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The purpose of this pilot study was to investigate the relationship between North Carolina pre-service music teachers' perceived preparedness to teach online, Technological, Pedagogical, and Content Knowledge (TPACK) score, and online pedagogy instruction included in methods classes. An online survey was emailed to members of the North Carolina Music Educators Association designated as collegiate. The survey respondents (n = 14) completed two categorical grouping questions, Likert-type items about perceived preparedness to teach in brick-and-mortar (face-to-face) and online settings, and Likert-type items measuring each of the seven TPACK domains.

Most participants reported they did not learn about online music pedagogy in their methods classes. Additionally, only one participant reported having had the opportunity to observe an online music class, and no participants reported having had the opportunity to complete a field experience in an online music classroom. Results from a Related-Samples Sign Test indicated that participants perceived themselves as more prepared to teach music in brick-and-mortar (face-to-face) settings than in online settings. A Friedman One-Way Repeated Measure Analysis of Variance by Ranks test indicated that TPACK domain scores differed from each other. Specifically, the content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK), pedagogical content knowledge (PCK), and technological content knowledge (TCK) domains differed from the technological-pedagogical knowledge (TPK) and technological, pedagogical, and content knowledge (TPACK) domains. A Kendall's Tau correlation indicated a strong, positive association between participants' perceived preparedness to teach online score and TPACK scores. Music teacher preparation programs may

consider focusing on integrating technology, including online music pedagogy, across methods classes to better prepare pre-service music teachers for online instructional settings.

AN ANALYSIS OF THE RELATIONSHIP BETWEEN NORTH CAROLINA PRE-SERVICE MUSIC TEACHERS' PERCEIVED PREPAREDNESS TO TEACH ONLINE, METHODS CLASSES, AND TPACK: A PILOT STUDY

by

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Approved by

Dr. Constance L. McKoy
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DEDICATION

In loving memory of my pop-pop, who always encouraged a love of learning, taught me the importance of seeing each person's humanity, and fostered my love of ice cream.

APPROVAL PAGE

This dissertation written by Michelle Anne Rose has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I: INTRODUCTION

Introduction

In December 2019, I was—as far as I knew—the only K-12 music teacher in North Carolina working at a fully online virtual school. Before 2020, when I mentioned I taught middle and high school students virtually, I often received blank stares and a barrage of questions about how I taught general music and ensembles on a laptop without a physical classroom. No one was more surprised than I was in March of 2020 when nearly every music teacher suddenly had the same *niche* job as me: virtual music educator.

Many teachers and administrators expressed a sense of disbelief and surprise about the possibility of students learning online when the COVID-19 pandemic shut down schools across the globe. Online learning, however, was not new. Many students at the K-12 level had learned online for nearly three decades before the pandemic began (Barbour & Reeves, 2009). The COVID-19 pandemic accelerated existing online teaching and learning that was already in progress, particularly at the K-12 level (Georgescu, 2022). Due to the sudden increase in online learning during the period of emergency online teaching due to COVID-19, the stigma surrounding the legitimacy of online learning decreased—more people began to recognize that online learning was a viable alternative to face-to-face classroom instruction (Kis, 2021). Thirty-eight states created permanent online learning options following the emergency online teaching period (Thompson, 2021). Beyond the period of emergency remote teaching, many districts have continued to offer virtual learning days for a variety of reasons, including inclement weather, school-based emergencies (i.e., asbestos, burst water pipes), and staff professional development days (Blad, 2022; Cobb County School District, 2023; Cray & Ome, 2021; Primary and Secondary Education - Virtual Education, 2023; Winn, 2023; Zarcone, 2022). Online learning is

not going away for the foreseeable future. Pre-service teachers entering the profession will need to have the skills necessary for teaching online.

Background and Need for Study

Teaching online requires different skills than face-to-face teaching (Ko & Rossen, 2017). If teaching online simply required a person to turn on their camera and teach as if students were directly in front of them, the transition into emergency online teaching in the early days of the COVID-19 pandemic would have been seamless; however, it was not (Judd et al., 2020). Therefore, shifting to an online music pedagogical approach is essential when music teachers teach online (Johnson, 2017).

Teacher preparation programs, including methods courses, have played a considerable role in pre-service teachers' acquisition of the skills necessary for effective teaching. Since the early 1990s, legislators, educational leadership, and teaching accreditation agencies have called on teacher preparation programs to cultivate technology skills in pre-service teachers (Council for the Accreditation of Educator Preparation, 2019; Gifford, 2023; Goals 2000: Educate America Act, 1994; Hofer, 2005). Many teacher preparation programs have implemented stand-alone technology courses despite calls for a more effective technology integration strategy across multiple courses (Dorfman, 2016; Foulger et al., 2019; Gronseth et al., 2010; Haning, 2015). Additionally, much of the technology instruction has focused on developing technological skills related to brick-and-mortar (face-to-face) settings, which may not transfer readily to teaching in online settings (Compton, 2009; Greene et al., 2023; Moore-Adams et al., 2016).

Because teaching online requires a unique set of technology skills, pre-service teachers should receive instruction about online pedagogy in their teacher preparation programs. Researchers and policymakers have called for teacher preparation programs to include online

learning pedagogy since the early 2000s (Archambault & Kennedy, 2014; Compton, 2009; Davis et al., 2007; Duncan & Barnett, 2009; Irvine et al., 2003; McCoy, 2008). However, most colleges and universities have not responded to these calls by updating their teacher preparation programs to include online pedagogy (Archambault & Kennedy, 2018). As a result of the COVID-19 pandemic, researchers have increased calls for teacher preparation programs to teach technological skills more effectively, including skills specific to online teaching and learning (Darling-Hammond & Hyler, 2020; Greene et al., 2023; Jenkins & Crawford, 2021). As of 2023, research on whether and how teacher preparation programs have adapted to include online pedagogy due to COVID-19 is limited.

Before the COVID-19 pandemic, little research existed about online music education and music-making, particularly at the K-12 level. As a result, the focus of the online music research before 2020 primarily centered around private music lessons (Bandopadhyay, 2002; Dammers, 2009; Holt, 2016; Lockett, 2010; Wilson, 2013), online music classes in higher education (Archer-Capuzzo, 2017; Johnson, 2017; Johnson & Lamothe, 2018; Keast, 2009; Scarnati & Garcia, 2008), and Eric Whitacre's Virtual Choir projects (Armstrong, 2012; Cayari, 2016; Schneidereit, 2017). The limited research before 2020 about teaching K-12 students online left music teachers with limited guidance during the sudden onset of emergency remote teaching due to the COVID-19 pandemic.

Research and guidelines about teaching elective classes other than music online before the COVID-19 pandemic were more abundant. For example, researchers began investigating the feasibility of online physical education (PE) classes as early as 1998 and online visual art classes as early as 1993 (St. Pierre, 1998; Lester, 1993). By 2007, the National Association for Sport and Physical Education had released official guidelines for online PE teachers; by 2013, the National

Art Education Association released official guidelines for online art teachers (National Art Education Association, 2021). As of 2023, the National Association for Music Education has not posted official guidelines for online music teachers.

As a result of the COVID-19 pandemic, music education researchers conducted and published a substantial amount of research on teaching and learning music online at the K-12 level. Most research focused on temporary adaptations to online teaching due to the sudden shift to online learning (Alonderė, 2020; Hash, 2021; Mercado, 2021; Mercado, 2022; Moscardini & Rae, 2020; Rucsanda et al., 2021; Swanson et al., 2021). Therefore, the results of these studies should be applied cautiously to non-emergency online teaching situations. The research conducted during the emergency remote teaching period of the COVID-19 pandemic does not reflect typical online music instruction during non-emergency periods of instruction.

High-quality research matters. Educational research impacts everything from curriculum and policy decisions to teacher preparation programs and in-service professional development (Singh & Gelat, 2022). Unfortunately, online pedagogy research in the field of music education has lagged behind other elective class areas, which may impact students in online environments. Perhaps it is no surprise that the second largest online public school in the United States—North Carolina Virtual Public School (NCVPS)—planned to offer nine visual arts classes and three health and physical education classes but zero music classes in the 2023-2024 school year (North Carolina Virtual Public School, 2023). The field of music education needs more research about online pedagogy, particularly at the K-12 level.

There is a gap in research related to online pedagogy in the field of music education. This study attempts to fill part of the gap. Surveying pre-service music teachers can serve as a first step in understanding the relationship between technology-integrated frameworks, methods

classes, and how prepared pre-service music teachers feel to teach online. This research can inform music teacher preparation programs and music teacher educators about the current state of online music pedagogy in methods classes and potential changes that could help better prepare pre-service music teachers.

Purpose

The purpose of this pilot study was to investigate the relationship between North Carolina pre-service music teachers' perceived preparedness to teach online, Technological, Pedagogical, and Content Knowledge (TPACK) score, and online pedagogy instruction included in methods classes. This study can begin to fill part of the gap in music education research focused on music teacher education and online teaching and learning at the K-12 level.

This study utilized the TPACK framework to measure pre-service music teachers' perceived capability across seven domains, four of which relate specifically to technology (Mishra & Koehler, 2006). The United States Department of Education (2016) recommended that teacher preparation programs use the TPACK framework as a guide to ensure pre-service teachers gain the skills necessary to teach with technology effectively, including in online environments. Additionally, several researchers have used the TPACK framework in previous music education studies (Bauer, 2013; Bauer & Dammers, 2016; Doherty, 2019; Dorfman, 2016). Therefore, the TPACK framework served as an appropriate framework for the present study.

This pilot study focused on North Carolina pre-service teachers for three reasons. First, North Carolina has an extensive history of online learning. East Carolina University became the first university in the United States to offer a master's degree entirely online in 1993 (ECU News Services, 2017). Cumberland County began offering the first online public-school classes at the

K-12 level in 2002, which later merged with Learn NC to become the North Carolina Virtual Public School (NCVPS) in 2006 (North Carolina e-Learning Commission, 2009; North Carolina Department of Public Instruction, 2006; Reiss, 2002). NCVPS has remained a vital part of online learning in North Carolina. In 2022, it was the second-largest virtual public school in the United States, enrolling thousands of students every year (NC Virtual, 2022). North Carolina's investment in and expansion of online learning in K-12 and higher education settings requires educators who can teach effectively in virtual environments.

Second, not all states continued with online learning after the period of emergency online learning due to the COVID-19 pandemic. Some state legislators enacted policies restricting online learning substantially (Klein, 2022). North Carolina legislators have not enacted restrictions that prevent districts from implementing online learning. Instead, North Carolina legislators passed bills that expanded online learning possibilities beyond emergency remote teaching due to COVID-19. Legislators passed a bill to grant all public-school districts up to five virtual learning days per school year with an option to request up to fifteen virtual learning days if a district applies for a "good cause" waiver (An Act to Provide for Virtual Education in Public School Units in Emergency Circumstances, 2021). Legislators also granted school officials the option to set up permanent, district-based virtual learning academies that enrolled students entirely online (An Act to Provide for Virtual Education in Public School Units in Emergency Circumstances, 2021).

Finally, in 2023, North Carolina's Office of Digital Teaching and Learning updated the North Carolina Digital Learning Competencies to align with the standards for educators issued by the International Society for Technology in Education (ISTE) (North Carolina State Board of Education, 2023). The ISTE standards for educators include standards about teaching in virtual

environments (International Society for Technology in Education, 2023b). Therefore, teachers in North Carolina must have some skill in teaching online to meet the expectations outlined in the North Carolina Digital Learning Competencies. Due to the history, continued practice of online learning in North Carolina, and expectation of online teaching as part of the Digital Learning Competencies, pre-service music teachers will likely need online teaching skills to teach effectively in the state.

Research Questions

This pilot study was designed to answer the following research questions:

1. To what extent do North Carolina pre-service music teachers feel prepared to teach online?
2. What is the relationship between North Carolina pre-service music teachers' perceptions about being prepared to teach online, TPACK score, and the amount of online music pedagogy in instruction methods classes?

Definition of Terms

The following terms and definitions served as a foundation for this study. Because the terms' meanings can vary depending on the context, they were defined below to provide clarification for the context of this study.

- ***Asynchronous*** Teaching and learning that can occur at any time online through the internet using digital tools such as discussion boards, pre-recorded audio or video, and quizzes (Kiryakova, 2009).
- ***Brick-and-mortar (face-to-face) school*** A type of school that has a physical building where students, teachers, and staff regularly meet face-to-face for instructional purposes (Yang & Yuen, 2012).

- ***Emergency online teaching / Emergency remote teaching*** "In contrast to experiences that are planned from the beginning and designed to be online, emergency remote teaching (ERT) is a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances," specifically referring to the early months of the COVID-19 pandemic (Hodges et al., 2020, para. 13).
- ***Face-to-face learning*** Less than 30% of the class occurs online. The class may contain technology elements that enhance student learning, but most instruction and interactions between teachers and students occur in person in a physical school building (Allen & Seaman, 2014).
- ***Methods Class*** A class that focuses on the content, methods, and materials used for teaching (Hewitt & Koner, 2013).
- ***Online music pedagogy*** "The pedagogical aspects influencing course development and learning outcomes in online music courses" (C. Johnson, 2017, p. 442).
- ***Online learning*** All teaching and learning occurs online using the Internet. Students and teachers rarely, if ever, meet in person in a physical location. Teaching and learning can occur synchronously or asynchronously (N. Johnson, 2020).
- ***Synchronous*** Online learning that occurs in real-time through digital tools such as digital whiteboards, video and audio streaming, and chatbox messaging (Chen et al., 2005). Students receive live, immediate feedback and responses from teachers. Synchronous instruction is also known as live instruction.
- ***Virtual School/Online School/Cyber School*** A school whose instruction and curriculum are entirely online, either synchronously or asynchronously. Students and teachers do not report to a classroom in a physical school building but rather interact from separate

locations via an internet connection (Miron & Urschel, 2012). Students and teachers may meet in a physical location on some occasions, such as social events and standardized testing. However, most of the instruction hours are entirely online.

