | 0.201 |

*Note:* Robust standard errors in parentheses. Reference variables are bachelor's degree, female, suburban, and public school. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

## Summary

This chapter provided detailed results for all four research questions. Descriptive analyses were presented to examine how frequently choral music educators used technology-assisted assessment tools, which types of tools they used, their purposes for using technology, and any

incentives or barriers they may have encountered when choosing to integrate technology. According to the results presented here, choral music educators seemed to use technology-assisted assessment tools infrequently, with a large percentage of teachers indicating that they never use technology for many areas of choral student assessment. Certain technological tools were used by a large percentage of the sample (e.g., laptops; 71%), but many respondents reported that they use a narrow range of tools when assessing choral students. While the teachers cited benefits to using technology-assisted assessment tools (e.g., efficiency in calculating and/or assigning grades, providing assessment feedback for students quickly), many barriers were found to impede successfully technology integration including: lack of time, lack of resources, and the high cost of implementing technology.

Multiple regression analyses revealed that personal and school-related demographic variables were not significant predictors for whether choral music educators use technology-assisted assessment tools with greater frequency or variety. The teachers overwhelmingly reported that they are comfortable using technology both in their personal lives and in the classroom, and multiple regression analyses revealed that this predictor variable significantly increased how frequently they use technology for assessment and the variety of technology tools they use. Overall, the results of this study suggest that choral music educators appear to be more comfortable with using technology in the music classroom compared to findings from prior research, and the teachers in this study clearly identified reasons why they might use it. However, the actual implementation of technology-assisted assessment tools is still relatively infrequent. Chapter five presents implications for the field and for research based on the results of chapter four.

# CHAPTER 5

# DISCUSSION, IMPLICATIONS, AND CONCLUSIONS

The purpose of this study was to investigate secondary choral music educators' use of technology-assisted assessment tools, their rationales for using assessment-related technology, their perceptions of the efficacy of tools in practice, and the relationships among demographic, educational, and attitudinal factors and their reported technology use. The following four research questions guided this research:

1. For what purposes and in what ways are choral music educators using technology-assisted assessment tools?
2. What factors enable or constrain choral music educators' integration of technology-assisted assessment tools?
3. What is the perceived efficacy of using technology-assisted assessment tools in the choral classroom?
4. To what extent do choral educators' demographics, professional backgrounds, comfort with technology, and levels of school support for technology predict:
    a. the amount of time they spend integrating technology-assisted assessment tools;
    b. the variety of technologies used for assessment of student learning?

Both student assessment and the use of technology in music education are growing research areas with practical implications for choral music educators. Henry (2015) asserts that choir teachers may be some of the best formative assessors in the school building, constantly listening to their choirs make music while providing immediate feedback on their achievement in the moment; however, assessing individual students in a large, performance-based ensemble is a

difficult task for many reasons—for example, the large number of students, limited instructional time, and limited teacher preparation in assessment techniques (Kotora, 2005; Russell & Austin, 2010). Choral music educators feel pressure from ever-increasing accountability measures that require them to provide quantitative documentation of student growth as part of their mandated teacher performance evaluations. It was hypothesized that technology-assisted assessment tools may help choir teachers assess their students in more efficient, effective, and practical ways in order to meet these demands.

The study was purposely focused on secondary schools because the main goal was to survey teachers' assessment practices in the choral ensemble setting specifically, and ensemble-based courses tend to be most prevalent in U.S. middle and high schools. The sample size was relatively large for music education studies of its kind ($N$ = 658) and represented teachers from states in the U.S. that require teachers to document student growth through assessment. The study drew its sample from the membership of the National Association for Music Education (NAfME), the nation's largest arts education organization (NAfME, 2017), and with adequate attention to the design and implementation of the study, it is reasonable to generalize the results to the larger population of U.S. secondary choir directors. This investigation of choral music educators' assessment practices and technology integration included the examination of three key areas supported by empirical research findings: (1) how and why choral music educators use technology-assisted assessment tools, (2) the factors associated with use of technology tools for assessment, and (3) teachers' perceived efficacy of using technology-assisted assessment tools (Dorfman, 2008; Dorfman & Dammers, 2015; Henry, 2014; Nielsen, 2011; Petty & Henry, 2014).

In this chapter, the findings presented in chapter four are discussed and implications for the profession are explored, with attention to the potential limitations of the study. Finally, the chapter concludes with suggestions for future research.

## How and Why Choral Music Educators Use Technology-Assisted Assessment Tools

Research question one asked, "For what purposes and in what ways are choral music educators using technology-assisted assessment tools?" Choir teachers responded to multiple survey questions to indicate what types of assessments they administered, how often they administered them in the choral setting, how many times technology was used for those assessments, and for what reasons. This was the first study of choral music educators that asked respondents to indicate numerically how many times they administered particular assessment types instead of relying exclusively on dichotomous (e.g., yes/no) or Likert-type items (e.g., 1 = *never*, 5 = *a lot*). This adds a new level of depth to the understanding of secondary choral teachers' assessment practices by giving researchers a point of comparison for the frequency of assessment administration. Specifically investigating the role of technology in assessment administration was also a new addition to the research base. Nielsen (2011) investigated the frequency of technology-assisted assessment tool use generally, but the main focus of his study was teachers' attitudes towards technology.

### Use of Technology-Assisted Assessment Tools in Relation to the NCAS

The National Core Arts Standards (NCAS; State Education Agency Directors of Arts Education [SEADAE], 2014) artistic processes for music (creating, performing, responding, connecting) serve as a helpful framework to begin the discussion of the results of the current study. This section includes an exploration of the study's findings within that framework by

examining choral music educators' use of technology for particular assessment formats as well as the possible reasons they used them.

A significant finding in the current study was that choral music educators assess student knowledge and skills related to the "responding" artistic process of the NCAS more than the other three processes and use technology-assisted assessment tools for this purpose more often. The assessment format that was most frequently administered using technology was listening responses, which scored much higher than the others ($M$ = 2.49 times per semester vs. the average of the nine formats, $M$ = 1.34). Playing an audio recording of a musical example and eliciting responses from choir students could include the use of a wide variety of technological tools, which may be why more teachers reported using technology for this type of assessment more often. Listening to a recording of a recent school choral concert and critiquing it is a very common form of group self-assessment. Although educators did not respond to specific questions about how they conducted their listening response assessments, a computer or smartphone could be used with classroom speakers as an audio playback device. Students could use laptops or tablets to type written responses after listening to a music example or use online collaborative platforms (e.g., Google Classroom, blogs) to submit responses to their teacher or classmates.

Performance-based assessment for the purpose of determining individual singers' musical achievement through choral literature was the next most frequently used assessment format among participants in the study. These data indicate that 50% of choral music educators used technology to assist with these assessments, which mirrors the results of Nielsen (2011), who found that 52% of K-12 music teachers used digital recordings when assessing performance skills. However, by also asking teachers to report the number of times they used technology to

assess singing tests, the current study adds another dimension to our understanding. Although half of choral music educators used technology to assist with performance-based assessments, they only administered them 1.8 times per grading period on average. Given that performing music is another of the four artistic processes espoused in the NCAS and is a crucial part of a student's experience in a choral ensemble, it is interesting that choral music educators are not making greater use of technology-assisted assessment tools to assess their students' singing more frequently.

A substantial amount of research has discussed the benefits of individual sight-singing assessment (Demorest, 1998; Henry, 2001: Kuehne, 2010) and it seems that many choral music educators are following best practice by assessing their students individually with the assistance of technology-assisted assessment tools; however, assessments are again infrequently administered. In the current study, performance-based assessments for the purpose of assessing individual students' sight-singing skills were administered using technology by 46% of choral teachers an average of 1.5 times per grading period. More choir teachers (58%) used technology to display/project choral literature or sight-singing examples for in-class instruction, which aligns with the findings of Nielsen (2011), who found that music educators use technology more for instruction than assessment purposes. Given that researchers have found that assessing sight-singing skills via technology such as SmartMusic can be equally as effective as traditional methods (Petty & Henry, 2014), the reasons why choral music educators are not using this technology more often warrants further investigation.

Choir students' ability to create music through composition or improvisation was the least frequently assessed and also the least likely to incorporate technology. Only 21% of choir teachers used technology to assess their students' compositional skills and only 11% used

technology-assisted assessment tools with improvisation. Music education researchers have consistently found that these two areas have historically been taught and assessed least often in the music classroom (LaCognata, 2013; Russell & Austin, 2010). Still, as part of the creating artistic process of the NCAS, composition and improvisation are important areas of music learning. A possible explanation for their omission could be that these areas can be time-consuming to teach and assess. Perhaps teachers might teach and assess them more if they had a technology tool to help them. It is more likely though, that teachers feel that composition and improvisation do not fit into the typical curriculum of a performance-based choral ensemble (Henry, 2015).

The use of technology to assist with assessing the final artistic process, "connecting," was reported to be effective ($M$ = 3.48 out of 5); however, only one survey question was designed to target this process. Within the NCAS, the connecting process is embedded within the other three processes, so it was cumbersome to isolate it from the rest, and unfortunately it was not a prominent theme in the findings as a result. It is very probable that certain assessment formats could have been used for the purpose of determining how students relate the music they perform, create, or study with societal, cultural, or historical contexts as well as their personal interests. Having students write in reflective journals, for example, was an assessment method used by 52% of choral music educators, but only 32% incorporated technology, so it appears that technology did not play a major role. On the other hand, 55% of respondents used online collaborative tools such as Google Classroom or blogs 8.25 times per semester on average, one of the most frequent ways technology was reportedly used according to the STUCA. Again, although the survey did not specifically ask respondents to specify what students were discussing

via these online forums, it is reasonable to think that they could have been using these tools as an online reflective journal to explore connections they were making with the music.

A final intriguing finding that could be related to all four NCAS artistic processes was that the largest percentage of choral music educators in the current study (78%) used written tests or quizzes for the purpose of assessing their students' knowledge of music; however, only 45% used technology to assist with the administration. This assessment format had the largest gap between the number of times assessments were administered and the number of times that technology was used to assist in those assessments. Prior research has also found that written tests or quizzes are commonly used in the music classroom (Russell & Austin, 2010), but based on the findings of the current study, it seems that few choral music educators are using technology to assist with this type of assessment. With an ever-increasing number of technologies to assist with written assessments, it is puzzling that teachers are not incorporating them more often.

Overall, it was surprising to see that a large percentage of teachers employed few assessment types presented in the survey, regardless of technology's role. For example, the assessment format with the highest mean frequency, listening responses, was still only used by 66% of choir teachers. The format used least frequently, assessment of students' improvisation, was only administered by 19% of teachers. Since many teachers did not administer these assessments at all, the mean frequency of technology use for all formats was consequentially low ($M$ = 1.34 times per semester).

**Use of Specific Technology-Assisted Assessment Tools**

In addition to assessment formats, teachers also reported the number of times they used given types of hardware-, software-, or web-based technology for assessment of choir students.

Laptops, iPads, or other tablets were the most frequently used technology tools, used 11 times per grading period on average by 71% of teachers. Given the versatility of laptops and tablets to assist with a variety of assessment-related tasks, both in the creation and administration of assessments, this finding is logical. It does, however, contrast with Dorfman and Dammers (2015), whose participants had negative feelings about computer use in the music classroom, saying that they found using computers with students to be intimidating. Still, regular computer use in the music classroom seems to have increased dramatically since Colwell (2002) noted the yet unseen potential of computer use and Dorfman (2008) found that only 7% of music teachers used computer-assisted applications on a regular basis.

