MUSIC EDUCATION TECHNOLOGY CURRICULUM AND DEVELOPMENT IN THE UNITED STATES: THEORY, DESIGN, AND ORIENTATIONS

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A new paradigm of music teaching and learning has emerged in secondary schools in the United States. Music educators are taking advantage of innovations in digital technologies by organizing courses in which students learn about and demonstrate music concepts through music technology. Despite the growth of such classes, technology-based music class (TBMC) curricula has not been thoroughly investigated at the national level. Therefore, the purpose of this dissertation was to examine the current state of this emerging paradigm, and to share these insights with a variety of stakeholders including music educators, school administrators, education policymakers, and others who will influence the future of technology-based music classes.

This study was organized around three research questions, each of which was formulated to address an area of concern reflected in extant music technology literature.

1. What are the features of technology-based music class (TBMC) curricula?
2. What are music educators' orientations toward TBMC curricula?
3. How do TBMC curricula align with professional music education standards?

Data were collected using a researcher designed instrument based on two previously published questionnaires that examine music technology curricula and teacher attitudes toward the curriculum orientations originally proposed by Eisner and Vallance (1974). The Music Technology Curriculum Inventory (MTCI) was distributed nationally through the National

Association for Music Education (NAfME) research service and through social media groups interested in TBMC.

Data analysis and reporting of the *N* = 69 eligible responses consisted of descriptive statistics and basic qualitative content analysis of open-ended survey questions. Two exploratory groups were formed to compare agreement with academic rationalism and social reconstruction to select music technology curriculum items. Participants in this study reported high levels of non-traditional music student enrollment and a curricular approach that emphasized composition without the use of standard notation. Music educators seem to be utilizing recently developed web-based music software, and the cost of starting a music technology class appears to be decreasing. The results of this study contribute much needed national-level baseline data to a discourse mainly consisting of case studies, advocacy articles, and self-reported descriptions of technology classes and programs.

CHAPTER I

INTRODUCTION

Background

In the era of email, interactive display boards, one-to-one student laptops, fully online courses, video conferencing, social media, and cell phones, it can be difficult to imagine a time when classrooms were not brimming with technology. Teachers make frequent use of digital technologies to improve longstanding practices, such as the use of online learning management platforms to communicate student progress and evaluation. Teachers also use these technologies to facilitate students experiences that were not possible in earlier eras. A music teacher may, for example, use video conferencing software to host a question-and-answer session between students and the composer of a piece programmed on the upcoming concert.

Music notation software, app-based digital tuners, recording devices, budgeting software, and online quiz platforms are helping music educators run classrooms more efficiently. However, student use of technology lags behind. Webster (2017) satirized the situation by retelling a "joke that often gets told at gatherings of people who want to improve today's music programs in K–12 schools." After a doctor, engineer, and school music teacher enter a time machine in 1917 and are transported 100 years into the future, neither the doctor nor engineer can make much sense of the world in which they now find themselves. The school music teacher, however, faced less of a problem.

> The music teacher looks about the classrooms and rehearsal spaces and sees that the blackboards are white instead of black, chairs and music stands have become sleeker in design, and the audio equipment has taken new forms. He sees computers used in various forms, and watching a television is a new experience. However, the music instruments look the same, and much of the music itself looks and sounds familiar. The music teacher observes a rehearsal, talks with a few classroom and ensemble teachers, and decides to apply for a position right away knowing that most parts of the job are familiar. (para. 2)

This story could take place in a majority of music classrooms, where ensemble-based classes are offered at fully 90% of US middle and high schools (Elpus, 2017).

Our fictional music teacher would be far less likely, however, to take a position as instructor of a technology-based music class (TBMC). In traditional music education settings, abundant technology is used by music teachers to facilitate or enhance teaching and learning practices otherwise recognizable to an educator from the early 20th century. Technology-based music classes, by contrast, are characterized by student use of technology in the course of learning and demonstrating achievement. These classes run contrary to many familiar features of classroom music including an emphasis on traditional notation, large one-off performances, and performing the work of others (Kratus, 2007).

Advances in computer technology have democratized music recording, performance, and composition, and they have enabled wholly new class formats and teaching possibilities in classroom settings (Watson, 2011). Students, guided by their teachers, are using technology to compose, listen, perform on instruments, and share their music with others. Dorfman (2022) referred to this practice as technology-based music instruction (TBMI). Importantly, TBMI can take place in any music classroom, even the most traditional. A band director may introduce a composition unit with Noteflight, a computer notation application, in the class meetings between concerts. The teacher of a middle school general class might, as Ruthmann (2012) suggested, help students make their own music videos or use a text-to-speech program to synthesize a beatboxing rhythm.