CHAPTER II: REVIEW OF LITERATURE

The purpose of this pilot study was to investigate the relationship between North Carolina pre-service music teachers' perceived preparedness to teach online, Technological, Pedagogical, and Content Knowledge (TPACK) score, and online pedagogy instruction included in methods classes. Chapter II includes a discussion of the existing literature on the role of teacher preparation programs in helping pre-service teachers acquire technological skills, the TPACK framework, the differences between face-to-face and online learning, a history of online learning, and the role of online learning during and beyond the period of emergency remote teaching due to the COVID-19 pandemic. The review of literature summarizes the findings of relevant literature and provides context for this pilot study.

The Role of Teaching Preparation Programs in Developing Technology Skills

Teacher preparation programs at colleges and universities play a substantial role in preparing pre-service teachers to instruct students effectively within their subject area(s). Pre-service teachers must gain various skills through coursework, fieldwork, and student teaching. Technological skills and the ability to incorporate technology into lessons are some of the many competencies pre-service teachers must learn as part of the process.

The emphasis on preparing pre-service teachers to integrate technology into their teaching began decades ago and has continued to grow. During the early 1990s, the US Congress recognized the "increasingly technology-driven workplace," which would require more students to have proficient technology skills to succeed after graduation (Heise, 1994, p. 357). In 1994, the US Congress passed the Educate America Act, which among many provisions, established the Department of Educational Technology to better support in-service teachers and pre-service teachers integrating technology in their teaching (Goals 2000: Educate America Act,

1994). In 1997, The National Council for the Accreditation for Teacher Education (NCATE) released the International Society for Technology in Education's (ISTE) National Educational Technology Standards, which required teacher preparation programs to incorporate technology standards (Hofer, 2005). The NCATE merged with the Teacher Education Accreditation Council (TEAC) to form the Council for the Accreditation of Educator Preparation (CAEP) in 2013 and released standards for program accreditation that included several technology-specific standards (Council for the Accreditation of Educator Preparation, 2019; Council for the Accreditation of Educator Preparation, n.d.). As of 2023, thirty-two states have a state-wide digital learning plan, and twelve additional states require districts to create their own digital learning plans, many of which require teachers to demonstrate technology proficiency (Gifford, 2023). Technology skills remain an essential part of teacher preparation programs and accreditation processes.

Although the focus on technology integration in teacher preparation programs began decades ago, and many teacher preparation programs have provided pre-service teachers with instruction on educational technology, these programs have not prepared pre-service teachers to use technology in their teaching successfully. Pre-service teachers have continued to report a lack of confidence in their ability to use educational technology in their classrooms (Akaadom, 2020; International Society for Technology in Education 2023a; US Department of Education, 2017). In response to the growing need for technology skills, universities have offered stand-alone technology courses to build pre-service teachers' technology skills, despite the recommendation that a more integrated approach across the entire teacher preparation programs would be more effective (Foulger et al., 2019; Gronseth et al., 2010; Mulder, 2016). Unsurprisingly, pre-service teachers have continued to express concerns that they had limited opportunities to put what they learned into practice in field experiences and student teaching

(Ottenbreit-Leftwich et al., 2018; Tondeur et al., 2017). Overall, including technology skills in teacher preparation programs has not led to better outcomes in technology competency for pre-service teachers. Technology skills are foundational to online teaching, yet many pre-service teachers have not developed the basic technology skills they need.

Part of the disconnect in technology integration may be attributed to teacher preparation program faculty's underdeveloped technology skills. Faculty may not have the skills necessary to adequately incorporate, model, and teach about technology, which can prevent pre-service teachers from fully grasping how to incorporate technology into their teaching practices (Amhag et al., 2019; Batane & Ngwako, 2016; International Society for Technology in Education 2023a; Tondeur et al., 2012). Additionally, teacher education faculty have expected pre-service teachers to use technology in more complex ways than what the faculty model through their own teaching (Barak, 2017; Teclehaimanot et al., 2011). A gap in faculty skills may have contributed to the gap in pre-service teachers' technology skills.

Much of the technology instruction for pre-service teachers has focused on brick-and-mortar (face-to-face) applications that are not specific to teaching in online environments (Moore-Adams et al., 2016). For example, in a brick-and-mortar (face-to-face) setting, pre-service teachers may learn how to plan a small group activity using a website on one device shared by each group of students. To translate that same activity into a virtual setting, the pre-service teacher must understand how to set up breakout rooms and monitor students' progress without being physically near them, in addition to understanding how to structure the activity using the website. Technology skills commonly used in face-to-face settings may not directly transfer to online settings (Compton, 2009; Greene et al., 2023).

Recent graduates who became beginner teachers during the emergency remote teaching period of the COVID-19 pandemic reported feeling unprepared to teach online, signifying a gap in online pedagogy in teacher preparation programs (Carver & Shanks, 2020; Moorhouse, 2021). Nevertheless, there are effective ways for education faculty to prepare students to teach in online settings. When education faculty model effective online teaching, integrate online teaching skills across the teacher preparation program and offer online field experiences, pre-service teachers feel more prepared to teach online (Compton et al., 2009; Luo et al., 2017; Reister & Rook, 2021). Technology skills related to online teaching are distinct from those related to face-to-face teaching. Therefore, pre-service teachers may benefit from technology instruction and activities specifically related to online settings.

Much of the research about technology in teacher preparation programs broadly mirrors the findings in the field of music education. While music faculty have reported they believe taking a stand-alone course in music technology will sufficiently prepare pre-service teachers to use technology in teaching effectively, stand-alone courses in music technology have not yielded gains in pre-service music teachers' proficiency in teaching with technology (Dorfman, 2016; Haning, 2015). Music faculty have also reported a gap between the technology skills they believed students would need after graduation (i.e., creating a professional website, creating a digital portfolio, educating others about technology) and the technology they used most frequently as part of their classes (i.e., recording lessons, slide decks, guided web searches) (Mroziak & Bowman, 2016). To prepare pre-service music teachers most effectively to incorporate technology in their teaching, music faculty must have developed technology skills and incorporate technology across all methods classes.

Observations and Early Field Experiences in Teacher Preparation

Early field experiences are opportunities for pre-service teachers to "observe, reflect, and teach" prior to student teaching (Kwok & Bartanen, 2022, p. 1). Early field experiences became a more widely accepted component of teacher preparation programs during the 1980s and have allowed pre-service teachers to put theory into practice by placing pre-service teachers in K-12 schools with real students (Huling, 1998; Retallick & Miller, 2010). Many states, including North Carolina, require early field experiences as part of the licensure requirements (Massachusetts Department of Elementary and Secondary Education, 2010; New York State State Education Department, n.d.; North Carolina General Assembly, 2017).

Early field experiences have yielded numerous benefits to pre-service teachers. Pre-service teachers who complete early field experiences before student teaching have persisted longer in the teaching profession than those who did not complete fieldwork (Latham & Vogt, 2007). Early field experiences can also help pre-service teachers develop self-efficacy in teaching (Çelik & Topkaya, 2017; Flores, 2015; McDonnough & Matkins, 2010). Finally, early field experiences with intentional technology inclusion can help pre-service teachers better understand how to integrate technology effectively into lessons (Lux & Lux, 2015; Lux et al., 2017; Meagher et al., 2011). When early field experiences are well designed, they can help pre-service teachers develop in numerous ways.

Although early field experiences are a cornerstone of teacher preparation, many teacher preparation programs have offered pre-service teachers limited opportunities for fieldwork in virtual school settings (Kennedy & Archambault, 2012; Archambault et al., 2016). While most face-to-face fieldwork placements shifted temporarily to an online setting due to the COVID-19 pandemic, they do not accurately depict non-emergency online environments (Astutik &

Hapsari, 2022; Hill, 2021; Holt, 2021). Fieldwork in a virtual school environment can play an important role in preparing pre-service teachers for online teaching (Archambault & Kennedy, 2018). Virtual field placements have provided pre-service teachers with a better understanding of common misconceptions about teaching online, opportunities to practice skills unique to online environments, and have given them an awareness of potential career paths in online education (Compton et al., 2010; Kennedy et al., 2013; Luo et al., 2017). Pre-service teachers can benefit from fieldwork completed in a virtual setting.

Effective early field experiences in music education have allowed pre-service music teachers to connect what they learn in methods classes to real-world contexts and prepare them for teaching (Ballantyne, 2006; Conway, 2002; Groulx, 2015). The National Association of Schools of Music (NASM) expects music teacher preparation programs to "encourage observation and teaching experiences prior to formal admission to the teacher education program" provided ideally in "actual schools" (National Association of Schools of Music, 2023, p. 128). Music education certifications in most states are broad, encompassing all grade levels and areas (May et al., 2017). Therefore, including early field experiences in multiple grade levels and music subject areas, including outside of the intended specialization area, has benefitted pre-service music teachers (Kuebel, 2019; Kuebel, 2021; Reese, 2019). Effective fieldwork experiences play an essential role in pre-service music teacher preparation.

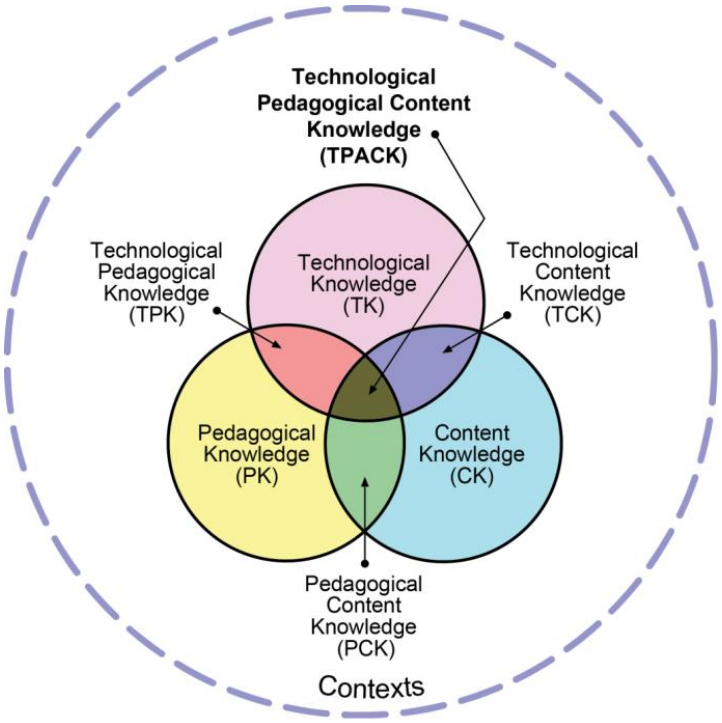
Research on early field experiences in virtual environments in music education is limited. As with much of the K-12 online music education research, an understanding of virtual music education field placements mainly came from emergency remote teaching during the COVID-19 pandemic. Mercado (2021) found that when pre-service teachers had to shift to an asynchronous online fieldwork experience due to the COVID-19 pandemic, they experienced unique benefits,

including more detailed lesson plan organization and improved direct instruction. Mercado (2022) found that shifting to a synchronous fieldwork experience yielded benefits, such as providing live, real-time support during a synchronous online class. More research is necessary for music education field placements in virtual schools outside emergency teaching situations.

Technological Pedagogical and Content Knowledge (TPACK) Framework

Learning about technology in stand-alone technology courses is not enough to prepare pre-service teachers—they must have opportunities to learn and apply their technological knowledge in face-to-face and online contexts throughout their teacher preparation program. The U.S. Department of Education recommended that teacher preparation programs use the TPACK framework as a tool to address the gap in pre-service teachers' technology integration skills, including in online settings (United States Department of Education, 2016). The TPACK framework includes technology, pedagogy, and content knowledge, which builds upon the previous pedagogy and content knowledge (PCK) framework introduced by Lee Shulman (Mishra & Koehler, 2006; Shulman, 1987). The three types of knowledge—technology, pedagogy, and content—overlap to create four additional combinations. The TPACK framework has seven domains: content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TCK), and technological, pedagogical, and content knowledge (TPACK) (Mishra & Koehler, 2006).

Figure 1 TPACK Framework



For teachers to use technology effectively, they must acquire mastery over all three components of TPACK and how they overlap—teachers must be able to choose technology appropriate for their content area and then implement that technology effectively with students (Koehler & Mishra, 2009). Therefore, understanding a teacher's level of knowledge development as related to TPACK domains may help in understanding how effectively a teacher could teach in an online environment. The TPACK Framework can help teacher preparation programs ensure their pre-service teachers have developed effective online teaching skills since online teaching requires content-area knowledge, pedagogical practices (i.e., classroom management, assessment), and an understanding of technology.

Universities have taught pre-service teachers about technology in education for many years (Betrus, 2012). Nevertheless, the technology instruction provided by teacher preparation programs has not translated to the classroom, as pre-service teachers have reported they feel

unprepared to teach effectively with technology (US Department of Education, 2017). The TPACK framework goes beyond knowing how to use technology by requiring pre-service teachers to be able to choose which technology is best for a teacher's content area and how to use that technology to teach students. Ensuring pre-service teachers develop proficiency across TPACK domains with opportunities to apply their knowledge may help close the gap between what pre-service teachers learn and how prepared they feel about teaching with technology (Neumann et al., 2021). Teacher preparation programs have played a role in developing pre-service music teachers' pedagogical content knowledge (PCK) (Gohlke, 1994; Haston & Leon-Guerrero, 2008). However, they have directed less attention to developing pre-service music teachers' TPACK (Bauer & Dammers, 2016).