The prevalent use of smartphones in the choral classroom was also evident from the results of this study. Articles in practitioner journals (e.g., Criswell, 2009; Kuzmich, 2010) have suggested that smartphones may be useful tools in music classrooms; however, this is the first empirical study to ask choir teachers if they have used their smartphones in their teaching. It is clear that many are, as 57% of teachers reported using their personal smartphones an average of 9.4 times per grading period, the second most used technology tool in the STUCA. Over half of the teachers also reported that their students' smartphones are used for assessment purposes, though one might surmise that the use of students' smartphones may be underreported because of school policies limiting their use. The advanced audio and video recording capabilities of modern smartphones make them powerful and convenient tools that can be used for multiple reasons in a choral classroom. Interestingly, the use of standalone video and audio recorders actually decreased compared with earlier research (Kotora, 2005; Nielsen, 2011), a finding likely due to the increased use of smartphones. With the ubiquity of smartphones, their potential as technology-assisted assessment tools in the music classroom is an area worthy of further study.

Music notation applications such as Finale or Sibelius were used by a moderate portion (42%) of choral music educators in the study. This is a lower percentage of use compared to Nielsen (2011), who found that music notation software was used more often than any other technology-assisted assessment tool (71% of K-12 music teachers in his study). This lower percentage may be due to the population examined in this study. Secondary choral teachers may not create as many assessments based on written music notation compared with the high percentage of elementary teachers in Nielsen's study. Also, the increasing availability of free, web-based notation applications over the past six years may have led teachers to abandon more expensive products like Finale or Sibelius.

The current study found that more than half of choral music teachers are using web-based technology more often than most other technology-assisted assessment tools. Resources such as online collaborative platforms (e.g., Google Classroom, blogs), video sharing sites (e.g., YouTube, Vimeo), and music-based websites (e.g., musictheory.net, sightreadingfactory.com) are being used an average of 8.3 times per grading period, more than all but three other tools presented in the STUCA. This represents a sharp increase in the use of web-based technology since Nielsen (2011) found that only 34% of music teachers incorporated web-based assessments. Interacting online is now commonplace for the digital natives in our U.S. secondary schools, so it makes sense that these tools are becoming more popular among practitioners.

Computer-based performance assessment applications such as SmartMusic seem to be gaining ground as assessment tools in the choral setting. Though this technology was among the least used tools in the current study, 19% of choral music educators reported using it to assess their choral students. The percentages are slightly larger in comparison to LaCognata's results (2010, 2013), which suggested 11-13% of high school band directors used SmartMusic

assessments. Henry (2014) found that only 1 of 138 high school choir camp students in her study had experienced computer-assisted assessment. Given that the choral assessment components in SmartMusic have only been available for five years, it is encouraging that almost a fifth of choral music teachers in the current study are using this type of performance assessment technology.

### Teachers' Use of Assessment Data

This study also investigated how choral music educators use the data that they obtain through technology-assisted assessment tools and found that the most common ways were to inform their instruction and assign grades. This finding parallels music education assessment studies not focused on technology (Kotora, 2005; Russell & Austin, 2010), and it seems that assessment data is used in similar ways regardless of the assessment medium. A small percentage of teachers (29%) said that they reported assessment data obtained through technology-assisted assessment tools to their school administrators, which is interesting given that the majority of teachers in the study (65%) said that their schools or school districts require them to document student growth data as part of their formal teacher evaluation process. Teachers who were required to document student growth data indicated using technology is effective in helping them fulfill this requirement, so there may other reasons why they choose not to use it for this purpose. Research question two and research question four will explore some of these factors.

## Factors Associated with Use of Technology Tools for Assessment

Research question two was developed with the goal of identifying what factors enable or constrain choral music educators' integration of technology-assisted assessment tools. The goal of research question four was to investigate more deeply to what extent choral educators'

demographics, professional backgrounds, comfort with technology, and levels of school support for technology predict (a) the amount of time they spend integrating technology-assisted assessment tools and (b) the variety of technologies they use for assessment of student learning. Descriptive statistical analyses (means, percentages) and inferential statistical analyses (multiple regression, correlations) were conducted to determine what factors are associated with choral music educators' use of technology tools for assessment.

**Comfort with Technology**

The most statistically significant finding in the current study is that choral music teachers' comfort with technology-assisted assessment tools seems to be the strongest predictor of increased frequency and variety of technology use. This finding aligns with prior research, which has shown that K-12 music teachers' personal comfort with and attitudes towards technology affect their technology integration (Bauer, 2012; Dorfman, 2008; Dorfman & Dammers, 2015; Nielsen, 2011). Overall, music teachers' comfort with using technology-assisted assessment tools appears to be increasing compared with these previous studies.

Teachers in the current study reported that they are very comfortable using technology in their personal and professional lives, and they use it frequently. Comfort and frequency levels for choir instruction and assessment were lower; however, the gap between indicated comfort and realized technology integration seems to be decreasing since Nielsen (2011) found teachers' positive attitudes towards technology were at odds with actual implementation. In the current study, frequency of technology use and comfort with technology showed a moderate positive correlation in all four areas at a statistically significant level. Further investigation via multiple regression analyses revealed that, when controlling for other variables such as personal and school demographics, teachers who indicated they were comfortable using technology-assisted

assessment tools in the choral classroom used them more often and also used a greater variety of technology tools.

The finding that increased comfort levels can predict increased frequency and variety of technology tool use is an encouraging result. Given that music teachers' comfort with technology in the classroom shows a positive trend, it is reasonable to think that more teachers are looking for technology-assisted assessment tools that may help them provide evidence of student achievement. Knowing this, research can now be focused on what might make teachers more comfortable with technology as more educators start to experiment with new tools.

**Pre-Service Technology Preparation and Professional Development**

Prior research has suggested that pre-service teacher education and professional development in music technology may enable choral music educators' integration of technology in the music classroom (Bauer, 2010, 2012; Bauer, Reese, & McAllister, 2003; Dorfman, 2008; Dorfman & Dammers, 2015; Nielsen, 2011). Teachers in the current study were asked if they learned to use technology for assessing student learning as part of their teacher preparation programs and, if so, how well they felt their programs prepared them to use technology to assess music students. The majority of teachers (83%) said their undergraduate teacher preparation did not include instruction in technology-assisted assessment tools. Graduate classes were found to have slightly more influence on choral music educators' use of technology-assisted assessment tools, but still ranked low on the list of factors that influenced their technology integration. It is disconcerting that this finding echoes those of studies going back almost 15 years (Bauer, Reese, & McAllister, 2003; Dorfman, 2008; Nielsen, 2011). It is encouraging, however, to see that of the small percentage of teachers who did receive some technology instruction during their

teacher preparation, the majority (74%) reported that it helped them feel well-prepared to use technology-assisted assessment tools in their choral classes.

Participants were also asked whether they had attended professional development sessions on the use of music technology (e.g., at state music education conventions, school-sponsored in-service, and/or ACDA conventions) and, if so, how much they felt the sessions helped them use technology effectively in their choral classroom. Unlike technology preparation during teacher education programs, the majority of teachers reported that they had attended music technology professional development sessions. Further, those teachers reported that the professional development experiences were among the most influential factors in their decision to use technology-assisted assessment tools in the choral classroom, second only to personal interest/philosophy. This finding is supported by Bauer (2012), who also found that music education conferences and summer workshops are important sources of technology education for music teachers.

These two findings related to technology preparation represent a compelling juxtaposition. The fact that research has consistently found music teachers report their preparation programs are not adequately preparing them to use tools that may enable them to be more successful teachers and assessors is puzzling. Although not related to assessment specifically, in a recent survey of 160 university music professors, Dorfman (2016a) found that 57% reported that their music education students were required to take a course focused on music technology. The largest percentage of professors said that they "agree" (33%) or "strongly agree" (9%) that the course adequately prepared pre-service teachers to use technology in their teaching. Haning (2015) surveyed 46 senior college music education majors in Ohio and found that 63% reported taking a music technology course. Perhaps these pre-service teachers received

instruction in technology-assisted assessment tools through an assessment-focused course, but large percentage of the students (43%) reported that they did not feel adequately prepared to use technology in the classroom and the main focus of the instruction they received was on music notation software or sound mixing/editing applications rather than technology used specifically with or by students. It is interesting that while teachers seem to feel that their teacher preparation programs are ineffective in preparing them to use technology, professional development focused on technology out in the field seems to be reaching more teachers and influencing their practice. While there is value in the knowledge or skills gained through music technology professional development, research has suggested that the effect of such fast-paced experiences can fade quickly (Bauer, 2012). Respondents in the current study reported that both forms of technology education were effective, so it seems that greater access to both would be beneficial to the profession.

**Personal and School-Related Factors**

It has been a common finding in music education assessment literature that educational philosophy is one of the biggest predictors of assessment practices (Hawkins, 2016; Henry, 2015; Russell & Austin, 2010), and it makes sense that this idea would carry over to technology-assisted assessment tool use. Teachers in the current study overwhelmingly reported that their personal interest/philosophy influenced them the most when deciding whether to use technology assessment tools. This contrasts with Dorfman and Dammers's (2015) study of technology integration, however, which found that teachers' educational priorities were not a significant predictor of successful integration of technology. The difference between these findings may be that Dorfman and Dammers considered "types" of teachers who were identified by their self-described alignment with the national standards (e.g., performance-oriented, creation-oriented).

The current study asked teachers specifically how much given factors (e.g., graduate courses, professional development, personal interest) influenced their decisions to use technology for assessment with the assumption that these factors may influence any teacher regardless of "type."

Dorfman and Dammers (2015) suggested further research into the effect of music teachers' demographic characteristics (e.g., years taught, age, gender, education) on technology integration. Based on the current study, these factors seem to have little effect on how often choral music educators use technology-assisted assessment tools. Surprisingly though, after controlling for other variables, holding a master's degree was associated with significantly less technology use. According to the multiple regression analysis, teachers with master's degrees were expected to use technology-assisted assessment tools about 5.8 times less per grading period than those with only bachelor's degrees. It is possible that since the sample was heavily weighted towards teachers with master's degrees (54%), this result may be skewed; however, it is also feasible that teachers with more educational experience may be inclined to assess their choral students in other, more traditional ways. Given the finding that teachers also found graduate courses to be inadequate sources of technology education, the effect of teachers' education level on technology integration may warrant further study.

School-related factors such as school setting (e.g., rural, suburban, urban) and school type (e.g., public, private, charter) were shown to have an effect on the frequency with which choral music educators used technology-assisted assessment tools. According to the multiple regression analysis, private school teachers were predicted to use technology significantly less compared with public school reference group. It is possible that these teachers used technology-assisted assessment tools less because they are not required to document student growth to the same

extent as their public school colleagues. Though prior research has found that teachers' educational philosophies are more influential than state requirements (Hawkins, 2016; Russell & Austin, 2010), multiple respondents who taught in private schools wrote in the open-ended response questions that they did not use technology because they were not required to. Teachers in charter schools were predicted to use a slight yet significantly wider variety of technology-assisted assessment tools. Though one might surmise that urban or rural schools might have smaller budgets and thus less access to expensive technology tools, these variables were not statistically significant. However, suburban teachers represented 51% of the sample, and urban and rural teachers could have been underrepresented. Thus, the sample is likely suffering from selection bias.

Additional school-related factors such as interaction with other teachers or administrators were also investigated. A colleague's suggestion to use technology seemed to have a moderate influence on choral music educators' decision to use technology-assisted assessment tools. One would think that this factor might be more influential as teachers share what they learn about new technology with each other; however, research has suggested music educators tend to make assessment decisions on their own, based more on personal preference than best practice (Russell & Austin, 2010). Similarly, over half of the respondents said that a school administrator's suggestion to use technology had little or no influence.