As more experiences like these take place in music classrooms across the United States, some music teachers have taken steps to organize entire classes where musical skills and understandings are acquired primarily through technology and are “focused almost entirely on creative processes and products" (Dorfman, 2019, p. 830). One can read about a growing number of classes with names including songwriting and technology (Tobias, 2010), music technology (D. A. Williams, 2019), music production (Watson, 2011), and other variations. At this early stage, no single name has dominated the nomenclature, but they share the common feature of being curricular courses dedicated to music teaching and learning through technology.

The course offerings under investigation in this dissertation are referred to as technology-based music class/classes (TBMC) both plurally and singularly, a deliberately chosen word order that emphasizes *music class*. This is a dissertation about what happens in these novel music classes, and what the music teachers designing them believe about the purpose and aims of music instruction.

Key Terminology

The following list includes the terminology used in this chapter. A list of terminology for the entire dissertation can be found in Appendix A.

Academic Rationalism Orientation—A belief that the most important goal of curriculum is to impart the facts and understandings of a specific discipline often "without regard to the interest or needs of the learner, or contemporary societal problems (Jenkins, 2009, p. 104).

Behavioral Orientation—A belief that the most important goal of curriculum is to teach according to learning objectives or standards. This behavioral orientation is similar to the academic rationalism orientation but allows for individualized instruction according to the needs of the learner and under the assumptions of behavioral psychology and operant conditioning.

Cognitive Process Orientation—A belief that the most important goal of instruction is to teach students how to think and solve problems.

Curriculum Orientations—What one believes about the purpose of instruction. The five curriculum orientations used in this dissertation are based on Jenkins' (2009) study of US teachers.

Curriculum Orientations Inventory—An instrument first developed by Cheung and Wong (2002), later modified by Jenkins (2009), that measures participant agreement with five curriculum orientations using a 5-point scale. Results are reported as mean scores for each orientation with a participant's preferred orientation having the highest mean score.

Humanistic Orientation—A belief that the most important goal of instruction is to "provide students with opportunities to foster their personal development as unique individuals" (Jenkins, 2009, p. 104).

Non-Traditional Music Students—Secondary students who, according to D. B. Williams (2011), do not participate in traditional ensemble music classes for a variety of reasons. Importantly, this group represents approximately 80% of all students. Supporters of TBMC believe that these classes will attract and retain these students.

Social Reconstruction Orientation—A belief that the most important goal of instruction is to help students "solve social problems and participate in society" (Jenkins, 2009, p. 104).

Technology—Mainly "computers and related digital tools" (Bauer, 2014, p. 5).

Technology-Based Music Class—A course where music concepts and skills are introduced, reinforced, and assessed primarily through student use of computers and related digital tools.

Statement of the Problem

Much has been written about the promise and potential of TBMC. Advocates of reform in music education support TBMC under the assumption that the classes will serve non-traditional music students (D. B. Williams, 2011), reflect a teaching and learning context more authentic to contemporary music making practices outside of schools (Kratus, 2007; D. B. Williams, 2011), and will diversify music offerings for 21st century music programs (Shuler, 2011). Few studies have directly examined the application of these ideals to classrooms in US schools. The problem under investigation in this study, therefore, is the underexplored TBMC curriculum landscape and the beliefs of music educators engaged in curriculum design.

This study was conducted during a period following a rapid increase in TBMC. Now that a critical mass of these trailblazing classes and programs have been established, research is needed to determine what curricular decisions are being made in classrooms today. Dammers (2012) compared the present state of TBMC understanding to ensemble-based music education programs approximately 100 years ago, and in doing so, articulated an urgent need for research in this area.

> Since the technology-based music-class movement appears to be in a similar place that the school band and orchestra movement was in during the 1920s and 1930s, a vigorous and challenging discussion of learning objectives and pedagogical practice is necessary during the formative stages to ensure that the establishment of a solid foundation of pedagogy will serve us well through the century. (p. 82)

Others have voiced similar concerns that TBMC scholarship, already in the third decade of the 21st century, has not had these vigorous and challenging discussions, particularly in the area of curriculum design. Savage (2017) asked and answered three questions about technology in the music classroom, expressing concern about the direction of the field.