Several researchers have used the TPACK framework in music education to investigate technology implementation by in-service teachers, pre-service teachers, and music faculty. Mroziak and Bowman (2016) used the TPACK framework to investigate music faculty's technology skills and use that information to create tailored professional development opportunities. The researchers discovered that faculty indicated that the skills involved in what their students would likely need after graduation did not align with how they modeled teaching with technology in their classrooms. Mroziak and Bowman suggested developing music faculty TPACK, including using a TPACK diagnostic questionnaire to inform faculty of their current TPACK levels, providing opportunities for peer observation of technology-integrated lessons, and encouraging faculty to discover and experiment with new technology.

Bauer (2013) also used the TPACK framework to investigate the relationship between in-service music teachers' TPACK levels and their technology classroom integration. Results indicated that music teachers rated themselves higher in non-technology domains (PK, CK,

PCK) than in technology domains (TK, TCK, TPK, TPACK). Bauer found that a positive, moderate correlation existed between participants' TPACK subscale score and their reported level of technology integration.

Bauer and Dammers (2016) used the TPACK framework to examine how teacher preparation programs prepared pre-service music teachers to integrate technology into their classes and found that programs rated PCK components (pedagogical knowledge, content knowledge, and pedagogical content knowledge) as more developed than TPACK components (technological knowledge, technological content knowledge, technological pedagogical knowledge, and technological pedagogical and content knowledge). The results from Bauer and Dammers (2016) aligned with the results of a 2013 study by Bauer, which found that less than a third of the participants felt their pre-service training helped them develop any technology-specific domains of the TPACK framework. Overall, music education researchers have demonstrated that technology domains remain underdeveloped across music education, from teacher preparation programs and collegiate music faculty to in-service teachers.

Online vs. Face-to-Face Teaching and Learning

Teaching online and learning online is different than teaching and learning face-to-face. Teachers have faced unique challenges when teaching in online settings, including classroom management, community building, and ensemble rehearsals.

The physical distance between students and teachers in online instructional environments has led to unique issues that are not as pronounced in brick-and-mortar (face-to-face) classrooms. For example, experts have touted proximity as a critical classroom management tool; however, teachers have little control over their proximity to students in online classrooms (Dyer et al., 2018). When physical distance increases in a brick-and-mortar(face-to-face) classroom, so do

physiological and communication distance; therefore, the potential for misunderstanding between teachers and students increases (Moore, 1991). Unlike in brick-and-mortar classrooms, however, teachers in online settings cannot simply move a student's seat closer to the front of the room to increase their proximity to the student. Therefore, teachers must use different techniques to mediate the physical distance between themselves and their students.

Teachers in online settings have mediated the physical distance between themselves and their students through consistent interaction. Moore (1989) established three kinds of interaction vital to successful online teaching: learner-content interaction, learner-teacher interaction, and learner-learner interaction. Interaction occurs more naturally in a brick-and-mortar classroom due to physical proximity. In online classrooms, a sense of community formed through interaction among students and teachers does not happen by accident and, therefore, requires teachers to intentionally implement activities to sustain communities for them to be successful (Garrison & Arbaugh, 2007). Effective online teachers can create a sense of togetherness without being in a physical classroom.

Teachers have increased interaction online by focusing on social presence. When teachers have created a social presence, students felt a "sense of 'being there together' when 'being there' does not involve a physical presence" (Öztok & Kehrwald, 2017, p. 263). Teachers have constructed social presence and increased teacher-learner interaction online by creating welcome messages, posting frequent announcements and reminders, using emoticons, and responding to email promptly (Çakıroğlu, 2014; Martin & Bolliger, 2018; Richardson et al., 2017; Tanis, 2020). In addition, teachers have used breakout rooms in synchronous classes and discussion boards to increase learner-learner interaction and build community (Aderibigbe, 2021; Robinson

et al., 2019). Teachers in online settings use different means to create a sense of togetherness outside the boundaries of physical proximity in face-to-face classrooms.

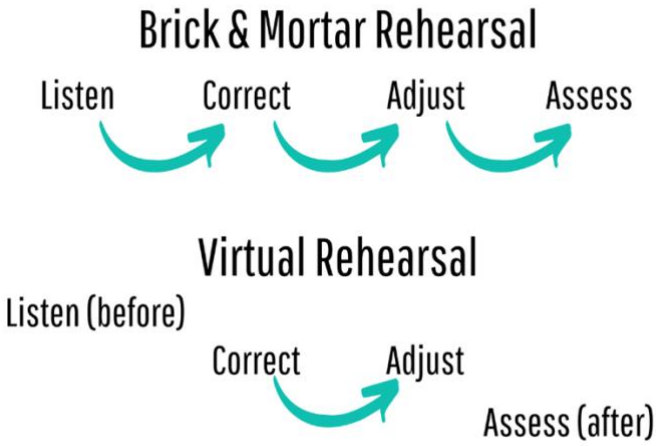
Classroom management strategies have varied depending on the setting. In brick-and-mortar classrooms, teachers tend to focus more on keeping noise at a reasonable level, whereas in online settings, students are often muted, and teachers must focus on keeping students engaged (Rose, 2020). In synchronous classes, teachers have focused on strategies that differ from anything they have had to do in face-to-face classes. For example, teachers have had to spend more time regulating who comes in and out of their classroom to prevent "Zoom bombing," a trend that surged during emergency online teaching in which hackers entered live class sessions and displayed vulgar, racist, or upsetting pictures and videos (Zalaznick, 2020). In a brick-and-mortar school, outsiders are typically required to pass through an office area to access classrooms, whereas, in virtual schools, outsiders can be anywhere with an Internet connection to hack into online classrooms.

Ensemble directors have adapted both rehearsal techniques and performances in online settings. Unfortunately, as of 2023, Internet Service Providers have not yet delivered high enough Internet speeds to enable people to rehearse synchronously without latency—although that did not deter people from trying during the early days of COVID-19 and posting videos of their unsuccessful attempts (Mersiovsky, 2020; Ollie Boorman Drums, 2020; Vivere Cantus, 2020). Therefore, ensemble directors have modified their rehearsal techniques. In brick-and-mortar rehearsals, the entire process of listening to students, suggesting corrections, students adjusting to the suggested corrections, and assessing whether the suggestion corrected the issue happens all at once in a matter of minutes during rehearsal. In a virtual ensemble with live

rehearsals, the same processes happen but not all simultaneously (see Figure 2). Rose (2020) explained the differences in the processes:

> All of the components of a brick-and-mortar rehearsal are present in virtual rehearsals. The difference is that some parts occur outside of synchronous rehearsal because the entire rehearsal is muted. The listening component happens before rehearsal. I assign students part of the music to record and submit each week. Prior to rehearsal, I listen to student submissions and pick out common mistakes across sections or the entire ensemble. I mark my score and decide which rehearsal techniques or exercises I want to use to address the issues. I run my virtual rehearsals just like I would in brick-and-mortar. … Lastly, I assess whether or not the adjustment was successful by listening to their next recorded assignment. We will either move on or revisit, if needed. (pp. 42-44)

Figure 2 Differences Between Brick-and-Mortar and Virtual Rehearsals (Rose, 2020)



Additionally, ensemble directors have formatted performances differently due to latency issues. Unlike brick-and-mortar performances, virtual performances do not happen with everyone in one place playing all together at the same time. Typically, in a virtual ensemble such as a virtual choir, each member records their part individually, and then someone edits the audio and video together to form a whole choir (Whitacre, 2011). Therefore, ensemble directors need different skills to rehearse and perform effectively in virtual environments. While the ensemble

directors may adjust their rehearsal and performance processes, the content of their ensembles remains the same.

History of Online Learning Before COVID-19

Although the COVID-19 pandemic brought distance learning to the forefront, students have learned separately from the physical location of their teachers for hundreds of years. Distance learning via the Internet has existed for several decades. Musicians had also collaborated online for many years before the pandemic.

Online learning falls under the umbrella of distance learning. Distance learning involves the separation between the teacher and student and the use of media to facilitate learning (Keegan, 1980). The first generation of distance learning involved sending educational materials via a postal system (Taylor, 2001). Distance learning has evolved to include audio recordings and videotape (second generation), audio and video conferencing (third generation), interactive multimedia and access to the World Wide Web (fourth generation), and school portals with widespread access and automated processes (fifth generation).

Online learning as a form of distance learning began over thirty years ago. The first instance of a college course taught entirely online for credit occurred at the New Jersey Institute of Technology in 1985 (Hiltz, 1986). K-12 schools in Canada began offering online classes in 1995, and K-12 schools in the United States soon followed in 1997 (Barbour & Reeves, 2009). Prior to the COVID-19 pandemic, an estimated 21% of public schools and 13% of private schools in the United States offered at least one course delivered entirely online (Spiegelman, 2019). Even though emergency online teaching magnified online learning, the beginnings of learning online stretch back decades.

North Carolina has a rich history of online teaching and learning. In 1993, East Carolina University became a pioneer in online education when it began offering the first online master's degree program in the United States (ECU News Services, 2017). In 2002, students in the Cumberland County School District could take classes online for the first time through the Cumberland Web Academy (Reiss, 2002). The county-based Cumberland Web Academy eventually merged with Learn NC and morphed into the state-wide North Carolina Virtual Public School (NCVPS) in 2006 (North Carolina Department of Public Instruction, 2006; North Carolina e-Learning Commission, 2009). NCVPS grew to become the second-largest virtual school in the United States in 2022 (NCVirtual, 2022). In 2007, the University of North Carolina at Greensboro began offering the nation's first virtual early college option through the iSchool program (Perrin, 2008). North Carolina has offered online learning options for over three decades, and the state has led the way as a pioneer in virtual education.

Although North Carolina has developed a history of online learning, North Carolina teacher-preparation programs have not mirrored that development. There is a gap between what North Carolina's schools and universities offer students in virtual education and how pre-service teacher programs in North Carolina prepare pre-service teachers to teach online. Kennedy and Archambault (2012) conducted a national survey on online field experiences offered by universities, receiving 30 responses from North Carolina universities—none indicated they offered virtual field placements. Only seven (1%) of the 522 universities surveyed nationwide reported offering online field experiences.

Archambault et al. (2016) conducted a similar survey in 2016 to assess if the landscape had changed. The 2016 survey received 20 responses from North Carolina universities, with only one (5%) respondent indicating they offered virtual field experiences to pre-service teachers.

Fifteen (4%) of the 363 universities surveyed reported offering a virtual field experience. While the two surveys were not longitudinal, one might expect to see a more substantial increase in virtual field experiences, particularly in North Carolina, considering North Carolina had the second largest virtual public school offering in the United States and two full-time virtual charter schools by the time the second survey was distributed (Granados, 2019).

The concept of teaching and learning music entirely online is not new either. Finnish music teachers began using video conferencing via the Internet to teach music classes in remote villages as far back as 2000 (Makki, 2001). Private lesson instructors have taught online lessons since the early 2000s (Litterst, 2003). In North Carolina, NCVPS started offering an online high school music appreciation course in 2007 (Rhea, 2007). Additionally, people have collaborated to make music in virtual spaces for over a decade. Eric Whitacre's first virtual choir launched in 2010, and his projects have become some of the most well-known examples of collaborating online for musical purposes (Eric Whitacre's Virtual Choir, 2010). Musicians also collaborated to form various virtual instrumental ensembles (Josh Turner Guitar, 2015; O'Leary, 2017). Not only is virtual music-making possible, but it has also yielded unique benefits for musicians, such as a sense of community and opportunities to connect with people they would not otherwise meet face-to-face through video comment sections and online discussion forums (Armstrong, 2012; Cayari, 2016).

Online music education had occurred for two decades before emergency online learning began, yet researchers have conducted limited research on online music pedagogy, particularly at the K-12 level. Much of the research before COVID-19 focused on music teaching and learning for private lessons in virtual settings (Bandopadhyay, 2002; Dammers, 2009; Holt, 2016; Lockett, 2010; Wilson, 2013). Most of the research on online pedagogy outside of private

lessons focused on collegiate-level music courses (Archer-Capuzzo, 2017; Johnson, 2017; Johnson & Lamothe, 2018). A substantial gap in the literature existed before COVID-19, particularly at the K-12 level, even though online music education has existed in some form since the early 2000s.

The Impact of COVID-19 on Online Learning

For better or worse, the disruptions caused by COVID-19 emergency online teaching impacted online education. More people experienced online teaching and learning than ever before. The impacts of the COVID-19 pandemic were far-reaching and have extended beyond the period of emergency online teaching.

Emergency online teaching impacted people's perceptions of the value of online education in positive and negative ways. Historically, employers have expressed negative opinions about hiring employees who earned their degrees online and have reported that they view online classes and degrees as a less academically rigorous option than brick-and-mortar classes and degrees (Columbaro & Monaghan, 2008). Because large swaths of people suddenly moved online due to the COVID-19 pandemic, some of the stigma associated with online learning, particularly at the collegiate level, may have decreased (Kis, 2021). Additionally, even though many universities and colleges had already offered some classes online, most K-12 school districts had no prior online classes in place and had to shift online quite suddenly without much prior infrastructure in place (Kronk, 2020). As a result, teachers felt inadequately prepared to teach online, which left many students, caregivers, and school administrators with a negative view of online learning. The effect reached a political level when states began enacting legislation that encouraged full-time virtual learning or, conversely, penalized schools for implementing online learning as an option (Klein, 2022).