Another potential factor that may affect teachers' use of technology in the music classroom is access to technology assistance in the school building (Dorfman & Dammers, 2015). Respondents reported if they had access to Information Technology (IT) professionals or technology assistants at their schools and, if so, how much they felt the IT professionals helped them implement technology in the classroom. Teachers overwhelmingly reported (92%) that they

had IT support at their schools and that their presence aided with technology integration. Given that teachers in the study said they did not consider technical problems out of their control (e.g., internet connectivity in their classroom) to be large barriers as they had in past studies (see Webster, 2011), it appears that IT support in schools may be a factor that enables choral music educators to use technology more easily. This is a positive change, considering early technology adopters struggled due in part to the technical limitations of their schools' infrastructure.

**Incentives and Barriers for Using Technology-Assisted Assessment Tools**

Respondents in the current study reported potential incentives for using assessment technology. A majority of teachers felt that technology assessment tools helped when assigning grades and organizing data obtained from assessments. Over half of the teachers reported that the ability to provide feedback to students faster was another key incentive for using technology tools for assessment. All of these incentives are related to gains in efficiency, which is a feature of many technology-assisted assessment tools. While some tools may be influential because they enhance the efficacy of an assessment (e.g., using an audio recorder to allow for more in-depth post-assessment analysis and self-reflection), it seems teachers find value in tools that make their jobs easier; software that tabulates assessment grades automatically, for example, allows teachers to focus their energy on other curricular goals. Though rather obvious, this finding is important to note as researchers may be able to provide data to support practitioners who need tools that help them meet the practical demands of life as a music teacher.

The number one barrier cited by the choral music teachers in the study was a lack of time to research, set up, and/or implement technology, reported by 53% of teachers to be a "large" or "extreme" barrier. The cost of technology implementation was also considered a "large" or "extreme" barrier by over half of the teachers. These two factors have consistently been found to

be the top impediments to technology implementation in music technology research (see Dorfman, 2008; Nielsen, 2011). Teachers have also said that their technology implementation is hindered by a lack of time to develop and administer assessments in past music education assessment research (see Kotora, 2005; Russell & Austin, 2010).

Despite teachers reporting that lack of time was their biggest barrier to integrating technology-assisted assessment tools, two time-saving incentives ("save time when administering an assessment" and "conduct a group rehearsal while students complete assessments independently") ranked lowest. This was a surprising result, especially since time-saving features are often the incentives for using technology most emphasized by practitioner articles (see Criswell, 2012; Furby, 2013). A possible explanation for this discrepancy could be that time is a multilayered construct, including preparation time, instructional time, teachers' time, students' time, etc. Teachers may also view time related to assessments in different categories: before, during, and after the assessment administration. First, they feel that technology tools require significant time to research, set up, and implement, which is seen as a barrier because it actually takes more of the teachers' personal preparation time to implement them. Second, teachers in this study do not feel that the technology-assisted assessment tools they have used save instructional time during the actual assessment administration. Finally, they feel that technology tools do save them time after the assessment administration when organizing assessment data, calculating grades, and sharing results takes place. So, time can be saved or lost at different points during the assessment process.

Looking at the types of assessments that the choral music educators in this study reported using, most teachers used technology in ways that probably would not save time during a class session (e.g., using a laptop or their smartphone to play a recording for a listening response). As

Dorfman (2016b) found, teachers working in one-to-one environments might actually spend more class time administering certain assessments using technology instead of paper and pencil. In contrast, Walls, Erwin, and Kuehne (2013) found teachers of instrumental ensembles can save significant instructional time (12.7 minutes per class session) by using computer-based performance assessment applications such as SmartMusic, which allows students to complete individual performance assessments while an ensemble rehearsal is running simultaneously. Only 19% of choir teachers in the current study made use of computer-based performance assessment tools, so it is probable that they have not experienced the potential time savings from using these tools.

It seems that a reason many teachers have not used computer-based performance assessment applications is cost related. Products such as SmartMusic, MusicProdigy, and MusicFirst/PracticeFirst cost hundreds if not thousands of dollars per year to implement, depending on the number of students in the music program. These products have also moved toward subscription-based services rather than software-based, so the cost is recurring. Even though teachers may see the benefit of such tools, many are unable to implement them. Instead, choir teachers appear to be opting for web-based services, which are often free. More than half of the teachers in the study made use of free online collaborative platforms (e.g., Google Classroom), video sharing sites (e.g., YouTube), and music-based websites (e.g., musictheory.net). In the open-ended questions of the STUCA, multiple respondents also specifically mentioned they used sightreadingfactory.com, a free website for sight-singing instruction, practice, and assessment. Though products such as SmartMusic have been making gains in popularity and may offer more features than free web-based tools, choral music educators are not using them as often at this time.

Finally, it should be noted that, though it was not specifically offered as a response option in the STUCA, multiple respondents did mention in one of the open-response questions that they choose not to use technology to assess their choral students because they feel there is value in the "old-fashioned way" of teaching and assessing music where human interaction is paramount. Some also found that technology is distracting for the students. The goals of this study are to identify and explore not only why choral music educators use technology, but also why they do not, so this result was appreciated. While the majority of the results examine incentives and barriers for using technology, it is important to remember that using these tools is optional for most teachers. Quality assessment can occur without technology-assisted tools, and some teachers simply choose not to use them because they have found other ways that they feel are effective. The next section discusses why choral music educators feel that using technology for student assessment is or is not effective.

### Teachers' Perceived Efficacy of Using Technology-Assisted Assessment Tools

In addition to discovering why choral music educators use technology to assess their students, how they implement their assessments, and what kinds of technology tools they use, it was a goal of this study to determine whether teachers felt that integrating technology was an effective way to improve their assessments. Therefore, research question three, "What is the perceived efficacy of using technology-assisted assessment tools in the choral classroom?" was developed to investigate a priori categories of student abilities based on the NCAS artistic processes (creating, performing, responding, connecting).

The means for all but one ability category (improvisation) fell into the "neutral" response category ($M$ = 3.2-3.8 on a Likert-type scale from 1-5, where 1 = *very ineffective* and 5 = *very*

*effective*). While choosing a neutral stance may possibly indicate a lack of opinion and potentially provide an inconclusive finding, when the individual responses for this survey item were examined, more teachers actually chose "effective" or "very effective" than chose "neutral" in three categories: (1) assessing students' ability to respond to music by listening, analyzing, and/or writing; (2) assessing students' ability to perform choral music repertoire effectively; and (3) assessing students' ability to sight-sing using music notation. This is an encouraging result. Earlier questions in the STUCA revealed that choral music educators use technology most often to assist with listening responses, singing tests on choral literature, and individual sight-singing tests, and it is interesting that these three categories corresponded exactly and in order. One might presume that teachers use technology for these more frequently because they find them to be effective tools to assess students' ability to respond to music and perform music individually.

The teachers in the study felt that technology-assessment tools were least effective at assessing choir students' musical creativity through improvisation. This assessment format was also the least frequently administered. Only 19% of teachers assessed their choir students using improvisation and 11% used technology to assist. Given that such a small percentage of teachers assessed improvisation, it makes sense that many (64%) would take a neutral stance on its effectiveness through technology. Overall, it is clear from this study that improvisation is not assessed often in the secondary choral classroom, which is a finding echoed in prior research (Kotora, 2005; Russell & Austin, 2010; Tracy, 2002).

The current study asked choral music educators about the accuracy of technology-assisted assessment tools and whether that affected their perception of their efficacy. Henry (2014) found that if choir students feel a technology-assisted assessment tool is inaccurate, they may form a negative opinion about its effectiveness. Though Henry's study only involved choir

students, it is feasible to believe choir teachers would feel the same. In the current study, choir teachers were asked generally if their trust or their students' trust in the accuracy of technology-assisted assessment tools were barriers to their integration. The teachers reported that a lack of trust in the accuracy of the technology was "not a barrier at all."

Teachers also indicated how accurate they believe computer-based performance assessment tools like SmartMusic, Music Prodigy, or PracticeFirst are in assessing students' singing accuracy. More than half of the teachers said that they have not used this type of technology, but those who had used it mostly reported that they felt these types of tools are accurate. This is a positive finding; however, multiple participants also responded an open-ended question to report that computer-based performance assessment tools can be ineffective because they pick up the human voice inaccurately and because they cannot judge factors other than pitch and rhythm. Still, another respondent added that they feel recording technology decreases student test anxiety during a performance-based singing test, which makes the assessment more effective. Overall, more research is needed to determine the true effectiveness of these types of tools in a choral setting.

Finally, since most states in the U.S. now require measures of student growth as part of public school teachers' performance evaluations, participants were asked how much they felt technology helps them effectively meet the requirement to document student growth data. Teachers reported on average that technology helps them with this requirement "a lot" or "a great deal" (4 or higher on a 5-point Likert-type scale, where 1 = *not at all*; 5 = *a great deal*). It is an encouraging finding that choral teachers report technology can help them meet this requirement. One premise of the study is that with this new requirement, some choral music educators may struggle to document student assessment data in a measurable form as required by

their administrators. If technology-assisted assessment tools can provide an effective and efficient solution to this problem, the implications for the profession could potentially be far-reaching.

## Implications for Choral Music Education

This study suggests a number of implications that could inform current practice or policy and potentially help choral music educators assess their students in more efficient, effective, and practical ways. Based on the analysis of this study, choir teachers are not assessing their students frequently nor are they using technology for these assessments consistently. Part of the reason for this may be that, in the U.S., bands, choirs, and orchestras are characteristically the pillars of a secondary school music program. These performance-based ensembles typically involve a large number of students and focus on the presentation of repertoire in a concert setting. Few choral music educators have the benefit of small group instruction or individual lesson time (Tracy, 2002) that can be tailored to individual differences and paths of growth; therefore, frequently assessing and documenting the individual growth of their students is challenging. This is especially problematic now that states and school districts are requiring quantitative documentation of student growth as part of teachers' performance evaluations.

The last survey study that was conducted solely on secondary choir teachers' assessment practices was Kotora's (2005) study of high school teachers in Ohio over 10 years ago. Much has changed in regards to assessment practices and technology use during that time. Though Kotora's study focused very little on technology, he called for further research in the area, saying, "With the increased availability of computer, audio, and video technology, it would be most interesting to look at how technology is being utilized by choral music teachers in assessing

and documenting student achievement in choral music performance classrooms" (p. 76). The current study provides a more detailed picture of choral music educators' assessment practices and how they use technology to assist with or enrich their assessments.

Bauer, Reese, and McAllister (2003) asserted that quality technology integration includes increased frequency of use. It is important for researchers and practitioners to recognize the types of technology-assisted assessment tools that are being used more often and consider why those tools might be more prevalent in choral classrooms. By identifying these tools, teachers and administrators may be able to work together to prioritize the allocation of resources and provide technology that would benefit choral students. The current study provides evidence that laptops/tablets, smartphones, and online resources are being used most frequently by choral music educators. These tools have seen increased use likely because of their availability. Many schools of all types have adopted one-to-one models where every student receives a school-issued laptop or tablet. Smartphones now sit in the pockets of most teachers and students, and an ever-growing assortment of free online music resources is available. Choir teachers should continue their use of these tools and look for additional ways to use them effectively when assessing choral students.