1. Does anyone know which way we are going?
2. Does anyone know where we want to go?

3. Does it matter where we end up? My answers to these questions are (1) no, (2) no, and (3) yes. This does worry me. (p. 149)

These questions omit the prerequisite orienting question: does anyone know where we are? Contemporary and historical descriptions written by teachers themselves (Fiano, 2020; Forest, 1995; Hagemann, 1968; Modungo, 1968) and case studies (Albert, 2020; Freedman & Reeder, 2019; Giotta, 2015; Tracy, 2018) offer the primary source of data with which to answer such a question. Prior to this study, no recently published research has established an updated baseline of TBMC curricula at the national level from which to continue the vital discourse of this growing paradigm.

Need and Purpose for the Study

Considering Dammers (2012) and Savage (2017) together, one might glean that those developments in music classroom practice are best served by a unified philosophy and a set of teaching methods at least as homogeneous as can be found in ensemble-based paradigms. A desire to achieve uniformity could be one motive behind the development of content standards in education generally (Apple, 1990), and in music education specifically (Reimer, 2003). Uniformity and standardization also afford a useful shorthand within the profession. Identifying oneself as a band director in conversation sufficiently relays the general nature of one's teaching position. However, while most school ensemble directors agree on standard instrumentations, repertoire, and teaching methods, the emerging practice of technology-based music education has, to date, resisted such neat description. Savage's (2017) concern over a lack of direction is linked to the sense of futility many music educators teaching TBMC experience when they attempt to describe their teaching context to others, even fellow music teachers (D. A. Williams, 2019).

The primary purpose of this study is to better understand TBMC curricula, thus informing stakeholders including music educators, school administrators, education policymakers, and others who will influence the future of these classes. Of particular interest is the degree of uniformity within the emergent practice and whether or not music educators have adopted a single, commonly understood approach. If uniformity leads to understanding, then perhaps a common approach would help administrators and other stakeholders support TBMC. However, if uniformity leads to institutionalization, these classes could be stripped of the fundamental characteristics that motivated their creation at the outset. “Can music education cultivate,” Shevock (2017) asked, “rather than continue to extinguish, diversity?” (p. 61).

Music educators working in K–12 settings, in contrast with their colleagues teaching mathematics, science, and other regularly tested disciplines, design classes with a high degree of autonomy (Barrett, 2007b). Therefore, it is essential to understand what beliefs these individuals hold about the aims and ideal outcomes of educational experiences. In addition, scholar-advocates of TBMC have clearly stated reasons for supporting reform. This study provides an opportunity to compare calls for reform emanating from music teacher educators and researchers within higher education institutions to the philosophical perspectives of practitioners making decisions for and with students in classrooms. Rather than continue a real or perceived divide between theory and practice, I hope the findings of this study offer an opportunity to build connections and strengthen the TBMC community at every level.

In addition to a teacher’s personal beliefs about curriculum, some may be designing classes in response to content standards. Prior to this study, the degree to which music teachers referenced content standards during TBMC curriculum work was unknown. Some music teachers may not reference standards at all, but rather rely on what Dorfman (2019) identified as the "instinctive behaviors" (p. 829) to which music teachers are accustomed, particularly in the area of assessment. Other music teachers may reference standards, but as a post hoc maneuver to satisfy teacher evaluation programs.

An investigation of content standards related to TBMC curriculum work is also tied to the previously mentioned issue of uniformity, understandability, and the extinguishment of diversity within music education classroom practice. A compromise may be found in what Richerme (2016) called "standards without standardization" (p. 92), or the process in which educators adopt rigorous and commonly understood standards without compromising on unique school-specific characteristics that lead to meaningful outcomes for students. Research studies such as the one reported in this dissertation are needed, not to encourage a standardization of practice, but rather to provide information, insight, inspiration, and the basis for a commonly understood vocabulary that can support discourse in this innovative practice. Stated as succinctly as possible, the purpose of this study was to identify the features of TBMC curricula and to explore the internal and external forces that guide curricular decisions.

Research Questions

This study was designed to illuminate the TBMC curricular landscape, teacher curriculum orientations, and the use of content standards to support an ongoing discourse during the formative stages of a transformational stage in US school music education. Therefore, this study was guided by the following research questions:

1. What are the features of technology-based music class (TBMC) curricula?
2. What are music educators' orientations toward TBMC curricula?
3. How do TBMC curricula align with professional music education standards?