The COVID-19 pandemic impacted pre-service teachers, particularly those completing field experiences and student teaching. Many pre-service teachers could no longer satisfy their field placement and student teaching requirements in face-to-face settings. As a result, researchers studied their experiences and made suggestions to continue offering virtual field experiences to students after emergency online teaching ended (Gilles & Britton, 2020; Ismaeel & Al Mulhim, 2022). Additionally, the edTPA—a system used by 41 states that assesses whether pre-service teachers are ready to begin teaching—pivoted to include virtual learning environments as an option to complete the portfolio requirements (edTPA, 2020). The edTPA has continued to allow virtual learning environments as an option after emergency remote teaching ended (edTPA, 2021). If pre-service teachers can complete their portfolio requirements in virtual environments, they should learn about online pedagogy as part of their teacher preparation.

Options for virtual schooling increased because of COVID-19. Before the COVID-19 pandemic, 3% of districts in the United States offered a virtual school option; as of 2021, 26% of districts provided a virtual school option (Diliberti & Schwartz, 2021). The growth in virtual school offerings in North Carolina paralleled the national growth in virtual school offerings. North Carolina had five virtual academies pre-pandemic; in the 2021-2022 school year, the number of virtual academies increased to 61 (NC Department of Public Instruction, 2022). As virtual schools have become more common, more teachers will need professional development related to online pedagogy. Additionally, pre-service teachers will have more opportunities to begin their teaching careers in virtual schools.

Although the prevalence of online learning experienced substantial growth due to the COVID-19 pandemic, the idea of incorporating online pedagogy as part of teacher preparation

programs began well before the sudden shift to online teaching during the early weeks of the pandemic. Researchers and policymakers have called for a shift in pre-service teacher preparation to include online learning pedagogy since the early 2000s (Archambault & Kennedy, 2014; Compton, 2009; Davis et al., 2007; Duncan & Barnett, 2009; Irvine et al., 2003; McCoy, 2008). Despite the recommendations to include online learning pedagogy before COVID-19, teacher preparation programs focused primarily on incorporating technology into traditional brick-and-mortar classrooms (Herold, 2021). The intensity of the focus on shifting to a different approach to ensuring pre-service teachers learn the skills they need for teaching and learning online has only increased because of the pandemic.

Emergency online teaching due to COVID-19 spotlighted music education in online settings at the K-12 level more than ever before, leading to more research about K-12 online music education. However, findings from research conducted during online emergency teaching must be interpreted cautiously. Most studies focused on temporary adaptations, and little, if any, of the research conducted during this time involved teachers and students who had taught or learned entirely online before 2020 (Carlson & Hanna-Weir, 2021; Grebosz-Haring et al., 2022; Hash, 2021; Mercado, 2021; Mercado, 2022; Swanson et al., 2021).

Although the results from research conducted during emergency online teaching may not be as applicable to non-emergency online music education, some recommendations could be helpful to music educators, administrators, and music teacher preparation programs. For example, Hash (2021) recommended that instrumental music teachers and pre-service music teachers continue to receive professional development related to teaching instrumental music online if they need to teach online in the future. Additionally, Rieker and Apanovitch-Leites (2021) recommended continuing to provide choral music educators with professional

development about online music pedagogy and how to integrate technology into their classes. Finally, Moscardini and Rae (2020) highlighted the sentiment that the period of emergency remote teaching seemed to have marked a turning point for many in the field of music education, viewing it more as an opportunity for a "way forward" rather than a "stop gap" (p. 42). While music teachers may not be able to glean best practices from research conducted during COVID-19, teacher preparation programs may apply the findings to prepare pre-service teachers better to teach online.

Online Learning Beyond Emergency Remote Teaching

The COVID-19 pandemic required many students and teachers to shift online. The transition to online teaching and learning was temporary. However, online learning did not end abruptly when brick-and-mortar schools began to reopen. Although fewer students attend school online than at the height of the COVID-19 pandemic, online learning has continued for K-12 students in short-term and long-term ways (Langreo, 2022).

School districts across the United States have continued to offer online learning options for various reasons beyond emergency remote teaching. For example, before the COVID-19 pandemic, most school districts would need to close due to site-specific emergencies, such as burst water pipes or asbestos detection. Now, schools can avoid days- or weeks-long closures and mitigate learning loss by transitioning to remote learning (Blad, 2022; Winn, 2023; Zarcone, 2022). Additionally, school officials may opt to shift to remote learning in place of inclement weather days (Cray & Ome, 2021). Finally, some districts have also transitioned their teacher professional development days to virtual learning days for students to continue learning (Cobb County School District, 2023; Primary and Secondary Education - Virtual Education, 2023). Thirty-eight states continued to offer online learning options by setting up full-time virtual

schools after emergency remote teaching ended (Thompson, 2021). Online learning at the K-12 level has not gone away, even though the period of emergency remote teaching ended.

In North Carolina, legislators passed a bill to ensure all school districts have up to five remote learning days per school when schools are unable to open due to "severe weather conditions, energy shortages, power failures, or other emergency situations" (An Act to Provide Relief to Public Schools in Response to the Coronavirus Disease 2019 [COVID-19] Pandemic, 2021, p. 3). During the 2022-2023 school year, 63 of the 100 school districts in North Carolina reported using at least one remote learning day (Dietrich, 2023). Most school districts in North Carolina have continued to use remote learning days beyond the period of emergency remote teaching, indicating that school districts continue to expect teachers in brick-and-mortar schools to be able to teach online in some capacity.

School districts in North Carolina can also request a "good cause" waiver, which allows school districts to implement up to fifteen remote learning days in a school year due to "severe weather conditions, energy shortages, power failures, or other emergency situations" (An Act to Provide Relief to Public Schools in Response to the Coronavirus Disease 2019 [COVID-19] Pandemic, 2021, p. 3). Therefore, North Carolina teachers who work in brick-and-mortar schools could reasonably expect to have to teach online for up to fifteen days per year in the case of a good cause emergency. Seven schools across six counties reported using more than five remote learning days during the 2022-2023 school year (Dietrich, 2023). Because schools must apply for a waiver to request more than five remote learning days, these schools likely experienced extenuating circumstances that required schools to close beyond the allotted five days. Since all North Carolina public school districts are automatically permitted up to five remote learning

days per school year and can request up to fifteen remote learning days, anyone teaching in a North Carolina public school can reasonably expect they will need skills for teaching virtually.

Additionally, North Carolina adopted new digital learning competencies in 2023 that mirror ISTE's standards for educators (North Carolina Board of Education, 2023). The standards included "manage the use of technology and student learning strategies in digital platforms, virtual environments, hands-on makerspaces and in the field" and "stay current with research that supports improved student learning outcomes, including findings from the learning sciences," which relate directly to teaching online (International Society for Technology in Education, 2023b). Therefore, pre-service music teachers working toward a North Carolina teaching license should have at least a basic knowledge of how to teach online to meet the expectations of the ISTE standards, even if they plan to teach at a brick-and-mortar school.

North Carolina legislators also passed a bill to expand permanent virtual learning academies within school districts (An Act to Provide for Virtual Education in Public School Units in Emergency Circumstances, 2022). Before 2020, only two full-time virtual charter schools existed, and only one offered music classes (North Carolina Department of Public Instruction, 2013a; North Carolina Department of Public Instruction, 2013b). In 2023, enough music teachers taught at virtual schools in North Carolina to form a Professional Learning Community that met monthly (North Carolina Virtual Music Educators PLC, 2023). Full-time virtual music teaching positions at the K-12 level have expanded in North Carolina due to the bill that permitted school districts to create permanent virtual learning academies.

Teaching music online at the K-12 level was once a niche, limited job. That is no longer the case. North Carolina pre-service music teachers can expect that they will need to have the skills necessary to teach online, even if they plan to teach at a brick-and-mortar school. Although

teacher preparation programs have included technology integration in brick-and-mortar classrooms, there must be an intentional shift toward technology integration in the virtual classroom if pre-service teachers are to be fully prepared to teach in virtual environments. Additionally, the shift towards more effective technology integration and online pedagogy should occur program-wide rather than in one class focused on technology.

Restatement of Purpose

The purpose of this pilot study was to investigate the relationship between North Carolina pre-service music teachers' perceived preparedness to teach online, Technological, Pedagogical, and Content Knowledge (TPACK) score, and online pedagogy instruction included in methods classes. This pilot study was designed to answer the following research questions:

1. To what extent do North Carolina pre-service music teachers feel prepared to teach online?
2. What is the relationship between North Carolina pre-service music teachers' perceptions about being prepared to teach online, TPACK score, and the amount of online music pedagogy in instruction methods classes?

CHAPTER III: METHODOLOGY

The purpose of this pilot study was to investigate the relationship between North Carolina pre-service music teachers' perceived preparedness to teach online, Technological, Pedagogical, and Content Knowledge (TPACK) score, and online pedagogy instruction included in methods classes. The research questions that were investigated include:

1. To what extent do North Carolina pre-service music teachers feel prepared to teach online?
2. What is the relationship between North Carolina pre-service music teachers' perceptions about being prepared to teach online, TPACK score, and the amount of online music pedagogy in instruction methods classes?

This pilot study used a cross-sectional survey design, which the participants took one time (Creswell and Creswell, 2018). A survey-based design enabled me to investigate and produce statistics on a target population—North Carolina pre-service music teachers (Fowler, 2009). I used a survey design because of the low costs of distributing a survey online and quick turnaround time (Creswell and Creswell, 2018). The data that I collected did not already exist elsewhere.

Population and Sampling Method

The population for this pilot study was pre-service music teachers who attended a college or university in North Carolina during the 2023-2024 academic school year and had taken at least one teaching methods class. I used data from the National Center for Education Statistics (NCES) through the Integrated Postsecondary Education Data System (IPEDS) to calculate the population size. I determined an approximate population (N = 462) by finding the average number of undergraduate music education degrees conferred by North Carolina colleges and

universities (M = 115.5) over the four most recent years of data available in the fall of 2023 (2019, 2020, 2021, 2022). I multiplied the average by four to reflect the four years of enrollment typically required for music education degree programs to find an approximate population of 462.

To define the minimum sample size, I used G*Power to compute several a priori power analyses. I planned to conduct a paired sample *t* test to determine if there was a significant difference between participants' perceived preparedness to teach online and participants' perceived preparedness to teach face-to-face. For a paired sample *t* test using a medium effect size (d_z = .15) and an alpha level of .05, the recommended sample size (n = 54) was required to achieve a power of .95 (Faul et al., 2007).

I planned to conduct a one-way repeated measures ANOVA to determine if there was a significant difference between participants' self-reported scores on the seven TPACK domains: CK, PK, PCK, TK, TCK, TPK, and TPACK. For a repeated-measures ANOVA with one group and seven measures (seven TPACK domains) using a medium effect size (f = .25) and an alpha level of .05, the recommended sample size (n = 26) was required to achieve a power of .95 (Faul et al., 2007). I planned to conduct a multiple linear regression to determine if participants' self-reported TPACK score, and the amount of online pedagogy participants reported receiving in their music methods classes were predictors for participants' perceived preparedness to teach online. For a multiple linear regression with two predictors using a medium effect size (f^2 = .15) and an alpha level of .05, the recommended sample size (n = 107) was required to achieve a power of .95 (Faul et al., 2007).

The North Carolina Music Educators Association (NCMEA) collegiate-member email list served as the sampling frame. I chose to distribute the survey through NCMEA because

professional organizations that maintain lists of members are more cost-efficient and less time-consuming to use in survey research than creating a list "from scratch" (Blair et al., 2014). NCMEA maintains an email list of active collegiate-level members in North Carolina, and those members likely reflected the target population of pre-service music teachers who attended a college or university in North Carolina during the 2023-2024 academic school year and had taken at least one music-specific methods class.

Survey Development and Data Collection

To develop the survey instrument for this pilot study (see Appendix C), I began by reviewing literature that included surveys based on the TPACK framework. Then, I examined item examples from several TPACK survey instruments, including the Music TPACK Questionnaire (MTPACK-Q) (Bauer, 2013), Short Questionnaire for Measuring TPACK (TPACK.xs) (Sahin, 2011), and TPACK Survey (Schmid et al., 2020). I modified survey items from each survey to create the *Survey for Online Music TPACK.*

The survey was developed and distributed online due to the geographical spread of the participants and the cost-effectiveness of digital surveys (Dillman et al., 2014). Qualtrics served as the mode of delivery. Qualtrics is a web-based software program that enables businesses and researchers to create surveys, distribute surveys to participants, and collect responses. The survey was designed so that participants could complete it on a variety of devices, including laptops, tablets, and mobile devices. Optimizing the survey for multiple devices ensured that the participants could easily access all the survey items and answer choices, which could help reduce potential non-response bias (Dillman et al., 2014). Additionally, Qualtrics enabled the secure collection of participant responses, which were only accessible by logging into the password-protected portal.

TPACK Framework

For this pilot study, I used the TPACK framework to investigate pre-service music teachers' self-reported levels of knowledge development in each of the seven domains: content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technological knowledge (TK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological, pedagogical, and content knowledge (TPACK) (Mishra and Koehler, 2006). The TPACK framework expands on the original PCK framework, which contains three domains: pedagogical knowledge, content knowledge, and pedagogical content knowledge (Shulman, 1987). According to Mishra and Koehler (2006), the seven domains of TPACK include:

1. *Content Knowledge* (CK) is the knowledge a teacher must know about the subject they teach. For example, teaching middle school band differs from teaching high school math.
2. *Pedagogical Knowledge* (PK) is understanding how students learn and the strategies teachers can use to teach effectively. PK is generic and includes classroom management, lesson planning, and assessment tasks.
3. *Pedagogical Content Knowledge* (PCK) is a combination of CK and PK. Teachers choose pedagogical strategies that best fit the subject area they teach to the students in their classroom effectively.
4. *Technology Knowledge* (TK) is the knowledge of technology tools, how to use them, and which situations benefit from technology. Because technology constantly evolves, teachers must continue learning and adapting to new technologies.