Knowing which technology tools are found to be most effective when assessing choral students' achievement based on the NCAS will be appealing to teachers looking to document evidence of student growth in these areas. In this study, it is clear that choral music educators feel technology-assisted assessment tools can be particularly effective in three areas: (1) assessing students' ability to respond to music by listening, analyzing, and/or writing; (2) assessing students' ability to perform choral music repertoire effectively; and (3) assessing students' ability to sight-sing using music notation. Perhaps this finding will encourage the half

of the sample that is not using technology to explore its benefits. While these areas were most effective, it also should be noted that in no identified areas of student knowledge or skill (creating, performing, responding, connecting) were technology-assisted assessment tools found to be ineffective. Consistent with prior research (Russell & Austin, 2010), a small percentage of music teachers assess their students' creativity through composition or improvisation; however, teachers in the current study still held a neutral position overall regarding technology's ability to assist with these types of assessments. This result is promising, as it shows that there may be potential for technology to make an impact in these areas and possibly enable teachers to assess improvisation and composition more easily.

Since comfort with technology-assisted assessment tools was the most significant predictor of increased frequency of use, those involved in the assessment process need to look for ways to help teachers feel more comfortable with technology. Bauer (2012) and Dorfman (2008) suggest professional development opportunities are effective in increasing the frequency and quality of music teachers' technology integration. Many choral music educators in the current study found professional development sessions to be an effective way to gain experience with technology-assisted assessment tools; however, not all teachers have access to quality professional development. Professional development is most effective when it is discipline-specific, and state music education conventions or other local conferences can be an influential source of professional development for music teachers. School administrators should commit funding for choral music educators in their schools to attend these conventions and consider enabling music-specific professional development during school improvement days or in-service experiences.

Many of the implications from this study involve removing barriers such as time constraints and high cost, the two factors that are consistently found to limit music teachers' use of technology. The findings of this study show that the time it takes to research and implement new technology continues to be a significant obstacle for choir teachers. It is apparent that school administrators need to provide time for teachers to incorporate technological tools that will assist in student assessment, especially since they are now requiring a new level of assessment documentation. This initial time investment seems to be the largest barrier, but after technology is in place, teachers find that the biggest incentive for using technology-assisted assessment tools is time saved through efficiency in recordkeeping (e.g., grade calculation, quicker feedback to students, ease in data organization).

The cost associated with technology-assisted assessment tools also continues to be a significant barrier for teachers. As many teachers in the current study reported, the use of web-based tools (e.g., sightreadingfactory.com, Google Classroom, blogs), which are often free, can be effective and should be considered. Music practitioner journals often include articles and features devoted specifically to the discovery of new technology tools, and choral music educators could gain valuable insights be exploring these resources. Though they may not be as feature-rich as more expensive technology-assisted assessment tools, these online tools may also increase teachers' ability to document student growth in more efficient and practical ways.

## Suggestions for Future Research

Research on the use of technology-assisted assessment tools in the choral classroom is a budding topic in music education research. By bridging two existing research areas, music education assessment and music education technology, the current study has opened the door for

future research beyond what each might address separately. It was beyond the scope of this study to evaluate the quality of the assessments administered by choral music educators or how they use these assessments to inform instruction; however, to extend the current study, researchers might investigate related topics that now call for deeper investigation. Also, it is important to recognized new topics that emerged that have yet to be explored.

A finding from the current study that is particularly promising for further research is the prevalent use of smartphones in the secondary choral classroom. Only laptops and tablets were used more often for assessment purposes, and given the growing capabilities of smartphones, opportunities for future studies are many. The use of smartphones for assessing music students has yet to be studied empirically in U.S. music education. Wallerstedt and Hillman (2015) studied how smartphones were used in Swedish school pop band classes and found that while there is potential for these devices to be effective in the music classroom, students need guidance from teachers to use their smartphone appropriately. More research on how both students and teachers may use smartphones in the music classroom could be influential for teachers in all music education settings as well as school administrators who enact policies restricting the use of smartphones in the classroom.

Future research might also include studies specifically focused on the use of computer-based performance assessment in secondary music ensembles. SmartMusic has been found to be effective with beginning choir students when teaching sight-singing (Petty & Henry, 2014), and a study of a high school band showed that the use of SmartMusic assessments saved significant rehearsal time compared to in-class assessments (Walls, Erwin, & Kuehne, 2013). The current study found that music teachers are using computer-based performance assessment more often

than in previous studies, so an investigation of its effectiveness in multiple settings (e.g., band, choir, orchestra, AP Music Theory courses, collegiate aural skills courses) would be timely.

Studies on music teachers' use of web-based technology tools would also be prudent given that the current study found teachers appear to be using these tools relatively often compared to other technology-assisted assessment tools. Online resources have also seemed to have gained popularity over the past decade and have become easily accessible to teachers and students. More focused research into the use of these tools would be especially valuable to the 53% of teachers who reported that cost of technology-assisted assessment tools was a "large" or "extreme" barrier for them. Future studies could not only identify what online tools are being used, but also how their use may mediate the musical experience.

A topic of interest that was expected to play a significant role in the current study, but remained relatively inconsequential, was the use of technology for sight-singing assessment. Though sight-singing was found to be one of the top three areas that choral music educators use technology to assist when assessing their students, a more nuanced understanding was desired. Sight-singing is a better developed area of research than music education assessment or music technology, but the connection among the three areas has not been made as of yet. It would be interesting for future research to investigate specific technology tools or resources uncovered in the current study (e.g., sightreadingfactory.com) to see why teachers are using them and how they may be effective.

Finally, the amount and quality of education on the use of technology-assisted assessment tools in preservice teacher preparation programs is a related topic that warrants further research. Researchers have consistently found that most music educators report that they did not receive instruction in assessment strategies or technology tools during their undergraduate degree

programs. However, perhaps we have yet to see the full effects of recent curricular changes at the university level amidst the digital technology revolution of the past decade. Only 28% of the respondents in the current study were new teachers (1-5 years of experience), so recent college graduates may have been underrepresented. While recent data does exist on music technology courses in general (Dorfman, 2016; Haning, 2016), no researcher has investigated the role of assessment in these courses. It would be interesting to conduct an analysis of music teacher education programs to determine if colleges are incorporating preparation on technology-assisted assessment tools into their courses and how these tools are being taught.

## Limitations of the Study

Though multiple measures were taken to ensure the representativeness and generalizability of the results of this quantitative study, there are some limitations. The sample size is relatively large for music education studies of its kind ($N$ = 658), but the 7% response rate is low, so readers should interpret the results with caution. The sampling frame for this study included individuals who elected to join the professional organization NAfME and were members at the time the sample was drawn from membership rolls. Teachers not represented in this frame could include music educators who cannot afford the membership fees, have allowed their memberships to lapse during the survey window, or have chosen not to join NAfME. Also, the 2-wave survey administration procedure could have introduced the potential for selection bias as the second wave was selected without replacement of first-wave respondents. Since potential respondents from the first wave were not included in the second, the overall population from which the sample was drawn was smaller.

Another limitation is that the response rate may not be precise because NAfME's membership list proved to be inaccurate. Even though the sampling conducted through NAfME's Research Assistance Program should have resulted in only secondary choir directors from states that require documentation of student growth, hundreds of teachers were disqualified through the STUCA's first question because they indicated that they did not teach choir or teach in a different state from what was listed on their membership record. It was impossible to tell if more teachers simply chose not to respond because they recognized they were not qualified.

Certain populations of choral music educators may have been underrepresented in the sample. Due to an apparent error with the set-up of the qualifying questions in SurveyMonkey, teachers from New Jersey were inadvertently disqualified. Since New Jersey is a state with a sizable number of choral music educators, its omission likely resulted in a degree of non-response bias. Teachers from urban schools were also underrepresented, although urban educators may presumably also be underrepresented in the NAfME membership. This is something to consider since technology accessibility may be different among urban and suburban educators. Young teachers also were low in number in this study, with only 3% younger than 25 years old. Larger representation of these younger teachers may have revealed different patterns of use related to recent changes in the technology offerings of music teacher education programs.

Methodologically, frequency of teachers' technology use was problematic to measure since it was difficult to anticipate when teachers use technology to assess their students. Most teachers likely have weeks when they do not use technology at all and other weeks where they use it very frequently. The cognitive interview revealed that it would also be difficult for some teachers to document how often they use technology on average throughout a full school year. Because of this, teachers were giving the option to answer frequency questions in times per

week, per month, or per grading period. Since many (60%), but not all, teachers employed a nine-week grading period, the data had to be transformed, making frequency potentially difficult to ascertain clear numeric indicators of how often teachers use technology for assessment purposes.

Despite these limitations, the current study still draws from a large national sample to provide a broad view of the way choral music educators use technology to assess their students in the choral setting. Steps were taken to ensure the reliability and validity of the results, and analyses were rigorous. Findings from the study can be considered valuable to both researchers and practitioners in choral music education as well as the music education profession at large.

## Conclusion

> "If we teach today as we taught yesterday, we rob our children of tomorrow."
>
> (John Dewey, 1916, p. 167)

All of us had *that* teacher at one point in our lives—the teacher who reused the same worksheets over and over, still clung to the same tests that he created on a ditto machine 20 years prior, and seemed thoroughly out of touch with the kids sitting in front of him. Though one would hope that teachers such as this are disappearing given the education reform efforts and fast-paced technological advances of today, Dewey's (1916) quote reminds us that if teachers are to be effective, they must know their students and adapt just as they do, staying current and embracing not only new instructional techniques, but also new assessment methods. Assessing student learning is an increasingly complex task in today's educational milieu but is a crucial part of what teachers do and serves an important role in the learning process.

Individual student assessment is often difficult for teachers of traditional performance-based choral ensembles, and this study sought to examine the potential of technology tools that might assist those teachers. By investigating what tools choir teachers are employing, how they use them, and whether or not they find them effective, a more current understanding of the landscape of technology-assisted assessment tool use in the choral classroom was gained. Many incentives for using these tools were discovered as well as multiple barriers choral music educators are experiencing that may limit their use. Finally, the effects of personal and school demography were analyzed to complete the big picture of choral music educators' integration of technology-assisted assessment tools.

By continuing to research and experiment with new technological innovations, choral music educators can stay current and discover tools that may make the student assessment process more effective, efficient, and practical for both teachers and students. Educational reform efforts and technological innovations will come and go, and it is often the nature of educators to be reactive rather than proactive. However, only by attempting to anticipate the needs of the students and champion any quality innovations that may improve the education process—assessment, technology, or other—will choral music education move forward with its vital contribution to education in American schools.

# REFERENCES


Abeles, H. F. (2010). Assessing music learning. In H. Abeles & L. Custodero (Eds.), *Critical issues in music education: From theory to practice* (pp. 167-193). New York, NY: Oxford University Press.

Abril, C. R., & Gault, B. M. (2008). The state of music in secondary schools: The principal's perspective. *Journal of Research in Music Education, 56*(1), 68-81.

Airasian, P. W. (2004). *Classroom assessment: Concepts and applications*. New York, NY: McGraw-Hill.

Allison, P. (1999). *Multiple regression: A primer.* Thousand Oaks, CA: Pine Forge Press.

Austin, J. R. (2003). *Hodgepodge grading in high school music classes: Is there accountability for artistic achievement?* Paper presented at the meeting of the American Educational Research Association, Chicago, IL.

Barrett, J. R. (2006). Developing the professional judgment of preservice music teachers: Grading as a case in point. *Journal of Music Teacher Education, 15*(2), 8-20.

Bauer, W. I. (2010). Technological pedagogical and content knowledge, music, and assessment. In T. Brophy (Ed.), *The practice of assessment in music education: Frameworks, models, and designs. Proceedings of the 2009 Florida Symposium on Assessment in Music Education* (pp. 425-434). Chicago, IL: GIA.