These questions were developed and refined through consultation with experts familiar with research practices in music education technology. Each question was addressed using data gathered from a researcher designed instrument: the Music Technology Curriculum Inventory (MTCI). The next section describes the curriculum orientations framework as it was utilized in this study.

Theoretical Framework

The use of theoretical frameworks in music education research can help "to define terms and constructs, suggesting relationships and interactions among variables, delimiting phenomena, and clarifying research questions/hypotheses" (Miksza & Johnson, 2012, p. 19), thus improving the quality of a study. Certain aspects of the design and analysis of this study were framed within the curriculum orientations model first developed by Eisner and Vallance in 1974. Given the relative novelty of technology-based music instruction in schools and the limited number of research projects concerned with understanding the phenomenon, the use of this framework provides a foundation for a discussion of enacted curricular features compared to the stated aims of the profession.

The curriculum orientations framework assumes that teachers hold beliefs "about how the school curriculum *should* be designed" [emphasis added] (Cheung & Wong, 2002, p. 226), and that those beliefs influence curriculum design. Cheung and Wong (2002) developed a survey to investigate the construct validity of five curriculum orientations. Levels of agreement with academic rationalism, cognitive process, social reconstruction, humanistic, and behavioral orientations were investigated using a researcher designed instrument. The findings of their study and the definitions of each orientation are described in detail in Chapter 2. The curriculum orientations model was subject to further psychometric work by Jenkins (2009), who modified the instrument to investigate the orientations of US teachers. A shortened version of Jenkins' survey was used in this study as the basis of a new instrument designed to address the specific context of technology-based music classroom curriculum.

Method

According to Miksza and Elpus (2018), "the importance and value of descriptive research lies in the necessity of having a clear enough understanding of a phenomenon of interest to aid in theorizing about it" (p. 17). The phenomena of interest in this study are curriculum orientations of US secondary school music educators and the curriculum design characteristics of the TBMC they teach. Given the current early stage of the "technology-based music class movement" and the need for a "challenging discussion of learning objectives and pedagogical practice" (Dammers, 2012, p. 82), a descriptive survey-based design best addresses the research questions and illuminates future research and practice.

Data were collected using a researcher designed survey based on Jenkins' (2009) modified-Curriculum Orientations Inventory and Dammers' (2012) TBMC Teacher Survey. Both researchers have granted permission for their work to be included in this project. Jenkins' original survey contained 36 statements, each of which described one of six curricular orientations. Three items per construct were used in this study to shorten the survey and reduce participant fatigue. The second section of the instrument, based on Dammers' Teacher Survey, remained relatively unchanged with the exception of updating software and hardware items and the addition of items that address music content standards. A complete account of the study design, including how the previously mentioned changes were checked for validity and reliability, can be found in Chapter 3.

A draft of the Music Technology Curriculum Inventory (MTCI) was sent to three experts in music technology and educational research methods and subject to a pilot test. Improvements suggested at these stages were implemented in the final draft. Participants were recruited through the National Association for Music Education (NAfME) research service, relevant social media groups, and snowball sampling to reach the highest number of potential participants as possible.

Results from the MTCI (N = 69 complete and eligible surveys) were imported into *R Studio*, a statistics analysis software package, and Excel for analysis. Due to the non-experimental nature of the study, reporting consists of primarily descriptive statistics and frequency counts of low-inference open-response items. Chapter 3 of this dissertation includes an account of the steps taken during the planning, design, recruitment, data collection, and analysis phases. Chapters 4 and 5 include a detailed report of results and a discussion of those results for each research question.

Limitations and Delimitations

Participation in this study was limited to music educators teaching TBMC in United States secondary public and private schools. That grade range is based on previous research on non-traditional music students who might enroll in TBMC (D. B. Williams, 2011) and two large scale studies of music course offerings at US middle and high schools (Elpus, 2017; Elpus & Abril, 2011). Music educators teaching outside the United States are not accountable to the music content standards of NAfME, Technology in Music Education (TI:ME), or any state department of education and were excluded. Furthermore, Jenkins (2009) compared the curriculum orientations of teachers from two countries and concluded that “cultural and historical differences in the development and maturation of the educational systems in the United States and Hong Kong” (p. 117) likely produce different curriculum orientations. Music technology classes are an international phenomenon; however the forces that influence curriculum orientations, education policy and funding, and content standards still observe national borders.