5. *Technological Content Knowledge* (TCK) is the combination of TK and CK. Teachers know the technologies specific to their field and how those technologies impact the content they teach.
6. *Technological Pedagogical Knowledge* (TPK) is the combination of TK and PK. Teachers understand how the choice of technology impacts student learning. Teachers weigh the costs and benefits of using a particular technology in a lesson, choose a developmentally appropriate technology, and implement the technology effectively with students.
7. *Technological Pedagogical and Content Knowledge* (TPACK) combines all three knowledge components. When combined, a teacher deeply understands how all three components interact and are necessary for effective teaching and learning with technology.

Survey items were written to measure participants' self-reported levels of knowledge development in each of the seven TPACK domains.

Survey Design

The survey for this pilot study contained items related to music instructional methods classes, TPACK, and perceptions of pre-service music teachers' readiness to teach music in brick-and-mortar (face-to-face) and online settings. I wrote the Likert-type items for the survey instrument to measure nine constructs: perceived preparedness to teach in an online setting, perceived preparedness to teach in a brick-and-mortar (face-to-face) setting, and pre-service teachers' self-reported knowledge development regarding the seven TPACK domains (CK, PK, PCK, TK, TPK, TCK, TPACK). I designed the survey instrument by consulting relevant literature on TPACK and music TPACK surveys (Bauer, 2013; Sahin, 2011; Schmid et al.,

2020). Examples of survey items from existing TPACK literature included: “I have sufficient knowledge and skill as a musical performer (singing and/or playing instruments, reading and notating music)” (Bauer, 2013), “I have knowledge in solving a technical problem with the computer” (Sahin, 2011), and “I can adapt my teaching based upon what students currently understand or do not understand” (Schmid et al., 2020). I modified the TPACK survey items to include language specific to online teaching. Each of the seven domains of TPACK contained three Likert-type items (Appendix C).

The online survey consisted of four parts. The first part included information about the pilot study and a request for consent from the participants. The consent form contained the required information from the UNCG Institutional Review Board (IRB) adult consent form template. The first part of the survey also asked if the participant was currently enrolled as a music education major at a North Carolina university or college and if the participant had taken at least one music instructional methods course. The survey ended if the participant answered “no” to any of the items in the first part.

The second part of the survey asked respondents to respond to categorical grouping questions. I chose to include two questions, including the year of the degree program in which the student was currently enrolled and the specific music instructional methods classes the student had completed. The choice to include only two categorical grouping questions was made to “minimize response burden,” and prevent “sitting on unused, but potentially, sensitive information” (Robinson & Leonard, 2019, p.140). I started the survey with the categorical grouping questions because the items signaled to the participants that the survey was intended for them and tapped into their expertise through their experiences (Blair et al., 2014).

The third part of the survey contained 25 Likert-type scale items that asked the participants to rate themselves on a scale of 1 to 5, with 1 as "Strongly Disagree" and 5 as "Strongly Agree." All items, except categorical grouping questions, were randomized, and the rating scale started with the least desirable answer (i.e., never, strongly disagree) to avoid a potential primacy effect (Robinson & Leonard, 2019). Each of the seven TPACK domains had three survey items, which were summed together to give each participant a total score for each domain ranging from 3-15. Four items explicitly related to how prepared pre-service teachers feel about teaching face-to-face (two items) and online (two items).

Piloting the Survey

I administered a pilot of the survey to establish content validity, determine internal consistency, examine items that needed improvement, and confirm that skip logic worked properly in the survey (Creswell & Creswell, 2018; Robinson & Leonard, 2019). The pilot of the survey was distributed to undergraduate students (n = 8) majoring in music education at the University of North Carolina at Greensboro and who were enrolled in a music education methods class. These students were selected because they had characteristics similar to the survey population (Nardi, 2018). In addition to the survey instrument items, the pilot of the survey had three additional questions to gather feedback about the instrument. I placed the three additional questions at the end of the survey to provide a true "dry run" of the survey and accurately account for the estimated time needed to take the survey (Robinson & Leonard, 2019, p. 176).

After collecting the responses from the pilot of the survey, I analyzed the data to determine what improvements I needed to make before distributing the final survey instrument. First, I used Cronbach's alpha to determine the internal consistency of the survey items. All survey instruments I consulted when creating the *Survey for Online Music TPACK* had Cronbach

alpha coefficients for each TPACK domain at levels of .70 or higher. The MTPACK-Q had an alpha coefficient range of .75-.96 (Bauer & Dammers, 2016), the TPACK.xs had an alpha coefficient range of .77-.91 (Sahin, 2011), and the TPACK Survey had an alpha coefficient range of .77-.84 (Schmid et al., 2020). Considering the existing TPACK survey alpha coefficients and the typical acceptable level of reliability of .70 or higher (Russell, 2018), I set the acceptable alpha coefficient for the Survey for Online Music TPACK at .70.

I computed reliability estimates for the pilot survey overall and for each survey construct (see Table 1). The overall Cronbach alpha for the pilot survey was .76, which exceeded the minimum acceptable alpha level of .70. The survey constructs that met or exceeded the acceptable alpha level included perceived preparedness to teach brick-and-mortar (face-to-face) (α = .92), perceived preparedness to teach online (α = .82), TPK (α = .74), and TPACK (α = .92). The constructs that did not meet the acceptable alpha level included PK (α = .36), TK (α = .55), PCK (α = .55), and CK (α = .34). Removing one survey item from each of the domains that did not meet the acceptable alpha level improved the alpha level. Therefore, I discarded and wrote new items for PK, TK, and PCK. I kept the TCK item "I learned how to incorporate technology into my lessons in at least one of my methods classes" because of the insight it could provide about technology integration in methods classes. The item would not be used as part of the calculation for the participant's TCK score, so I wrote an additional item for TCK.

Two of the three items for CK yielded no variance, so the reliability estimate could not be calculated. All participants (n = 8) were in 100% agreement for both items—they all selected "strongly agree." Survey items should be rewritten or removed if all participants choose the same response because items should detect variation among participants (Center for Drug Evaluation

and Research, 2009; Ruel et al., 2016). Therefore, I rewrote both CK items to increase the potential of capturing variation among participants.

All participants (n = 8) indicated that the survey length felt "just right." Participants took an average of 9 minutes and 32 seconds to complete the survey, which is below the maximum acceptable length of an online survey of 15 minutes (Blair et al., 2014). Additionally, participants wrote open-ended comments that I used to make changes to the final survey instrument, including removing a repeated item and bolding the terms "face-to-face" and "online" to distinguish between the two more clearly. I revised the survey items in Qualtrics to produce the final version of the survey instrument.

Table 1 Pilot Survey Reliability Estimates

Construct	**Reliability Estimate**	**Reliability Estimate with One Item Removed**
Preparedness to teach brick-and-mortar (face-to-face)	.92	
Preparedness to teach online	.82	
CK	n/a	
PK	.36	.51
PCK	.55	.68
TK	.55	.91
TCK	.34	.60
TPK	.74	
TPACK	.92	
Overall	.76	

Survey Administration

After this pilot study received IRB approval, the Executive Director of NCMEA distributed an email at my request (see Appendix B) to members in the organization's database listed as collegiate (N = 326). The email contained an invitation to participate and a link to the finalized version of the survey instrument in Qualtrics. The Executive Director of NCMEA sent two additional follow-up emails at my request, one two weeks after the initial email and one at the beginning of the following semester, to meet the established response rate for a paired sample *t* test (n = 54), repeated measures ANOVA (n = 25), and multiple linear regression (n = 107). The response rate for the survey was 7.7% (n = 25). Eleven surveys were incomplete and discarded, leaving a total of fourteen survey responses used for analysis.

Data Analysis

Data were analyzed using the software program Statistical Package for Social Sciences (SPSS). I used Russell's (2018) recommended Cronbach's alpha coefficient of .70 to determine the internal consistency and establish the reliability of the survey instrument. Descriptive statistics were computed to analyze the data, including means, standard deviations, frequencies, and percentages. Initially, I had planned to compute a paired sample *t* test, repeated measures ANOVA, and multiple linear regression. However, due to the small sample size (n = 14), I used non-parametric tests (Fein et al., 2022). I conducted a Related-Samples Sign Test to determine if there was a difference between pre-service music teachers' perceived preparedness to teach in face-to-face and online settings. I conducted a Related-Samples Friedman's Analysis of Variance by Ranks to determine if there was a difference in scores on each of the seven TPACK domains. Finally, I conducted a Kendall's Tau-b Correlation to determine if there was an association

between perceived preparedness to teach online, TPACK, and the amount of online pedagogy included in methods courses.

Similar to the pilot-tested survey, the acceptable Cronbach alpha coefficient for the final survey instrument was set at .70 (Russell, 2018). I computed reliability estimates for the survey overall and for each survey construct (see Table 2). The overall Cronbach alpha for the survey was .91, which exceeded the minimum acceptable alpha level of .70. Preparedness to teach brick-and-mortar (face-to-face), preparedness to teach online, CK, PK, TK, TPK, and TPACK had Cronbach alpha coefficients of .70 or above. PCK had a Cronbach alpha coefficient of .69, which closely approached the acceptable level of .70. TCK had a Cronbach alpha coefficient of .65, which was below the acceptable alpha level of .70.

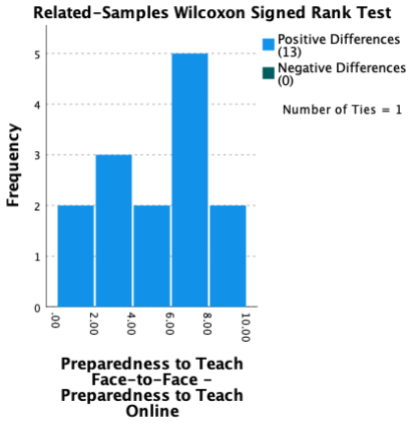
Table 2 Distributed Survey Reliability Estimates

Construct	Reliability Estimate
Preparedness to teach brick-and-mortar (face-to-face)	.82
Preparedness to teach online	.86
CK	.81
PK	.70
PCK	.69
TK	.77
TCK	.65
TPK	.71
TPACK	.86
Overall	.91

Analysis Assumptions

For research question one, I had planned to conduct a paired sample *t* test to determine if there was a difference between pre-service music teachers' perceived preparedness to teach face-to-face and online. Due to the small sample size ($n = 14$), I used a non-parametric test. Initially, I checked the assumptions for the Related-Samples Wilcoxon Signed Rank Test, which included a continuous or ordinal dependent variable, a bivariate independent variable, and a symmetrical distribution of differences (Fein et al., 2022). The independent variable was bivariate because it contained two groups: perceived preparedness to teach face-to-face and perceived preparedness to teach online. Because each group had two survey items summed together, the data satisfied the continuous or ordinal variable assumption. The symmetrical distribution of differences was violated (see Figure 3), so a Related-Samples Sign Test was computed instead. The Related-Samples Sign Test had the same assumptions as the Related-Samples Wilcoxon Signed Rank Test except for the assumption of symmetrical distribution of differences (Laerd Statistics, 2015).

Figure 3 Distribution of Differences



For research question one, I had planned to conduct a within-subjects (repeated measures) ANOVA to determine if there was a difference between the scores of the seven TPACK domains: CK, PK, PCK, TK, TCK, TPK, and TPACK. Due to the small sample size (n = 14), I used a non-parametric test instead. The Friedman One-Way Repeated Measure Analysis of Variance by Ranks test had several assumptions, including one independent variable that is ordinal or continuous and one independent variable that has three or more categorical related groups (Laerd Statistics, 2015). The dependent variable was comprised of scores for each TPACK domain, which satisfied the assumption of an ordinal or continuous dependent variable. The independent variable had seven levels for each TPACK domain, which satisfies the assumption of a categorical independent variable.

For research question two, I had planned to conduct a multiple linear regression. Due to the small sample size (n = 14), I did not compute the regression analysis. Instead, I computed Kendall's Tau-b Correlation, the non-parametric alternative to Pearson's Correlation, to determine if there was an association between North Carolina pre-service music teachers' perceptions about being prepared to teach online, TPACK score, and the amount of online music

pedagogy in instruction methods classes. Kendall's Tau-b Correlation has two assumptions, including variables that are ordinal or continuous and paired observations (Laerd Statistics, 2016). Because each variable was comprised of corresponding survey items summed together, the data satisfied the continuous or ordinal variable assumption. Additionally, all observations for the variables were matched across each participant.

Null Hypotheses

There were several null hypotheses that guided this pilot study. The statistical tests were computed with an alpha level of .05. To address research question one (*To what extent do North Carolina pre-service music teachers feel prepared to teach online?*), two statistical tests were computed: a Related-Samples Sign Test and a Friedman One-Way Repeated Measure Analysis of Variance by Ranks test. The null hypothesis for the Related-Samples Sign Test was: the median of the paired differences of participants' perceived preparedness to teach in a brick-and-mortar (face-to-face) setting and participants' mean perceived preparedness to teach in an online setting is 0.

$$H_0\colon \theta = 0$$

The null hypothesis for the Friedman One-Way Repeated Measure Analysis of Variance by Ranks was: there is no significant difference in participants' median scores on each TPACK domain (CK, PK, PCK, TK, TCK, TPK, TPACK).

$$H_0\colon Mdn_1 = Mdn_2 = Mdn_3 = Mdn_4 = Mdn_5 = Mdn_6 = Mdn_7$$

To address research question two (*What is the relationship between North Carolina pre-service music teachers' perceptions about being prepared to teach online, TPACK score, and the amount of online music pedagogy in instruction methods classes?),* one statistical test was computed: Kendall's Tau-b Correlation. The null hypothesis for the Kendall's Tau-b Correlation

was: there is no association between North Carolina pre-service music teachers' perceptions about being prepared to teach online, TPACK score, and the amount of online music pedagogy in instruction methods classes.

$$H_0\colon \tau_b = 0$$

CHAPTER IV: RESULTS

The purpose of this pilot study was to investigate the relationship between North Carolina pre-service music teachers' perceived preparedness to teach online, Technological, Pedagogical, and Content Knowledge (TPACK) score, and online pedagogy instruction included in methods classes. This pilot study was designed to answer the following research questions:

1. To what extent do North Carolina pre-service music teachers feel prepared to teach online?
2. What is the relationship between North Carolina pre-service music teachers' perceptions about being prepared to teach online, TPACK score, and the amount of online music pedagogy in instruction methods classes?