Bauer, W. I. (2012). The acquisition of musical technological pedagogical and content knowledge. *Journal of Music Teacher Education, 22*(2), 51–64.

Bauer, W. I. (2014). *Music learning today: Digital pedagogy for creating, performing, and responding to music*. New York, NY: Oxford University Press.

Bauer, W. I., Reese, S., & McAllister, P. A. (2003). Transforming music teaching via technology: The role of professional development. *Journal of Research in Music Education, 51*(4), 289-301.

Boyle, J. D., & Radocy, R. F. (1987). *Measurement and evaluation of musical experiences*. New York, NY: Schirmer Books.

Broomhead, P. (2001). Individual expressive performance: Its relationship to ensemble achievement, technical achievement, and musical background. *Journal of Research in Music Education*, *49*(1), 71-84.

Buck, M. W. (2008). *The efficacy of SmartMusic assessment as a teaching and learning tool* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses database. (3346520)

Colwell, R. (2002). Assessment's potential in music education. In R. Colwell & C. Richardson (Eds.), *The new handbook of research on music teaching and learning* (pp. 1128-1158). New York, NY: Oxford University Press.

Consortium of National Arts Education Associations. (1994*). National standards for arts education: Dance, music, theatre, visual arts.* Reston, VA: MENC.

Cook, I., & Upton, G. (1996). *Understanding statistics*. New York, NY: Oxford University Press.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: Sage.

Criswell, C. (2012). Capturing performance in sight and sound. *Teaching Music, 19*(4), 26–27.

Criswell, C. (2017). Using technology in assessment. *Teaching Music, 24*(3), 22-32.

Dammers, R. J. (2012). Technology-based music classes in high schools in the United States. *Bulletin of the Council for Research in Music Education, 194*, 73-90.

Demorest, S. M. (1998). Improving sight-singing performance in the choral ensemble: The effect of individual testing. *Journal of Research in Music Education, 46*(2), 182-192.

Demorest, S. M. (2004). Choral sight-singing practices: Revisiting a web-based survey. *International Journal of Research in Choral Singing, 2*(1), 3-10.

Demorest, S. M., & May, W. V. (1995). Sight-singing instruction in the choral ensemble: Factors related to individual performance. *Journal of Research in Music Education, 43*(2), 156-167.

Dewey, J. (1916). *Democracy and education.* New York, NY: MacMillan.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2009). *Internet, mail, and mixed mode surveys: The tailored design method*. Hoboken, NJ: John Wiley & Sons.

Dorfman, J. (2008). Technology in Ohio's school music programs: An exploratory study of teacher use and integration. *Contributions to Music Education, 35*, 23-46.

Dorfman, J. (2013). *Theory and practice of technology-based music instruction.* New York, NY: Oxford University Press.

Dorfman, J. (2016a). Exploring models of technology integration into music teacher preparation programs. *Visions of Research in Music Education, 28*. Retrieved from http://www.rider.edu/~vrme

Dorfman, J. (2016b). Music teachers' experiences in one-to-one computing environments. *Journal of Research in Music Education, 64*(2), 159-178.

Dorfman, J., & Dammers, R. (2015). Predictors of successful integration of technology into music teaching. *Journal of Technology in Music Learning, 5*(2), 46-59.

Eisner, E. W. (1996). Evaluating the teaching of art. In D. Boughton, E. Eisner, & J. Ligtvoet (Eds.), *Evaluating and assessing the visual arts in education: International perspectives* (pp. 75-94). New York, NY: Teachers College Press.

Farnum, S. (1969). *Farnum String Scale: A performance scale for all string instruments*. Winona, MN: Hal Leonard Music.

Fautley, M., & Colwell, R. (2012). Assessment in the secondary music classroom. In G. McPherson & G. Welch (Eds.), *The Oxford handbook of music education* (Vol. 1, pp. 476-494). New York, NY: Oxford University Press.

Flanigan, G. P. (2008). *An investigation of the effects of the use of SmartMusic software by brass players on intonation and rhythmic accuracy* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses database. (3401785)

Floyd, E., & Bradley, K. D. (2006). Teaching strategies related to successful sight-singing in Kentucky choral ensembles. *Update: Applications of Research in Music Education*, *25*(1), 70–81.

Floyd, E., & Haning, M. A. (2015). Sight-singing pedagogy: A content analysis of choral methods textbooks. *Update: Applications of Research in Music Education*, *25*(1), 11–21.

Fowler, F. J. (2014). *Survey research methods*. Thousand Oaks, CA: Sage.

Furby, V. J. (2013). Idea bank: Individualized assessment in the choral ensemble. *Music Educators Journal, 100*, 25–29.

Haning, M. (2016). Are they ready to teach with technology? An investigation of technology instruction in music teacher education programs. *Journal of Music Teacher Education, 25*(3), 78-90.

Hash, P. M. (2013). Large-group contest ratings and music teacher evaluation: Issues and recommendations. *Arts Education Policy Review, 114*(4), 163–169.

Hawkins, J. A. (2016). Assessment practices of a high school choir director: A case study. In T. Brophy, J. Marlatt, & G. Ritcher (Eds.), *Connecting practice, measurement, and evaluation: Selected papers from the Fifth International Symposium on Assessment in Music Education* (pp. 109-128). Chicago, IL: GIA.

Heeringa, S., West, B., & Berglund, P. (2010). *Applied survey data analysis.* Boca Raton, FL: Taylor & Francis.

Henry, M. L. (2001). The development of a vocal sight-reading inventory. *Bulletin of the Council for Research in Music Education, 150*, 21–35.

Henry, M. L. (2004). The use of targeted pitch skills for sight-singing instruction in the choral rehearsal. *Journal of Research in Music Education, 52*(3), 206–217. doi:10.2307/3345855

Henry, M. L. (2011). The effect of pitch and rhythm difficulty on vocal sight-reading performance. *Journal of Research in Music Education, 59*(2), 72–84. doi:10.1177/0022429410397199

Henry, M. L. (2014). Vocal sight-reading assessment: Technological advances, student perceptions, and instructional implications. *Update: Applications of Research in Music Education, 33*(2), 58-64. doi:10.1177/8755123314547908

Henry, M. L. (2015). Assessment in choral music instruction. *Oxford Handbooks Online*. doi:10.1093/oxfordhb/9780199935321.013.101

Henry, M. L., & Demorest, S. M. (1994). Individual sight-singing achievement in successful choral ensembles. *Update: Applications of Research in Music Education*, *13*(1), 4-8.

Horn, M. B., & Staker, H. C. (2011). The rise of K–12 blended learning. San Mateo, CA: Innosight Institute. Retrieved from http://www.innosightinstitute.org/innosight/wp-content/uploads/2011/01/The-Rise-of-K-12-Blended-Learning.pdf

Kancianic, P. M. (2006). *Classroom assessment in U.S. high school band programs: Methods, purposes, and influences* (Doctoral dissertation). Retrieved from Dissertations Abstracts International. (3222315)

Keene, J. A. (1982). *A history of music education in the United States*. Hanover, NH: University Press of New England.

Killian, J. N., & Henry, M. L. (2005). A comparison of successful and unsuccessful strategies in individual sight-singing preparation and performance. *Journal of Research in Music Education, 53*(1), 51-65.

Koehler, M. J., & Mishra, P. (2008). Introducing TPCK. In AACTE Committee on Innovation and Technology (Ed.), *The handbook of technological pedagogical content knowledge for educators* (pp. 3-29). New York, NY: Routledge/Taylor & Francis.

Kotora, E. J. (2005). Assessment practices in the choral music classroom: A survey of Ohio high school choral music teachers and college choral methods professors. *Contributions to Music Education, 32*(2), 65-80.

Kratus, J. (2007). Music education at the tipping point. *Music Educators Journal*, *94*(2), 42-48.

Kuehne, J. M. (2007). A survey of sight-singing instructional practices in Florida middle-school choral programs. *Journal of Research in Music Education*, *55*(2), 115-128.

Kuehne, J. M. (2010). Sight-singing: Ten years of published research. *Update: Applications of Research in Music Education, 29*(1), 7–14.

Kuzmich, J. (2010). Using smart phones for music education. *Choral Director, 7*, 22-24.

LaCognata, J. P. (2010). Student assessment in the high school band ensemble class. In T. Brophy (Ed.), *The practice of assessment in music education: Frameworks, models, and designs. Proceedings of the 2009 Florida Symposium on Assessment in Music Education* (pp. 227-238). Chicago, IL: GIA.

LaCognata, J. P. (2013). Current student assessment practices of high school band directors in the United States. In T. Brophy & A. Lehmann-Wermser (Eds.), *Music assessment across cultures and continents: The culture of shared practice* (pp. 109-128). Chicago, IL: GIA.

Lehman, P. R. (1998). Grading practices in music. *Music Educators Journal, 84*(5), 37-40.

Levy, P. S., & Lemeshow, S. (2013). *Sampling of populations: Methods and applications.* New York, NY: John Wiley & Sons.

Manzo, A. N., & Burke, J. M. (2012). Increasing response rate in web-based/internet surveys. *Handbook of survey methodology for the social sciences* (pp. 327-343). New York, NY: Springer.

McClung, A. C. (1997). Learning assessment and grading practices in the high school choral music performance classroom. *Southeastern Journal of Music Education, 9*, 252–272.

McCoy, C. W. (1991). Grading students in performing groups: A comparison of principals' recommendations with directors' practices. *Journal of Research in Music Education, 39*(3), 181–190.

Miksza, P. (2013). The future of music education: Continuing the dialogue about curricular reform. *Music Educators Journal, 99*(4), 45-50.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*, 1017-1054.

National Association for Music Education. (2015). *Music model cornerstone assessment: Artistic process: Performing ensembles: Accomplished & advanced.* Retrieved from http://www.nafme.org/wp-content/files/2014/11/Music_MCA_Ensemble_Performing_Accomplished_Advanced_2015.pdf

National Association for Music Education. (2017). Assessment in music education position statement. Retrieved from http://www.nafme.org/about/position-statements/assessment-in-music-education-position-statement/assessment-in-music-education/

National Association for Music Education: About NAfME. (n.d.). Retrieved from https://nafme.org/about/

National Council on Teacher Quality. (2015). State of the states 2015: Connect the dots: Using evaluations of teacher effectiveness to inform policy and practice. Accessed May 15, 2016, at http://www.nctq.org/dmsStage/State_of_the_States_2015_Using_Teacher_Evaluations_NCTQ_Report.

Nielsen, L. D. (2011). *A study of K-12 music educators' attitudes toward technology-assisted assessment tools* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses database. (3461345)

Norris, C. E. (2004). A nationwide overview of sight-singing requirements of large-group choral festivals. *Journal of Research in Music Education, 52*(1), 16–28.

O'Toole, P. A. (2003). *Shaping sound musicians: An innovative approach to teaching comprehensive musicianship through performance*. Chicago, IL: GIA.

Okojie, M. C., Olinzock, A. A., & Okojie-Boulder, T. C. (2006). The pedagogy of technology integration. *Journal of Technology Studies*, *32*(2), 66-71.

Pellegrino, K., Conway, C. M., & Russell, J. A. (2015). Assessment in performance-based secondary music classes. *Music Educators Journal, 102*(1), 48-55.

Petty, C., & Henry, M. L. (2014). The effects of technology on the sight-reading achievement of beginning choir students. *Texas Music Education Research*, 23-28.