I collected data to answer this pilot study's research questions using a survey instrument I created. I designed the survey using the online platform, Qualtrics. The survey was distributed to NCMEA collegiate members via email. After the survey closed, the responses were entered into SPSS for data analysis.

Characteristics of the Sample

The survey for this pilot study was distributed via email to 326 potential participants who were on the NCMEA collegiate email list. The response rate for the survey was 7.7% (n = 25). Eleven surveys were incomplete and discarded before data analysis. A final participant count of 14 was included for analysis.

The first categorical grouping question asked participants to indicate the year of their degree program in which they were currently enrolled. The largest number of participants were in the fourth year of their degree program (n = 5; 35.7%). The smallest number of participants

were in the first year of their degree program (*n* = 2; 14.3%). Table 3 shows the distribution of the sample by program year.

Table 3 Distribution of Sample by Year in Program

Year in Program	Frequency	Percent
1st Year	2	14.3%
2nd Year	4	28.6%
3rd Year	3	21.4%
4th Year	5	35.7%
5th Year	0	0.0%
6th Year or Later	0	0.0%
Total	**14**	**100%**

The second categorical grouping question asked participants to indicate the methods classes they had taken. Most participants had taken an instrumental (woodwinds, brass, or percussion) methods class (*n* = 10; 71.4%). The fewest participants indicated they had taken a music methods class that was not listed (*n* = 5; 35.7%). Table 4 shows the distribution of the sample by methods classes taken. Percentages add up to more than 100% because participants could indicate they had taken more than one methods class.

Table 4 Distribution of Sample by Methods Classes Taken

Methods Class	Frequency	Percent
Choral or Vocal Techniques	9	64.3%
General Music (pre-k, elementary, or secondary)	9	64.3%
Instrumental (strings)	7	50%
Instrumental (woodwinds, brass, or percussion)	10	71.4%
Other Music Methods Class Not Listed	5	35.7%
General Education Methods Course Outside of the Music Department	7	50%

Research Question One

To what extent do North Carolina pre-service music teachers feel prepared to teach online?

Descriptive statistics were computed to determine the means and standard deviations for each construct. Four items measured participants' perceived preparedness to teach in brick-and-mortar (face-to-face) and online settings (see Table 5). Participants answered survey items using a 5-point Likert-type scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *strongly agree*). Most participants "agreed" (n = 7; 50.0%) or "strongly agreed" (n = 6; 42.9%) that they felt prepared to accept a job teaching an ensemble at a brick-and-mortar (face-to-face) setting. Most participants also "agreed" (n = 6; 42.9%) or "strongly agreed" (n = 5; 35.7%) that they felt prepared to accept a job teaching general music at a brick-and-mortar (face-to-face) school. Contrastingly, most participants "disagreed" (n = 4; 28.6%) or "strongly disagreed" (n = 8; 57.1%) that they felt prepared to accept a job teaching an ensemble at a virtual

school. Most participants also "disagreed" (n = 1; 7.1%) or "strongly disagreed" (n = 9; 64.3%) that they felt prepared to accept a job teaching general music at a virtual school. Participants' total scores on perceived preparedness to teach in brick-and-mortar (face-to-face) settings were higher (M = 8.43, SD = 1.45) than participants' total scores on perceived preparedness to teach in online settings (M = 3.72, SD = 2.52).

Table 5 Descriptive Statistics for Preparedness to Teach in Brick-and-Mortar (Face-to-Face) and Online Environments

Item	Mean	SD	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I feel prepared to accept a job teaching an ensemble (band, choir, or orchestra) at a brick-and-mortar (face-to-face) school.	4.36	.63	0 (0.0%)	0 (0.0%)	1 (7.1%)	7 (50%)	6 (42.9%)
I feel prepared to accept a job teaching general music at a brick-and-mortar (face-to-face) school.	4.07	.92	0 (0.0%)	1 (7.1%	2 (14.3%)	6 (42.9%)	5 (35.7%)
Total Brick-and-Mortar (Face-to-Face) Preparedness	**8.43**	**1.45**					
I feel prepared to accept a job teaching an ensemble (band, choir, or orchestra) at a virtual school that is entirely online.	1.79	1.25	8 (57.1%)	4 (28.6%)	0 (0.0%)	1 (7.1%)	1 (7.1%)
I feel prepared to accept a job teaching general music at a virtual school that is entirely online.	1.93	1.44	9 (64.3%)	1 (7.1%)	1 (7.1%)	2 (14.3%)	1 (7.1%)
Total Online Preparedness	**3.72**	**2.52**					

Related-Samples Sign Test Analysis

Initially, I planned to conduct a paired sample t test to determine participants' perceived preparedness to teach in brick-and-mortar (face-to-face) and online settings. However, due to the

small sample size (n = 14), I used a non-parametric test instead. Results from a Related-Samples Sign Test indicated a significant difference between participants' perceived preparedness to teach in a brick-and-mortar (face-to-face) setting and participants' perceived preparedness to teach in an online setting ($p < .001$). Participants' median perceived preparedness to teach in an online setting (Mdn = 2.5) was less than participants' perceived preparedness to teach in a brick-and-mortar setting (Mdn = 8.5) (z = -3.33, $p < .001$).

TPACK Domains Descriptive Statistics

Each of the seven TPACK domains contained three items to measure participants' perceived proficiency in each domain (see Table 6). Participants answered survey items using a 5-point Likert-type scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *strongly agree*). The scores for each domain were summed to produce a total score. Table 6 provides a summary of each item and total scores. Participants scored highest on the content knowledge (CK) domain (M = 14.21, SD = 1.12) and lowest on the technological, pedagogical, and content knowledge (TPACK) domain (M = 7.07, SD = 3.50).

Table 6 Summary of Means and Standard Deviations for TPACK Domains

Item	Mean	SD	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I can read pitches in at least two clefs (i.e., bass clef, treble clef, TAB).	4.86	.36	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (14.3%)	12 (85.7%)
I have sufficient knowledge and skill as a musical performer.	4.57	.51	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (42.9%)	8 (57.1%)
I can read rhythms in simple and duple meters.	4.79	.43	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (21.4%)	11 (78.6%)
Total CK	**14.21**	**1.12**					
I know how to adapt my lessons in the moment based on whether students are grasping the material or not.	3.79	.89	0 (0.0%)	1 (7.1%)	4 (28.6%)	6 (42.9%)	3 (21.4%)

Table 6 continued Item	Mean	SD	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I know how to differentiate lessons for students at different levels of learning.	4.07	.48	0 (0.0%)	0 (0.0%)	1 (7.1%)	11 (78.6%)	2 (14.3%)
I know how to assess students and then use the assessment data to inform my teaching.	4.00	.88	0 (0.0%)	1 (7.1%)	2 (14.3%)	7 (50.0%)	4 (28.6%)
Total PK	**11.86**	**1.83**					
I know how to select music for a performance based on the skill level of my students.	4.50	.52	0 (0.0%)	0 (0.0%)	0 (0.0%)	7 (50.0%)	7 (50.0%)
I know of strategies I can use to effectively run a rehearsal.	4.36	.63	0 (0.0%)	0 (0.0%)	1 (7.1%)	7 (50.0%)	6 (42.9%)
I can evaluate students' singing or playing and then provide them immediate feedback.	4.29	.83	0 (0.0%)	1 (7.1%)	0 (0.0%)	7 (50.0%)	6 (42.9%)
Total PCK	**13.21**	**1.95**					
I have the technical skills to figure out new technologies.	4.43	.76	0 (0.0%)	0 (0.0%)	2 (14.3%)	4 (28.6%)	8 (57.1%)
I know how to use video conferencing platforms such as Zoom, Google Meet, or Microsoft Teams.	4.29	.83	0 (0.0%)	1 (7.1%)	0 (0.0%)	7 (50.0%)	6 (42.9%)
I keep up with important new technologies	3.86	.77	0 (0.0%)	1 (7.1%)	2 (14.3%)	9 (64.3%)	2 (14.3%)
Total TK	**12.57**	**1.95**					
I can list at least 3 technology resources I could use when teaching music classes.	4.07	1.00	0 (0.0%)	2 (14.3%)	0 (0.0%)	7 (50.0%)	5 (35.7%)
I know of technology that students can use to create/compose music.	4.29	.61	0 (0.0%)	0 (0.0%)	1 (7.1%)	8 (57.1%)	5 (35.7%)
I know of technology that students can use to record music.	4.50	.52	0 (0.0%)	0 (0.0%)	0 (0.0%)	7 (50.0%)	7 (50.0%)
Total TCK	**12.86**	**1.70**					
I know how to choose technology that enhances student learning.	3.57	1.09	0 (0.0%)	3 (21.4%)	3 (21.4%)	5 (35.7%)	3 (21.4%)

Table 6 continued Item	Mean	SD	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I know how to utilize technology to differentiate my lessons for students.	3.07	1.07	0 (0.0%)	6 (42.9%)	2 (14.3%)	5 (35.7%)	1 (7.1%)
I know of classroom management techniques I could use when teaching synchronously on a videoconference platform such as Zoom, Google Meet, or Microsoft Teams.	2.36	1.39	5 (35.7%)	4 (28.6%)	1 (7.1%)	3 (21.4%)	1 (7.1%)
Total TPK	**9.00**	**2.63**					
I know how to prepare an online lesson for students to complete asynchronously on a Learning Management System (LMS) such as Canvas, Blackboard, or Brightspace.	2.36	1.39	3 (21.4%)	6 (42.9%)	1 (7.1%)	2 (14.3%)	2 (14.3%)
I know of strategies I can use to effectively run a synchronous online rehearsal using a videoconference platform such as Zoom, Google Meet, or Microsoft Teams.	1.93	1.27	7 (50.0%)	4 (28.6%)	1 (7.1%)	1 (7.1%)	1 (7.1%)
If I were given two days to plan a lesson for a music class of my choice in a virtual school that is entirely online, I feel confident I could teach that lesson successfully.	2.57	1.28	3 (21.4%)	5 (35.7%)	2 (14.3%)	3 (21.4%)	1 (7.1%)
Total TPACK	**7.07**	**3.50**					

For the CK domain, the majority of participants "agreed" (n = 2; 14.3%) or "strongly agreed" (n = 12; 85.7%) they could read pitches in at least two clefs. Additionally, the majority of participants "agreed" (n = 6; 42.9%) or "strongly agreed" (n = 8; 57.1%) they have sufficient

knowledge and skill as a musical performer. Finally, the majority of participants "agreed" (*n* = 3; 21.4%) or "strongly agreed" (*n* = 11; 78.6%) they can read rhythms in simple and duple meter.

For the pedagogical knowledge (PK) domain, the majority of participants "agreed" (*n* = 6; 42.9%) or "strongly agreed" (*n* = 3; 21.4%) they knew how to adapt lessons in the moment based on whether students were grasping the material or not. Additionally, the majority of participants "agreed" (*n* = 11; 78.6%) or "strongly agreed" (*n* = 2; 14.3%) they knew how to differentiate lessons for students at different levels of learning. Finally, the majority of participants "agreed" (*n* = 7; 50.0%) or "strongly agreed" (*n* = 4; 28.6%) they knew how to assess students and then use the assessment data to inform their teaching.

For the pedagogical content knowledge (PCK) domain, the majority of participants "agreed" (*n* = 7; 50.0%) or "strongly agreed" (*n* = 7; 50.0%) they knew how to select music for a performance based on the skill level of their students. Additionally, the majority of participants "agreed" (*n* = 7; 50.0%) or "strongly agreed" (*n* = 6; 42.9%) they knew of strategies they could use to effectively run a rehearsal. Finally, the majority of participants "agreed" (*n* = 7; 50.0%) or "strongly agreed" (*n* = 6; 42.9%) they knew how to evaluate students' singing or playing and then provide them immediate feedback.

For the technological knowledge (TK) domain, the majority of participants "agreed" (*n* = 4; 28.6%) or "strongly agreed" (*n* = 8; 57.1%) they have the technical skills to figure out new technologies. Additionally, the majority of participants "agreed" (*n* = 7; 50.0%) or "strongly agreed" (*n* = 6; 42.9%) they knew how to use video conferencing platforms. Finally, the majority of participants "agreed" (*n* = 9; 64.3%) or "strongly agreed" (*n* = 2; 14.3%) they kept up with important new technologies.

For the technological content knowledge (TCK) domain, the majority of participants "agreed" (*n* = 7; 50.0%) or "strongly agreed" (*n* = 5; 35.7%) they could list at least three technology resources they could use when teaching music classes. Additionally, the majority of participants "agreed" (*n* = 8; 57.1%) or "strongly agreed" (*n* = 5; 35.7%) they knew of technology students could use to create or compose music. Finally, the majority of participants "agreed" (*n* = 7; 50.0%) or "strongly agreed" (*n* = 7; 50.0%) they knew of technology students could use to record music.

For the technological pedagogical knowledge (TPK) domain, the majority of participants "agreed" (*n* = 5; 35.7%) or "strongly agreed" (*n* = 3; 21.4%) they knew how to choose technology that enhances student learning. Just as many participants "disagreed" (*n* = 6; 42.9%) as "agreed" (*n* = 5; 35.7%) or "strongly agreed" (*n* = 1; 7.1%) they knew how to utilize technology to differentiate their lessons for students. Finally, the majority of participants "disagreed" (*n* = 4; 28.6%) or "strongly disagreed" (*n* = 5; 35.7%) they knew of classroom management techniques they could use when teaching synchronously.

For the technological pedagogical and content knowledge (TPACK) domain, the majority of participants "disagreed" (*n* = 6; 42.9%) or "strongly disagreed" (*n* = 3; 21.4%) they knew how to prepare an online lesson for students to complete asynchronously. Additionally, the majority of participants "disagreed" (*n* = 4; 28.6%) or "strongly disagreed" (*n* = 7; 50.0%) they knew of strategies they could use to effectively run a synchronous online rehearsal using a videoconferencing platform. Finally, the majority of participants "disagreed" (*n* = 5; 28.6%) or "strongly disagreed" (*n* = 3; 21.4%) if they were given two days to plan a lesson of their choice for a virtual school that was entirely online, they felt confident they could teach that lesson successfully.

Friedman One-Way Repeated Measure Analysis of Variance by Ranks

Initially, I planned to conduct a one-way repeated measures ANOVA to determine if there was a difference between participants' self-reported scores on the seven TPACK domains: CK, PK, PCK, TK, TCK, TPK, and TPACK. However, due to the small sample size (n = 14), I used a non-parametric test instead. Table 7 shows the results from a Friedman One-Way Repeated Measure Analysis of Variance by Ranks. The results indicated there was a significant difference between the medians of the domains (χ^2 = 56.46, df = 6, p < .001).

Table 7 Test of Friedman One-Way Repeated Measure Analysis of Variance by Ranks

χ^2	***df***	**Asymptotic Sig. (2-sided)**
56.46	6	<.001

A Stepwise Step-down Post Hoc Test indicated three homogeneous subsets: 1) TPACK and TPK (p = .11), 2) PK, TK, TCK, and PCK (p = .20), and 3) TK, TCK, PCK, and CK (p = .06) (see Table 8). The TPACK and TPK domains did not overlap with any other subset and, therefore, differed from the PK, TK, TCK, PCK, and CK domains. The PK and CK domains differed from each other but were not different from the TK, TCK, and PCK domains.

Table 8 Homogeneous Subsets

Domains	Subsets		
	1	**2**	**3**
TPACK	1.64		
TPK	2.14		
PK		3.86	
TK		4.36	4.36
TCK		4.71	4.71
PCK		5.32	5.32
CK			8.85
Test Statistic	4.57	5.89	8.85
Adjusted Sig. (2-sided)	.11	.20	.06

Research Question Two

What is the relationship between North Carolina pre-service music teachers' perceptions about being prepared to teach online, TPACK score, and the amount of online music pedagogy in instruction methods classes?

Participants were asked to indicate how frequently they learned about teaching online in methods courses (see Table 9). For each methods course they indicated they had taken, participants specified whether the topic of teaching online: (a) was covered in this methods course, (b) was covered for part or all of one class session, (c) was covered for all or part of 2-3 class sessions, (d) was covered for part or all of 4-5 class sessions, and (e) was covered for part or all of more than 5 class sessions. Table 9 includes a summary of the frequency at which pre-service music teachers reported online pedagogy was covered as part of the methods classes they

indicated they had taken. Most participants indicated that teaching online was not covered in the methods classes they had taken: choral or vocal techniques (*n* = 9; 100%), general music (*n* =4; 44.4%), instrumental (strings) (*n* = 6; 85.7%), instrumental (woodwinds, brass, or percussion) (*n* = 7; 70%), other music methods (*n* = 4; 80%), and general education methods class (*n* = 4; 57.1%).

Table 9 Frequencies of Online Pedagogy Covered in Methods Class

Methods Class	Not covered in this methods course.	Covered for part or all of one class session	Covered for part or all of 2-3 class sessions	Covered for part or all of 4-5 class sessions
Choral or Vocal Techniques	9 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
General Music (pre-k, elementary, or secondary)	4 (44.4%)	1 (11.1%)	3 (33.3%)	1 (11.1%)
Instrumental (strings)	6 (85.7%)	1 (14.2%)	0 (0.0%)	0 (0.0%)
Instrumental (woodwinds, brass, or percussion)	7 (70.0%)	0 (0.0%)	3 (30.0%)	0 (0.0%)
Other Music Methods Class Not Listed	4 (80.0%)	1 (20.0%)	0 (0.0%)	0 (0.0%)
General Education Methods Class Outside of the Music Department	4 (57.1%)	0 (0.0%)	3 (42.9%)	0 (0.0%)

Participants were asked to indicate if they completed an observation or a fieldwork/practicum experience in an online classroom (see Table 10). For each methods course they indicated they had taken, they were presented with three options: (a) I did not have the opportunity to observe or complete fieldwork/practicum experience in an online classroom, (b) I had the opportunity to observe an online classroom, and (c) I had the opportunity to complete fieldwork/practicum experience in an online classroom. Most participants indicated they did not

have the opportunity to observe or complete fieldwork/practicum experience in an online classroom. One participant had the opportunity to observe an online classroom, and no participants completed fieldwork/practicum experience in an online classroom.

Table 10 Frequencies of Online Classroom Observation and Fieldwork/Practicum

Methods Class	**I did not have the opportunity to observe or complete fieldwork/practicum experience in an online classroom**	**I had the opportunity to observe an online classroom**	**I had the opportunity to complete fieldwork/practicum experience in an online classroom**
Choral or Vocal Techniques	9 (100%)	0 (0.0%)	0 (0.0%)
General Music (pre-k, elementary, or secondary)	9 (100%)	0 (0.0%)	0 (0.0%)
Instrumental (strings)	7 (100%)	0 (0.0%)	0 (0.0%)
Instrumental (woodwinds, brass, or percussion)	10 (100%)	0 (0.0%)	0 (0.0%)
Other Music Methods Class Not Listed	5 (83.3%)	1 (16.7%)	0 (0.0%)
General Education Methods Class Outside of the Music Department	6 (100%)	0 (0.0%)	0 (0.0%)

One item was originally included in the pilot survey TCK domain: “I learned how to incorporate technology into my lessons in at least one of my methods classes.” Results from the pilot survey indicated that the item negatively impacted the Cronbach alpha level for TCK. However, I chose to keep the item in the survey because of its potential to provide valuable insight into the extent to which participants perceived they learned how to incorporate technology specifically in their methods classes. The item was not included in the calculation for

the Cronbach alpha for the distributed since it was not intended to contribute to the TCK score. Participants answered the survey item using a 5-point Likert-type scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, 5 = *strongly agree*). Less than half of participants "agreed" (n =3; 21.4%) or "strongly agreed" (n =3; 21.4%) they learned how to incorporate technology into their lessons in at least one of their methods classes.

Table 11 Descriptive Statistics and Frequencies for Technology in Methods Classes Item

Survey Item	Mean	SD	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I learned how to incorporate technology into my lessons in at least one of my methods classes.	3.00	1.57	4 (28.6%)	1 (7.1%)	3 (21.4%)	3 (21.4%)	3 (21.4%)

Kendall's Tau-b Correlation Analysis

Initially, I planned to conduct a multiple linear regression to determine if participants' self-reported TPACK score and the amount of online pedagogy participants reported receiving in their music methods classes were predictors for participants' perceived preparedness to teach online. However, due to the small sample size (n = 14), I chose not to run the regression. Instead, I conducted a Kendall's Tau-b Correlation, the non-parametric alternative to the Pearson Correlation. Results indicated there was a strong, positive association between North Carolina pre-service music teachers' perceived preparedness to teach online and TPACK score (τ_b = .77, p < .001). The association between perceived preparedness to teach online and the amount of online pedagogy encountered in methods classes was not significant (τ_b = .39, p = .10). The association between TPACK score and the amount of online pedagogy encountered in methods classes was not significant (τ_b = .32, p = .15).

Table 12 Kendall's Tau Correlations

Variable		1	2	3
1 Preparedness to Teach Online	Correlation Coefficient	1.00		
	Sig. (2-tailed)	-		
2 TPACK Score	Correlation Coefficient	.77	1.00	
	Sig. (2-tailed)	<.001***	-	
3 Amount of Online Music Pedagogy	Correlation Coefficient	.39	.32	1.00
	Sig. (2-tailed)	.10	.15	-

****indicates significance at p < .001*

CHAPTER V: DISCUSSION & CONCLUSIONS

The purpose of this pilot study was to investigate the relationship between North Carolina pre-service music teachers' perceived preparedness to teach online, Technological, Pedagogical, and Content Knowledge (TPACK) score, and online pedagogy instruction included in methods classes. I developed a survey, which was distributed via email to potential participants listed as collegiate NCMEA members. Data were input into SPSS and analyzed. Results indicated that participants perceived themselves as less prepared to teach online than face-to-face. Additionally, participants' scores in content knowledge (CK), pedagogical knowledge (PK), technological knowledge (TK), pedagogical content knowledge (PCK), and technological content knowledge (TCK) differed from scores in technological pedagogical knowledge (TPK) and technological, pedagogical, and content knowledge (TPACK). Finally, there was a strong, positive association between participants' perceived preparedness to teach online and TPACK score.

Summary and Discussion of Findings

The number of participants included in this pilot study (n = 14) comprised only 4.3% of the targeted sample (N = 326). Survey response rates have declined over the past decade, and non-response rates further increased since the COVID-19 pandemic, potentially due to the increase in survey distribution causing survey fatigue (de Koning et al., 2021; Krieger, 2023). Because the response rate was low, the results of the study could be skewed due to non-response bias. The participants could have responded differently than the potential participants who did not respond. Although the results of this pilot study do not generalize to the population, they can provide a starting point for conversation and future research about online pedagogy in music teacher preparation programs.

Most participants reported not learning about online music pedagogy in their methods classes. Even though the COVID-19 pandemic demonstrated the need for online teaching skills and all districts in the state of North Carolina can use up to five virtual learning days per year, the participants, who were pre-service music teachers in North Carolina, reported they did not learn about these skills in their methods classes. The findings aligned with Rieker and Apanovitch-Leites (2021), who found that choral music educators did not feel their teacher preparation program equipped them with the skills to teach online during emergency online learning. Of the choral music educators they surveyed, 89% disagreed or strongly disagreed that their formal education had prepared them to teach online.

Fewer than half of the participants indicated that they "strongly agreed" (n = 3, 21.4%) or "agreed" (n = 3, 21.4%) with the statement "I learned how to incorporate technology into my lessons in at least one of my methods classes." Despite calls for program-wide technology integration into music methods classes, it appears that similar to previous findings, participants did not have the opportunity to learn technology integration skills taught within the context of methods classes (Dorfman, 2016; Haning, 2015). An absence of technological content in music methods classes could potentially be due to a gap in the technological skills of faculty (Amhag et al., 2019; Batane & Ngwako, 2016; International Society for Technology in Education, 2023a; Tondeur et al., 2012). Music teacher preparation programs may need to provide more guidance and professional development about technology integration across methods classes.

Similar to previous findings (Archambault et al., 2016; Kennedy & Archambault, 2012), most participants also reported that they did not have the opportunity to observe or complete field experiences in an online music classroom. Only one participant indicated they had the opportunity to observe an online music class, and no participants indicated they had the

opportunity to complete a field experience. One advantage of online classes is the lack of physical boundaries. Even if the nearest school district to a university does not have a virtual school, that is not a problem for online observations and field experiences. Therefore, virtual schools beyond the distance a pre-service teacher could physically and feasibly travel to are viable options for observations or field experiences.

Participants indicated they felt more prepared to teach in a brick-and-mortar (face-to-face) setting than in an online setting. The findings aligned with much of the research from the early months of COVID-19, indicating early career teachers did not feel prepared to teach online during emergency online teaching (Carver & Shanks, 2020; Moorhouse, 2021). As more K-12 school districts offer virtual learning options for the short-term (i.e., inclement weather, site-specific emergencies) and the long-term (i.e., fully online virtual schools), they will likely expect beginner teachers to have a basic understanding of how to teach online. In North Carolina, even if music teachers work at a brick-and-mortar (face-to-face) school, they can still expect to teach online for up to five days each school year. Over half of school districts in North Carolina used at least one virtual learning day within the 2022-2023 school year (An Act to Provide Relief to Public Schools in Response to the Coronavirus Disease 2019 [COVID-19] Pandemic, 2021; Dietrich, 2023). Any pre-service music teacher working toward a North Carolina teaching license should be prepared to teach online.

Participants' TPACK domain scores differed. Participants scored highest in content knowledge (CK) (M = 14.21, SD = 1.12). A substantial portion of music education majors' coursework (music theory, aural skills, proficiency on instrument/voice) focuses on content knowledge skills, so it is reasonable that participants would rate themselves highest in CK. Additionally, their CK, PK, TK, TCK, and PCK domain scores were significantly different than

their TPK and TPACK domain scores ($p < .05$). These findings differ slightly from previous findings by Bauer (2013), indicating that music teachers rated themselves lower in the technology domains (TK, TCK, TPK, TPACK)—the participants in this pilot study had lower scores only in TPK and TPACK.