Pressey, B. (2013). Comparative analysis of national teacher surveys. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop. Retrieved October 27, 2013 from http://www.joanganzcooneycenter.org/wpcontent/uploads/2013/10/jgcc_teacher_survey_analysis_final.pdf

Robinson, M. (2015). The inchworm and the nightingale: On the (mis) use of data in music teacher evaluation. *Arts Education Policy Review, 116*(1), 9-21.

Robinson, R. L., Gackle, L., Renfroe, W., & Usher, A. (2010). Assessment practices in the choral classroom. In T. Brophy (Ed.), *The practice of assessment in music education: Frameworks, models, and designs. Proceedings of the 2009 Florida Symposium on Assessment in Music Education* (pp. 281-286). Chicago, IL: GIA.

Rudolph, T. E. (Ed.). (2005). *Technology strategies for music education*. Wyntoce, PA: Hal Leonard.

Russell, J. A., & Austin, J. R. (2010). Assessment practices of secondary music teachers. *Journal of Research in Music Education, 58*(1), 37-54.

Ryan, K., Gannon-Slater, N., & Culbertson, M. J. (2012). Improving survey methods with cognitive interviews in small- and medium-scale evaluations. *American Journal of Evaluation, 33*(3), 414-430.

Salkind, N. J. (2010). *Encyclopedia of research design.* Thousand Oaks, CA: Sage.

Scheib, J. W. (2003). Role stress in the professional life of the school music teacher: A collective case study. *Journal of Research in Music Education*, *51*(2), 124-136.

Shuler, S. C., Norgaard, M., & Blakeslee, M. J. (2014). The new national standards for music educators. *Music Educators Journal, 101*(1), 41–49. doi:10.1177/0027432114540120

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

Sight-Singing (n.d.). In *The Oxford Dictionary of Music Online*. Retrieved from http://www.oxfordmusiconline.com/subscriber/article/opr/t237/e9422

SmartMusic (Version 2017) [Computer software]. Boulder, CO: MakeMusic.

Stata Statistical Software (Release 15) [Computer software]. College Station, TX: StataCorp.

State Education Agency Directors of Arts Education. (2014). *National Core Arts Standards: A conceptual framework for arts learning*. Retrieved from http://www.nationalartsstandards .org/content/conceptual-framework

Stiggins, R. J., & Conklin, N. F. (1992). *In teachers' hands: Investigating the practices of classroom assessment.* Albany, NY: State University of New York Press.

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research*, *81*(1), 4-28.

Technology Institute for Music Education: Areas of Pedagogical Skill and Understanding. (n.d.). Retrieved from https://ti-me.org/index.php/home/tapsu.html

Tracy, L. H. (2002). *Assessing individual students in the high school choral ensemble: Issues and practices* (Doctoral dissertation). Retrieved from Dissertation Abstracts International. (3065486)

United States Department of Education. Institute of Education Sciences. National Center for Education Statistics. (2011). *Fast Response Survey System (FRSS): Arts Education Surveys of Secondary School Teachers, 2009-2010*. Report No. ICPSR36070-v2. Ann Arbor, MI: Inter-university Consortium for Political and Social Research. http://doi.org/10.3886/ICPSR36070.v2

VeraQuest. (2013). *Teacher attitudes about digital games in the classroom*. Prepared for the Joan Ganz Cooney Center at Sesame Workshop. Armonk, NY: VeraQuest.

Wallerstedt, C. & Hillman, T. (2015). Is it okay to use the mobile phone? Student use of information technology in pop-band rehearsals in Swedish music education. *Journal of Music, Technology, and Education, 8*(1), 71–93.

Walls, K. C., Erwin, P. M., & Kuehne, J. M. (2013). Maintaining efficient ensemble rehearsals without sacrificing individual assessment: SmartMusic assessment could leave the director on the podium. *Journal of Technology in Music Learning, 5*(1), 4-16.

Watkins, J., & Farnum, S. (1962). *The Watkins–Farnum Performance Scale*. Winona, MN: Hal Leonard Music.

Webster, P. R. (2011). Key research in music technology and music teaching and learning. *Journal of Music, Technology, and Education, 4*(2), 115-130.

Wiggins, G., & McTighe, J. (1998). *Understanding by design*. Alexandria, VA: Association for Supervision and Curriculum Development.

Williams, D. A. (2011). The elephant in the room. *Music Educators Journal*, *98*(1), 51-57.

Wise, S., Greenwood, J., & Davis, N. (2011). Teachers' use of digital technology in secondary music education: Illustrations of changing classrooms. *British Journal of Music Education, 28*(2), 117-134.

Zelenak, M. S. (2015). A professional development program for integrating technology: Examining the impact on K-12 music teachers. *Journal of Technology in Music Learning, 5*(2), 3-25.

# APPENDIX A

# SURVEY OF TECHNOLOGY USE IN CHORAL ASSESSMENT

## Survey of Technology Use in Choral Assessment

Dear NAfME Member,

As a secondary choral music teacher, you understand that assessment practices play an important role in music education and also in teachers' performance evaluations. Technology may assist teachers in making assessments more effective, efficient, and/or practical.

We are music teachers and researchers from the University of Illinois who are conducting a research study to learn more about student assessment in the secondary choral classroom. We hope we can count on you to take our online survey. You can even take the survey on your phone or tablet.

At the end of the survey you will have the option to include your email address and be entered in a random drawing for a **$50 Amazon gift card!**

This online survey will take approximately **15 minutes** of your time. **We would appreciate your response by *June 16.***

Your decision to participate or decline participation in this study is completely voluntary, and you have the right to terminate your participation at any time without penalty. You may skip any questions you do not wish to answer. If you do not wish to complete this survey, just close your browser.

Your participation in this research will be completely anonymous and confidential. Data will be averaged and reported in aggregates so that no individuals could potentially be identified. Possible outlets of dissemination may include a doctoral dissertation, a professional conference presentation, and/or a journal article. Although your participation in this research may not benefit you personally, it will help us understand how and why choral music educators use technology tools to assess their students. There are no risks to individuals participating in this survey beyond those that exist in daily life.

This project has received approval from the Institutional Review Board (IRB) at the University of Illinois. The IRB is the campus office that works to protect the rights of subjects in research conducted through the University of Illinois. If you feel you have not been treated according to the descriptions in this form, or if you have any questions about your rights as a research subject, including questions, concerns, complaints, or to offer input, you may call the Office for the Protection of Research Subjects (OPRS) at 217-333-2670 or e-mail OPRS at irb@illinois.edu.

Thank you for your participation! Click the "Next" button below to begin!

Sincerely,

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## Survey of Technology Use in Choral Assessment

1. Do you currently teach a high school or middle school choir?

- ◯ Yes
- ◯ No

2. In which state you teach?

[ ]

## Survey of Technology Use in Choral Assessment

Throughout this survey, please consider your answers relative to the most recent school year and with the two following definitions in mind:

***Technology:*** Any hardware, software, or web-based programs/applications you might use.

***Assessment:*** The process of gathering evidence of individual students' understanding, formally or informally.

Finally, please consider your technology use and assessment practices across all choral ensembles you teach, even though your assessments may differ for each class/level you teach.

3. How often do you use technology in:

| | Very often | Often | Sometimes | Seldom | Never |
|---|---|---|---|---|---|
| Your personal life? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Your professional administrative tasks? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Your choir instruction? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Your assessment of choir students? | ◯ | ◯ | ◯ | ◯ | ◯ |

## Survey of Technology Use in Choral Assessment

4. How comfortable do you feel using technology in:

| | Very comfortable | Comfortable | Neutral | Uncomfortable | Very uncomfortable |
|---|---|---|---|---|---|
| Your personal life? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Your professional administrative tasks? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Your choir instruction? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Your assessment of choir students? | ◯ | ◯ | ◯ | ◯ | ◯ |

## Survey of Technology Use in Choral Assessment

5. How often do you use technology as a tool to:

| | Very often | Often | Sometimes | Seldom | Never |
|---|---|---|---|---|---|
| Play choral parts for ensemble rehearsals? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Accompany choral ensemble rehearsals? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Display/project choral literature or sight-singing examples for in-class instruction? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Provide a way for students to practice choral repertoire alone? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Provide a way for students to practice sight-singing alone? | ◯ | ◯ | ◯ | ◯ | ◯ |
| Provide a way for students to practice technique (e.g., scales, triads, range) alone? | ◯ | ◯ | ◯ | ◯ | ◯ |

## Survey of Technology Use in Choral Assessment

6. Do you have Information Technology (IT) professionals or technology assistants at your school(s)?

◯ Yes, I do have IT professionals or technology assistants at my school(s).

◯ No, I do not have IT professionals or technology assistants at my school(s).

## Survey of Technology Use in Choral Assessment

7. How much do the IT professionals help you when you have problems with technology in your classroom?

- ◯ A great deal
- ◯ A lot
- ◯ A moderate amount
- ◯ A little
- ◯ Not at all

## Survey of Technology Use in Choral Assessment

8. Have you attended professional development training sessions on the use of music technology (e.g. state music education conventions, school-sponsored in-service, and/or ACDA conventions)?

- ◯ Yes, I have attended professional development training sessions on the use of music technology.
- ◯ No, I have not attended professional development training sessions on the use of music technology.

## Survey of Technology Use in Choral Assessment

9. How much do you feel the technology training sessions helped you use technology effectively in your choral classroom?

- ◯ A great deal
- ◯ A lot
- ◯ A moderate amount
- ◯ A little
- ◯ Not at all

## Survey of Technology Use in Choral Assessment

Just a reminder:

***Technology*** can include any hardware, software, or web-based programs/applications you might use.

***Assessment*** refers to the process of gathering evidence of individual students' understanding, formally or informally.

Please consider your technology use and assessment practices across all choral ensembles you teach, even though your assessments may differ for each class/level you teach.

10. During a typical academic year, about how many times do you assess your choir students in the following ways? (select a pair of responses per item)

| | Number of Times (select a number) | per Week, Month, or Grading Period |
|---|---|---|
| Written tests or quizzes | | |
| Written homework | | |
| Compositions or arrangements | | |
| Improvisations | | |
| Reflective journals | | |
| Listening responses | | |
| Individual singing tests on choral literature | | |
| Individual sight-singing tests | | |
| Singing tests in quartets, trios, or another small group | | |

Other (please specify type of assessment AND the number of times you use technology for it per week/month/grading period)

11. How many weeks long are your grading periods?

## Survey of Technology Use in Choral Assessment

12. During a typical academic year, about how many times do you ***use technology to assist*** with the administration of these types of assessments? (select a pair of responses per item)

| | Number of Times (select a number) | per Week, Month, or Grading Period |
|---|---|---|
| Written tests or quizzes | | |
| Written homework | | |
| Compositions or arrangements | | |
| Improvisations | | |
| Reflective journals | | |
| Listening responses | | |
| Individual singing tests on choral literature | | |
| Individual sight-singing tests | | |
| Singing tests in quartets, trios, or another small group | | |

Other (please specify type of assessment AND the number of times you use technology for it per week/month/grading period)

Survey of Technology Use in Choral Assessment

13. During a typical academic year, about how many times do you use the following ***hardware-based technology*** for assessment of your choral students' learning? (select a pair of responses per item)

| | Number of times (select a number) | per Week, Month, or Grading Period |
|---|---|---|
| Laptop computers, iPads, or other tablets | | |
| Handheld audio recorders | | |
| Audio recorder built into your classroom sound system | | |
| Video recorders | | |
| Interactive whiteboards (e.g., Smartboard) | | |
| Your personal smartphone | | |
| Your students' smartphones | | |
| Clickers (personal response systems) | | |

Other (please specify type of tool AND the number of times you use it per week/month/grading period)

## Survey of Technology Use in Choral Assessment

14. During a typical academic year, about how many times do you use the following ***software-based technology*** for assessment of your choral students' learning? (select a pair of responses per item)

| | Number of times (select a number) | per Week, Month, or Grading Period |
|---|---|---|
| Computer-based performance assessment applications (e.g., SmartMusic, MusicProdigy, MusicFirst/PracticeFirst) | | |
| Music notation applications (e.g., Finale, Sibelius, NoteFlight) | | |
| Digital audio applications (e.g, GarageBand, Audacity, Pro Tools) | | |
| Music theory applications (e.g., Alfred's Essentials of Music Theory, Music Ace, Practica Musica) | | |

Other (please specify type of tool AND the number of times you use it per week/month/grading period)

## Survey of Technology Use in Choral Assessment

15. During a typical academic year, about how many times do you use the following ***web-based technology*** for assessment of your choral students' learning? (select a pair of responses per item)

| | Number of Times (select a number) | per Week, Month, or Grading Period |
|---|---|---|
| Videos shared by posting on the web (e.g., YouTube, Vimeo) | | |
| Music-based websites (e.g., musictheory.net) | | |
| Electronic portfolios through a school website or other platform | | |
| Online collaborative platform (e.g., BlackBoard, Google Classroom, Schoology, Edmodo, blogs) | | |

Other (please specify type of tool AND the number of times you use it per week/month/grading period)

## Survey of Technology Use in Choral Assessment

16. Are there other ways you use technology to assist with your assessment of choir students? (If so, please provide details in the space below.)

## Survey of Technology Use in Choral Assessment

17. How do you use ***student assessment data*** you retrieved from the technology-assisted assessment tools? (Check all that apply.)

- [ ] I use it to assign grades
- [ ] I share it with the students to discuss their progress
- [ ] I report it to my administrators
- [ ] I analyze it to show individual student growth
- [ ] I use it to inform my instruction
- [ ] I use it informally to gauge class trends
- [ ] I use it for ensemble placement (auditions)
- [ ] Other (please specify)

## Survey of Technology Use in Choral Assessment

18. How much does technology help you:

| | A great deal | A lot | A moderate amount | A little | Not at all | N/A |
|---|---|---|---|---|---|---|
| Save time when administering an assessment. | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Present an assessment in a convenient, clear format. | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Provide accurate and objective assessment feedback to students. | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Provide immediate or faster feedback to students. | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Organize data obtained from assessments. | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Maintain an ongoing digital portfolio of student assessment data. | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Calculate and/or assign grades. | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Conduct a group rehearsal while students complete assessments independently. | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Communicate assessment results with school administration, parents, or other stakeholders. | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |

## Survey of Technology Use in Choral Assessment

19. Did you learn to use technology to assess student learning as part of your teacher preparation program?

- ◯ Yes, I did learn to use technology to assess student learning as part of my teacher preparation program.
- ◯ No, I did NOT learn to use technology to assess student learning as part of my teacher preparation program.

## Survey of Technology Use in Choral Assessment

20. How well did your teacher preparation program prepare you to use technology effectively to assess choral students?

- ◯ Very well
- ◯ Pretty well
- ◯ Fairly well
- ◯ A little
- ◯ Not at all

## Survey of Technology Use in Choral Assessment

21. Does your school or school district require you to document student growth data as part of your formal teacher evaluation process?

- ◯ Yes, I am required to document student growth data as part of my formal teacher evaluation process.
- ◯ No, I am not required to document student growth data as part of my formal teacher evaluation process.

## Survey of Technology Use in Choral Assessment

22. How much do you feel technology helps you effectively meet the requirement to document student growth data?

- ◯ A great deal
- ◯ A lot
- ◯ A moderate amount
- ◯ A little
- ◯ Not at all

## Survey of Technology Use in Choral Assessment

23. How much do the following factors influence your decisions to use technology for assessment?

| | A great deal | A lot | A moderate amount | A little | Not at all |
|---|---|---|---|---|---|
| Already in place prior to employment | ◯ | ◯ | ◯ | ◯ | ◯ |
| Administrator's suggestion | ◯ | ◯ | ◯ | ◯ | ◯ |
| Colleague's or colleagues' suggestion | ◯ | ◯ | ◯ | ◯ | ◯ |
| Professional development such as conferences or workshops | ◯ | ◯ | ◯ | ◯ | ◯ |
| Professional article(s) | ◯ | ◯ | ◯ | ◯ | ◯ |
| Teacher preparation program | ◯ | ◯ | ◯ | ◯ | ◯ |
| Personal interest/philosophy | ◯ | ◯ | ◯ | ◯ | ◯ |
| Graduate courses | ◯ | ◯ | ◯ | ◯ | ◯ |

Other (please specify)

## Survey of Technology Use in Choral Assessment

24. How much of a barrier do each of the following factors play when deciding to use technology for your assessments?

| | An Extreme Barrier | A Large Barrier | A Moderate Barrier | A Small Barrier | Not at all a Barrier |
|---|---|---|---|---|---|
| Personal discomfort with technology | ◯ | ◯ | ◯ | ◯ | ◯ |
| Lack of training with technology | ◯ | ◯ | ◯ | ◯ | ◯ |
| Lack of time to research, set up, and/or implement technology | ◯ | ◯ | ◯ | ◯ | ◯ |
| Lack of technology resources at my school | ◯ | ◯ | ◯ | ◯ | ◯ |
| Cost of implementation | ◯ | ◯ | ◯ | ◯ | ◯ |
| Number of students I teach/assessments I have to grade | ◯ | ◯ | ◯ | ◯ | ◯ |
| My lack of trust for accuracy of the technology | ◯ | ◯ | ◯ | ◯ | ◯ |
| My students lack of trust for accuracy of the technology | ◯ | ◯ | ◯ | ◯ | ◯ |
| Technical problems out of my control | ◯ | ◯ | ◯ | ◯ | ◯ |

Other (please specify)

## Survey of Technology Use in Choral Assessment

25. Are there other reasons why you use technology-assisted assessment tools with your choral students? (If so, please provide details in the space below.)

26. Are there other reasons why you **DO NOT** use technology-assisted assessment tools with your choral students? (If so, please provide details in the space below.)

## Survey of Technology Use in Choral Assessment

27. How effective is technology at helping you assess your choral students' abilities to:

| | Very effective | Effective | Neutral | Ineffective | Very ineffective |
|---|---|---|---|---|---|
| Understand how composers create music. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Compose their own music. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Improvise. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Sight-sing using music notation. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Demonstrate appropriate vocal technique. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Perform choral repertoire effectively. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Respond to music by listening, analyzing, and/or writing. | ◯ | ◯ | ◯ | ◯ | ◯ |
| Connect with music on a personal level. | ◯ | ◯ | ◯ | ◯ | ◯ |

## Survey of Technology Use in Choral Assessment

28. How accurate do you believe technology-based assessment tools like Smart Music, Music Prodigy, or PracticeFirst are in assessing students' singing accuracy?

- ◯ Very Accurate
- ◯ Accurate
- ◯ Neutral
- ◯ Inaccurate
- ◯ Very Inaccurate
- ◯ I do not use this type of technology based assessment tool.

## Survey of Technology Use in Choral Assessment

29. Are there other reasons why you feel technology-assisted assessment tools are effective? (If so, please provide details in the space below.)

13

30. Are there other reasons why you feel technology-assisted assessment tools are **NOT** effective? (If so, please provide details in the space below.)

## Survey of Technology Use in Choral Assessment

31. Excluding time spent on family or parental leave or sabbatical, how many school years have you worked as a secondary-level choral teacher in public, public charter or private schools?

- ◯ 1-5 school years
- ◯ 6-10 school years
- ◯ 11-20 school years
- ◯ 21-30 school years
- ◯ 31+ school years

32. What is your age?

- ◯ Under 18
- ◯ 18-24
- ◯ 25-44
- ◯ 45-64
- ◯ 65+

33. Which best describes your school setting?

- ◯ Rural
- ◯ Suburban
- ◯ Urban

34. In what type of school do you work?

- ◯ Public, non-Charter
- ◯ Public, Charter
- ◯ Not Public (e.g, religious, other private)

35. What is your primary teaching assignment for the 2016-2017 school year?

- ◯ Choir
- ◯ Band
- ◯ Orchestra
- ◯ General Music

36. What is your highest level of education?

- ◯ High School Diploma
- ◯ Bachelor's Degree
- ◯ Some Graduate Study
- ◯ Master's Degree
- ◯ Some Doctoral Study
- ◯ Doctorate Degree

37. What was/were your major field/s of study? (Check all that apply.)

- ☐ Choral Music Education
- ☐ Instrumental (Wind/Percussion) Music Education
- ☐ Instrumental (Strings) Music Education
- ☐ General Music Education
- ☐ Vocal Performance
- ☐ Instrumental Performance
- ☐ Piano Performance and/or Pedagogy
- ☐ Education, Non-Music

38. Which of the following best describes your gender identity?

- ◯ Female
- ◯ Male
- ◯ Transgender Female
- ◯ Transgender Male
- ◯ Gender variant/non-conforming
- ◯ Prefer not to answer
- ◯ Other (please specify)

## Survey of Technology Use in Choral Assessment

39. Thank you for completing the survey!

Enter your email below to be entered into a drawing for a **$50 Amazon gift card**! *Email addresses will be kept confidential and will not be used in any way to identify respondents.*

# APPENDIX B

## COGNITIVE INTERVIEW PROTOCOL

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

**Department of Music Education**

School of Music
Music Building
1114 W. Nevada St.
Urbana, IL 61801

ADULT CONSENT LETTER

Dear Participant,

You are invited to participate in a cognitive interview as part of my dissertation on Technology-Assisted Assessment Tools in the Secondary Choral Classroom. The faculty member in charge of this project is Dr. Louis Bergonzi from the Department of Music Education at the University of Illinois at Urbana-Champaign.

We will be doing a 45-60 minute interview to test survey questions I have prepared for the study. The goal is to observe and describe your thinking aloud while answering survey questions. We may probe your thinking aloud for specific questions when there is confusion. We will record their observational notes for each question using pencil and paper or computer, and will refer to the respondents we are observing as Respondent A, Respondent B, etc. In some cases, we will audio tape the interview.

We do not anticipate any risk to this project greater than normal life and we anticipate that the results will increase our understanding of survey questionnaire development. The results will be used only of the purposes of this project.

Your participation in this project is completely voluntary, and you are free to withdraw at any time and for any reason without penalty. Your choice to participate or not will not impact your status with the university. You are also free to refuse to answer any questions you do not wish to answer.

If you have any questions about this research project, please contact me at 815-985-3501. If you have any questions about your rights as a research participant please contact BER at 217-333-3023 or Office of School-University Relations at osurr@education.illinois.edu.

Sincerely,

Jason Hawkins
PhD Candidate in Music Education
1114 W. Nevada Street, MC-056
Urbana, IL 61801
jahawki@illinois.edu
815-985-3501

Louis Bergonzi, Ph.D.
Professor, Music Education
1114 W. Nevada Street, MC-056
Urbana, IL 61801
bergonzi@illinois.edu
217-244-6654

Signed: _____ Date: _____

UNIVERSITY OF ILLINOIS
AT URBANA–CHAMPAIGN

**Department of Music Education**

School of Music
1114 W. Nevada St.
Urbana, IL 61801

**Cognitive Interview Protocol**

**Survey of Secondary Music Educators' Use of Technology-Assisted Assessment**

**Jason Hawkins - University of Illinois**

SET-UP

- Facilitator's script
- Items example for participant
- Items lists (2) for participant and facilitator
- Two tape recorders (check that they work)
- Pens
- Consent form
- Table & at least 2 chairs

---

## INTRODUCTION

In an effort to better understand how high school and middle school choir directors use technology to assist with student assessments, we are conducting a research study with the members of the National Association for Music Education. As a member of NAfME, we would like to invite you to participate in a survey examining:

- The types of technology you use to assess your students.
- The frequency with which you use technology in your assessments.
- Your reasons for using (or not using) technology to assist with assessments.
- Your perception of the effectiveness of technology-assisted assessment tools

In order to interpret the survey results correctly, it is important that teachers, like you, understand the survey items in the same way as we do.