Bauer (2013) also found that in-service music teachers rated themselves lowest in TK out of all seven TPACK domains, whereas the participants in this pilot study rated themselves lowest in TPACK ($M = 7.07$, $SD = 3.50$). Participants in this pilot study rated themselves as having sufficient technological knowledge (TK) and music-specific technological knowledge (TCK). Many pre-service teachers may have some basic technological skills because they are considered "digital natives" (Lei, 2009, p. 87). However, basic technological knowledge may not transfer to pedagogical-specific domains (TPK, TPACK). The finding that participants had general technological knowledge and music-specific technological knowledge but fewer developed domains outside of TK and TCK aligned with previous findings that tech-savvy "digital native" teachers may understand technology generally but may not proficiently integrate technology into their classrooms (Mulder, 2016). Knowing about general technology and music technology is not enough—pre-service music teachers may need more support in developing the pedagogical domains (TPK and TPACK). Pre-service music teachers should have ample opportunities to put what they learn about technology integration into practice, including in online settings.

There was a strong, positive association between participants' TPACK scores and perceived preparedness to teach music in an online setting. The higher the participants' TPACK score, the more prepared they felt to teach music in an online setting. Moore-Adams et al. (2016) found that the TPACK framework was beneficial for preparing pre-service teachers to

teach online effectively. The TPACK framework can provide a foundation for teacher educators to address each TPACK domain and explain how their interconnections relate to teaching online.

Implications

Much of the research about teaching music online at the K-12 level happened because of the COVID-19 pandemic. Several researchers recommended that in-service and pre-service music teachers continue to develop the skills needed to effectively teach with technology, including in online settings (Hash, 2021; Moscardini & Rae, 2020; Rieker & Apanovitch-Leites, 2021). Most participants in this pilot study, however, indicated that they did not learn about online music pedagogy in their methods classes. Skills required for integrating technology into brick-and-mortar (face-to-face) settings do not necessarily transfer directly into online settings (Greene et al., 2023; Compton, 2009). Therefore, it is important that pre-service music teachers receive instruction about online pedagogy specifically. Music teacher preparation programs should consider incorporating online music pedagogy into music methods courses to better prepare pre-service teachers for the realities they will face after graduation.

The call to better integrate technology and online music pedagogy in teacher preparation programs should not necessitate adding another class to the already packed schedule of music education majors. As previous researchers have found, teachers have continued to report a lack of confidence in technology integration, and stand-alone technology courses do not necessarily translate to pre-service teachers effectively incorporating technology into their lessons (Akaadom, 2020; International Society for Technology in Education 2023a; Foulger et al., 2019; Gronseth et al., 2010; Mulder, 2016; US Department of Education, 2017). The methods class remains an important place where pre-service teachers develop their skills to become music educators. Music teacher preparation programs may consider intentionally integrating technology

skills, including online music pedagogy, across their classes as a more effective approach to ensuring pre-service music teachers acquire technology skills. The TPACK framework may serve as a helpful tool for music teacher educators to ensure they are incorporating opportunities for pre-service teachers to learn about and demonstrate skills related to all the TPACK domains.

An absence of online music pedagogy in methods classes could be due to music faculty's underdeveloped technological skills and lack of knowledge about online pedagogy. Previous researchers found that a gap existed in music faculty's expectations of how students should use technology after graduation and how faculty incorporate technology into their own teaching (Mroziak & Bowman, 2016). Modeling technology skills and structuring activities and assignments involving technology can help pre-service teachers better understand how to incorporate technology into their teaching, including in online settings (Compton et al., 2009; Reister & Rook, 2021; Luo et al., 2017). Colleges and universities may consider providing professional development opportunities about teaching with technology and online music pedagogy for faculty who teach music methods classes.

Only one participant indicated they had the opportunity to observe an online music class, and no participants indicated they had the opportunity to complete a field experience in an online classroom. Opportunities to complete field experiences in online settings can help improve pre-service teachers' TPACK scores (Ismaeel & Al Mulhim, 2022). Providing pre-service music teachers with at least one opportunity for a field experience in an online classroom could benefit them.

Additionally, because online classes are not bound by physical locations, accessing an online classroom poses fewer barriers than setting up observations or fieldwork at a brick-and-mortar (face-to-face) school. Although fewer full-time virtual schools exist compared to brick-

and-mortar (face-to-face) schools, not having to consider physical distance can enable music education faculty to explore options beyond their local district and state. Additionally, music education faculty may consider partnering with a music teacher at a virtual school and bringing them into their methods class as a guest to teach pre-service music teachers how to teach online. When I taught middle and high school music at a full-time virtual school, I hosted pre-service music teachers from many different states around the country in my middle and high school synchronous general music classes and ensemble rehearsals for observations and fieldwork. I was also an invited guest lecturer in several methods courses to cover the topic of teaching online.

Previous researchers have found that technology instruction integrated across classes, opportunities for virtual field experiences, and appropriate modeling of online teaching by education faculty have led to increased pre-service teachers' preparedness to teach online (Reister & Rook, 2021). Music education faculty should consider building a program that incorporates technology and online learning skills across all methods classes.

Research Limitations

The purpose of this pilot study was to investigate the relationship between North Carolina pre-service music teachers' perceived preparedness to teach online, Technological, Pedagogical, and Content Knowledge (TPACK) score, and online pedagogy instruction included in methods classes. Due to time and funding restraints, I used the NCMEA collegiate email list as the sampling frame. This pilot study's population encompassed all North Carolina pre-service music teachers who may or may not have had current NCMEA membership at the time the emails were sent to them. There was potential for coverage bias due to the differences between the population and sample.

Because of the limited number of participants in this pilot study (n =14), the results cannot be generalized to the population. Survey response rates across all mediums have declined over the past 20 years (Brick & Williams, 2012; Medway et al., 2022; Cray & Ome, 2021). Online survey response rates have declined further recently, possibly because of survey fatigue due to the increased amount of research that shifted online due to the COVID-19 pandemic (de Koning et al., 2021; Krieger, 2023). Including an incentive or distributing the survey through a different method may have increased the survey response rate to an acceptable level that would have enabled the results to generalize to the population.

The content of methods classes may not be consistent across universities—some universities may use "techniques" and "methods" interchangeably (Pickering, 2020). In the survey, there was a question that asked participants which methods courses they had taken. The question provided a definition for methods courses as "classes where you learn how to teach. They may be music specific (i.e. elementary music methods, marching band techniques, foundations of teaching vocal music) or general (i.e. teaching diverse learners, teaching in the 21st century)." However, the definition may have caused confusion, particularly if the universities do not label the courses as "methods." Participants may have underreported or incorrectly reported the classes they had taken.

I included two categorical grouping questions: one about the participants' program year and one about the type of methods class(es) taken by the participants. Including only two categorical grouping questions limited the types of comparisons that could be calculated. Additional categorical grouping questions could have given a greater depth of understanding of the participants. For example, researchers have found gender differences in experiences with music technology (Armstrong, 2008; Hopkins & Berkers, 2019). Adding a gender categorical

grouping question could have potentially provided additional insight into differences in perceived preparedness to teach online and TPACK domain scores. Additionally, adding categorical grouping about age and school size could have given more insight into how representative the sample was of the population.

Recommendations for Future Research

The focus of this pilot study was limited to pre-service music teachers in North Carolina. Future research may expand to include pre-service music teachers from universities across the United States to encompass a broader geographical area, particularly because online learning legislation and teacher preparation program requirements may vary from state to state.

This pilot study included pre-service music student teachers' self-reported TPACK levels and the frequency at which they learned about online pedagogy in music methods classes. Self-reported data can be unreliable because the participant may incorrectly recall information, which can be a limitation of survey research (Gonyea, 2005). Future researchers may consider surveying music education methods faculty about their inclusion of online pedagogy in their classes. Future researchers may also consider measuring music education methods faculty TPACK levels to determine if their TPACK level is a predictor of the inclusion of online pedagogy in their methods classes.

This pilot study focused on a quantitative approach to understanding the relationship between pre-service music teachers' perceptions of preparedness to teach online, TPACK score, and online pedagogy included in methods courses. There were no opportunities for participants to comment or give open-ended responses to explain their answers. A qualitative or mixed-methods approach could help future researchers gain deeper insight into what shapes perceptions of preparedness to teach online.

Finally, much of the research about teaching and learning music online at the K-12 level occurred during emergency remote teaching due to COVID-19. More research in music education beyond the emergency period is necessary to better understand how to teach students in fully online settings and how to prepare pre-service music teachers to do so effectively.

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APPENDIX A: IRB APPROVAL

IRB #: IRB-FY24-14
Title: An Analysis of How Methods Classes and TPACK Impact North Carolina Pre-Service Music Teachers' Preparedness to Teach Online
Creation Date: 7-15-2023
End Date:
Status: Approved
Principal Investigator: Michelle Rose
Review Board: UNC-Greensboro IRB
Sponsor:

Study History

Submission Type	Review Type	Decision
Initial	Exempt	Exempt

APPENDIX B: SURVEY EMAIL

RESEARCH PARTICIPATION REQUEST

The following research opportunity is being sent by NCMEA on behalf of a legitimate researcher. Your participation in this research is strictly voluntary, and your email has not been disclosed to a third party. The sending of this invitation does not constitute endorsement of the content or quality of the research project.

Hello,

My name is Michelle Rose and I am a graduate student at the University of North Carolina, Greensboro. This email is an invitation to participate in a research study about understanding how North Carolina music education majors think about teaching with technology in face-to-face and online settings.

To participate, please click on the link to complete the brief survey: https://uncg.qualtrics.com/jfe/form/SV_7QGMYMZyRHAp4AS

The survey should take about 10 minutes to complete. The survey will be open for 3 weeks. Participation is voluntary and anonymous.

If you have any questions you may contact me at mawarsha@uncg.edu or the University of North Carolina at Greensboro Institutional Review Board at ori@uncg.edu.

Thank you for your consideration!

Michelle Rose
PhD Candidate, Music Education
University of North Carolina at Greensboro
mawarsha@uncg.edu

APPENDIX C: SURVEY INSTRUMENT

Are you at least 18 years old and currently enrolled in a music education program at a North Carolina college or university?
Yes
No

Have you completed at least one methods course? Methods courses are classes where you learn how to teach. They may be music specific (i.e. elementary music methods, marching band techniques, foundations of teaching vocal music) or general (i.e. teaching diverse learners, teaching in the 21st century).
Yes
No

Which of the following methods courses have you completed?
Choral or vocal techniques
General music (pre-k, elementary, or secondary)
Instrumental - strings
Instrumental - woodwinds, brass, or percussion
Other music methods class not listed (indicate below)
General education methods course outside of the music department

What year of your degree program are you currently in?
1st year
2nd year
3rd year
4th year
5th year
6th year or later

How frequently did you learn about teaching online during the following methods courses? (the methods courses listed in the participant's survey were displayed in a grid and only included the methods courses which the participant previously selected)

Teaching online was not covered in this methods course.
For part or all of one class session
For part or all of 2-3 class sessions
For part or all of 4-5 class sessions
For part or all of more than 5 class sessions

In which of the following methods classes did you have the opportunity to observe or complete fieldwork/practicum experience in an online classroom? (the methods courses listed in the participant's survey were displayed in a grid and only included the methods courses which the participant previously selected)

Consider the following statements then rate them on a scale of 1-5 with 1 as STRONGLY DISAGREE and 5 as STRONGLY AGREE.

Statements related to how prepared students feel to teach in brick-and-mortar vs. online schools

I feel prepared to accept a job teaching an ensemble (band, choir, or orchestra) at a brick-and-mortar (face-to-face) school.
I feel prepared to accept a job teaching general music at a brick-and-mortar (face-to-face) school.
I feel prepared to accept a job teaching an ensemble (band, choir, or orchestra) at a school that is entirely online.
I feel prepared to accept a job teaching general music at a school that is entirely online.

Technology Knowledge TK

I have the technical skills to figure out new technologies.
I know how to use video conferencing platforms such as Zoom, Google Meet, or Microsoft Teams.
I keep up with important new technologies.

Content Knowledge CK

I can read pitches in at least two clefs (i.e., bass clef, treble clef, TAB).
I can read rhythms in simple and duple meters.
I have sufficient knowledge and skill as a musician.

Pedagogical Knowledge CK

I know how to adapt my lessons in the moment based on whether students are grasping the material or not.
I know how to differentiate lessons for students at different levels of learning.
I know how to assess students and use that data to inform my teaching.

Pedagogical Content Knowledge PCK

I know of strategies I can use to effectively run a rehearsal.
I know how to select and teach music for a performance.
If I were given two days to plan a lesson for a music class of my choice in a brick-and-mortar(face-to-face) setting, I feel confident I could teach that lesson successfully.

Technological Content Knowledge TCK

I can list at least 3 technology resources I could use when teaching music classes.
I know of technology that students can use to create/compose music.
I know of technology that students can use to record music.

Technological Pedagogical Knowledge TPK

I know how to choose technology that enhances student learning.
I know how to utilize technology to differentiate my lessons for students.
I know of classroom management techniques I could use when teaching synchronously on a videoconference platform such as Zoom, Google Meet, or Microsoft Teams.

Technological Pedagogical and Content Knowledge TPACK

I know how to prepare an online lesson for students to complete asynchronously on a Learning Management System (LMS) such as Canvas, Blackboard, or Brightspace.

I know of strategies I can use to effectively run a synchronous online rehearsal using a videoconference platform such as Zoom, Google Meet, or Microsoft Teams.

If I were given two days to plan a lesson for a music class of my choice in an online setting, I feel confident I could teach that lesson successfully.

Other

I learned how to incorporate technology into my lessons in at least one of my methods classes.