## DEMOGRAPHICS

Before we begin, I'd like to ask a few questions about your experience:

- What do you teach? [Subject and/or grade level]
- How long have you taught?
- Where do you teach?
- Have you taught at other schools or other subjects?

*telephone* 217-333-2245 ● *toll free* 888-843-3779 ● *fax* 217-244-7620
*email* music@uiuc.edu ● *url* http://www.uiuc.edu/music

UNIVERSITY OF ILLINOIS
AT URBANA–CHAMPAIGN

**Department of Music Education**

School of Music
1114 W. Nevada St.
Urbana, IL 61801


## INSTRUCTIONS

In a moment I'll give you a part of the survey we're developing. Please read each item out loud; then describe out loud what you're thinking while you respond as if you were taking this survey at home by yourself. Do not be concerned if you don't understand part of an item. Please let me know if you don't understand any part of an item, and feel free to make suggestions about how to make the item clearer.

*Give the participant a copy of the example items (attached).*

Here is an example survey item. Let me demonstrate thinking out loud as I respond to it as if I were an elementary school teacher who received the survey.

## EXAMPLE

First, I read the item out loud: "How has your instructional time changed in the following subject areas as result of the Enhanced ISAT in the past school year? Increased a lot (more than 20 min), moderately increased (less than 20 min), no change, moderately decreased (less than 20 min), decreased a lot (more than 20 min), or not applicable. Math." Well, we divide up the subjects in my school, and I'm in charge of reading and history. The kids spend more time on math now, but since the question says "*your* instruction," I guess I should mark "not applicable."

## CONCLUSION

Do you have any questions about how to think out loud as you respond to each survey item?

In this interview, we're primarily concerned with how you understand these survey items and how you arrive at your responses. At the end of the interview, we'll have some time for you to give your thoughts and feelings in general.

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*email* music@uiuc.edu • *url* http://www.uiuc.edu/music

UNIVERSITY OF ILLINOIS
AT URBANA–CHAMPAIGN

**Department of Music Education**

School of Music
1114 W. Nevada St.
Urbana, IL 61801

*Give the participant the survey items.*

Please read each item out loud; then describe out loud what you're thinking while you respond as if you were taking this survey at home by yourself. Once you have decided on a response, please mark it on the form. After each group of items, I may ask you a couple of follow-up questions. Go ahead and start with the first item.

**FOLLOW UP POST-INTERVIEW QUESTION**

At a global level, how well does this questionnaire address the concerns High School or Middle School choir directors may have in regards to using technology in their assessment practices?

**REJOINDERS**

*If the participant asks for clarification of an item:*

- How would you respond if you were taking the survey at home by yourself?

*After the participant has finished responding to the item, the interviewer may clarify the item and then ask:*

- Would that change how you responded?

*If the participant lapses into reflective silence:*

- What are you thinking?

*To elicit more from the participant:*

- What do you mean? *(or)*
- Could you say a little more about that? *(or)*
- How did you decide on your response?

*Once the participant has finish responding to an item, the interviewer may probe about specific features of the item with:*

- How do you understand the word (phrase) … ? *(or)*
- What do you think of when you hear … ? *(or)*
- What … were you thinking about when you responded?

*telephone* 217-333-2245 • *toll free* 888-843-3779 • *fax* 217-244-7620
*email* music@uiuc.edu • *url* http://www.uiuc.edu/music

APPENDIX C

PARTICIPATION IN THE STUCA BY STATE

*Table C.1. Participation in the STUCA by State*

| State | Number of Respondents | Actual % | Desired % to be Proportional |
|---|---|---|---|
| Alabama | 0 | 0% | 0% |
| Alaska | 0 | 0% | 0.2% |
| Arizona | 18 | 2.7% | 1.7% |
| Arkansas | 3 | .5% | 0.3% |
| California | 0 | 0% | 0% |
| Colorado | 16 | 2.4% | 1.7% |
| Connecticut | 22 | 3.3% | 2.5% |
| Delaware | 0 | 0% | 0.6% |
| District of Columbia | 5 | .8% | 0.0% |
| Florida | 30 | 4.6% | 5.5% |
| Georgia | 35 | 5.3% | 5.3% |
| Hawaii | 2 | .3% | 0.1% |
| Idaho | 8 | 1.2% | 0.9% |
| Illinois | 42 | 6.4% | 5.4% |
| Indiana | 15 | 2.3% | 1.6% |
| Iowa | 0 | 0% | 0% |
| Kansas | 29 | 4.4% | 3.0% |
| Kentucky | 12 | 1.8% | 2.6% |
| Louisiana | 11 | 1.7% | 1.5% |
| Maine | 13 | 2.0% | 0.9% |
| Maryland | 10 | 1.5% | 1.6% |
| Massachusetts | 19 | 2.9% | 3.5% |
| Michigan | 1 | .2% | 0.6% |
| Minnesota | 18 | 2.7% | 2.6% |
| Mississippi | 11 | 1.7% | 0.8% |
| Missouri | 23 | 3.5% | 3.9% |
| Montana | 0 | 0% | 0% |
| Nebraska | 0 | 0% | 0% |
| Nevada | 4 | .6% | 0.6% |
| New Hampshire | 0 | 0% | 0% |
| New York | 46 | 7.0% | 6.3% |
| New Jersey | 0 | 0% | 4.3% |
| New Mexico | 0 | 0% | 0.9% |
| North Carolina | 29 | 4.4% | 4.5% |
| North Dakota | 2 | .3% | 0.8% |
| Ohio | 47 | 7.1% | 6.9% |

*Table C.1. (Cont.)*

| | | | |
|---|---|---|---|
| Oklahoma | 13 | 2.0% | 2.1% |
| Oregon | 12 | 1.8% | 1.9% |
| Pennsylvania | 41 | 6.2% | 6.6% |
| Rhode Island | 7 | 1.1% | 0.7% |
| South Carolina | 16 | 2.4% | 2.3% |
| South Dakota | 4 | .6% | 0.7% |
| Tennessee | 0 | 0% | 2.7% |
| Texas | 0 | 0% | 0% |
| Utah | 8 | 1.2% | 1.1% |
| Virginia | 41 | 6.2% | 4.3% |
| Vermont | 0 | 0% | 0% |
| Washington | 20 | 3.0% | 3.4% |
| West Virginia | 8 | 1.2% | 0.9% |
| Wisconsin | 14 | 2.1% | 1.7% |
| Wyoming | 3 | .5% | 0.5% |
| Total | 658 | 100% | 100% |

# APPENDIX D

# IRB APPROVAL LETTER

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

**Department of Music Education**

School of Music
Music Building
1114 W. Nevada St.
Urbana, IL 61801

**CONSENT LETTER FOR ONLINE SURVEY**

USE, RATIONAL, AND PERCEIVED EFFICACY OF TECHNOLOGY-ASSISTED ASSESSMENT IN CHORAL MUSIC EDUCATION

You are invited to participate in a research study on the use of technology-assisted assessment tools in the secondary choral classroom. This study is conducted by Dr. Louis Bergonzi, professor of Music Education, and Jason Hawkins, PhD student in Music Education, from the University of Illinois Urbana Champaign.

This study will take approximately 15 minutes of your time. You will be asked to complete an online survey about choral music educators' use of technology-assisted assessment tools in the secondary choral setting. Specifically, the following research questions will be addressed:

1. How are choral music educators using technology-assisted assessment tools?
2. Why are choral music educators using technology-assisted assessment tools?
   a. What are the incentives and barriers to choral music educators' use and continued use of technology-assisted assessment tools?
3. What is the perceived efficacy of using technology-assisted assessment tools in the choral classroom?
4. To what extent do demographic factors of gender, level of educational degree, and years of music teaching experience influence secondary choral music educators' use of technology□assisted assessment tools?

Your decision to participate or decline participation in this study is completely voluntary and you have the right to terminate your participation at any time without penalty. You may skip any questions you do not wish to answer. If you want do not wish to complete this survey just close your browser.

Your participation in this research will be completely confidential and data will be averaged and reported in aggregate. Possible outlets of dissemination may include a doctoral dissertation, a professional conference presentation, and/or a journal article. Although your participation in this research may not benefit you personally, it will help us understand how and why choral music educators use technology tools to assess their students. There are no risks to individuals participating in this survey beyond those that exist in daily life.

If you have questions about this project, you may contact Dr. Louis Bergonzi at 217-244-6654 or bergonzi@illinois.edu. If you have any questions about your rights as a participant in this study or any concerns or complaints, please contact the University of Illinois Office for the Protection of Research Subjects at 217-333-2670 or via email at irb@illinois.edu.

Please print a copy of this consent form for your records, if you so desire.

I have read and understand the above consent form, I certify that I am 18 years old or older and, by clicking the submit button to enter the survey, I indicate my willingness voluntarily take part in the study.

<SUBMIT>

Sincerely,

Jason Hawkins
PhD Graduate Student in Music Education
1114 W. Nevada Street, MC-056
Urbana, IL 61801
jahawki@illinois.edu
815-985-3501

Professor, Music Education
1114 W. Nevada Street, MC-056
Urbana, IL 61801
bergonzi@illinois.edu
217-244-6654

Louis Bergonzi, Ph.D.



**University of Illinois at Urbana-Champaign Institutional Review Board**

Approved: MARCH 14, 2017
IRB #: 17433

# WAIVER OF DOCUMENTATION OF INFORMED CONSENT FORM

Application for Waiver of Documentation on Informed Consent

**ALL APPLICATIONS MUST BE SIGNED AND SUBMITTED VIA EMAIL TO IRB@ILLINOIS.EDU.**

**Responsible Project Investigator:** Dr. Louis Bergonzi
**Project Title:** USE, RATIONAL, AND PERCEIVED EFFICACY OF TECHNOLOGY-ASSISTED ASSESSMENT IN CHORAL MUSIC EDUCATION
**IRB Number** 17433

RECEIVED
MAR 14 2017
UIUC OPRS

**To request a waiver of documentation [signature] of informed consent, please provide a response to either of the following questions. Please be specific in explaining why either statement is true for this research.**

In cases in which the documentation requirement is waived, the IRB may require the investigator to provide subjects with a written statement regarding the research.

1. Explain that the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern. *Note: A waiver of documentation of informed consent is **not permissible under this category if subject to FDA regulations.**

2. The research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside the context.

Participants in this study will complete a one-time, anonymous, online survey about the ways that they assess their students. The decision to participate or decline participation in this study is completely voluntary, and participants have the right to terminate their participation at any time without penalty. They may skip any questions they do not wish to answer. If they do not wish to complete this survey they may simply close their browser. Participation in this research will be completely confidential, and data will be averaged and reported in aggregate. There are no risks to individuals participating in this survey beyond those that exist in daily life.

Laura Bergonzi

February 7, 2017

Responsible Principal Investigator — Date

**IRB Approval:** University of Illinois at Urbana-Champaign Institutional Review Board

Approved: MARCH 14, 2017

IRB #: 17433