Much of the previous research on TBMC has utilized qualitative methodologies often studying a single case or a small number of cases (Dammers, 2010; Giotta, 2015; Minott, 2015; Tracy, 2018). The research questions in this study, by contrast, were best answered through a quantitative approach that includes, ideally, all possible participants at the national level. A study focused on the curriculum design of a single teacher could help readers understand a great deal about even the most minute details ranging from the format of assessments to the interactions between classroom design and curriculum. Such a study, though, would not capture the current state of this emerging practice from enough sources to approach generalizability. This study was necessarily situated closer to generality than specificity, resulting in the central limitation that the data will not allow for conclusions about the daily experience of any specific TBMC, classroom, students, or instructors.

A final set of concerns, not just for this study but research in all areas of education, are the ongoing medium to long-term effects of the COVID-19 pandemic on schools. The design, pilot, and data collection phases of this study mainly took place during the unprecedented disruption to the normal operation of classrooms. The effects of these changes on every aspect of curriculum are likely numerous, and the challenges posed by remote learning, social distancing, and other factors probably weighed heavily in the minds of many participants. That said, care was taken to ensure that survey items address an “average year,” or “typical” experience. In some cases, participants were instructed to consider a time before or hypothetical time after these disruptions when responding.

Summary

Music educators are designing and facilitating classes in which student learning and musical expression occurs primarily through technology. These classes represent an important and ongoing development in a profession that believes in access to high-quality music instruction for all students. A better understanding of these classes as they exist now, and the beliefs of teachers designing TBMC, will help all stakeholders to support and improve music programs. This dissertation describes a research project that investigated the curriculum decisions and orientations of music teachers designing those classes at the national level using data collected from an online survey. Echoing Savage's (2017) questions, perhaps this dissertation can serve as a guidepost for future scholarship by answering: *where are we now?*

Chapter 2 includes a review of literature which addresses technology in education, technology in music classrooms, the advantages and disadvantages of technology in music classrooms, curriculum orientations, and published curriculum materials. Chapter 3 describes the design of this study including the formation and validation of the instrument, sampling, and data collection and analysis procedures. Chapter 4 contains a detailed written description of findings accompanied by tables and visual representations of the data. Chapter 5 includes a discussion of each research question, comparisons between this study, and findings from similar previous research, and implications for the future of technology-based music education.

CHAPTER II

REVIEW OF RELATED LITERATURE

Overview

The purpose of this chapter is to review extant scholarship related to technology-based music class (TBMC) curricula. Phelps et al. (2005) stated that literature reviews are necessary in music education research studies to "(1) avoid duplication of efforts . . .; (2) delimit the research; (3) determine what areas need further investigation; and (4) discover new approaches, methods, or insights into a problem" (p. 68). To those ends, this chapter is organized according to the major components of the phenomena under investigation: music technology, music classes organized in consideration of music technology, and the curricula of those classes.

The review begins with scholarship on general technology use in music classrooms as a place of introduction to the specific phenomenon of technology-based music classes. That section includes a discussion of the history of music technology classes in the United States leading to present descriptions that serve as the setting for this study. Additional context for a later exploration of curriculum orientations is provided in two sections addressing the motivations for creating such classes and the concerns some have over their creation and implementation.

The second focus area of the literature review includes scholarship on curriculum in music education, including the autonomy afforded to most music educators when making curriculum decisions, a review of curriculum orientations, and a discussion of education standards related to technology-based music teaching. The third focus area consists of a review of published TBMC curriculum materials and the social media based peer networks where curriculum is regularly discussed and curricula frequently shared.

Technology and Music Education

Advances in technology have been adopted by music educators throughout the history of US school music education. Mass production and engraving technologies allowed early music educators to make use of published songbooks in the 19th century (Mark & Gary, 2007). Lowell Mason enthusiastically recommended the installation of large chalkboards in new music classrooms, and in 1899, the newly patented Adjustable Blackboard Liner enabled teachers to move from "exclusively rote methods to strategies that combined aspects of visual and aural learning" (Karpf, 2012, p. 73). King and Himonides (2016) noted that "technological innovation in music has a long tradition in the historical development of musical instruments (the development of valves for brass instruments is one of the obvious examples)" (p. 1).

Technological advances continued into the first half of the 20th century, as did their adoption by music educators. Perhaps the most significant innovation of that time was the development of inexpensive and reliable audio playback technology. Initially, general music teachers used phonographs and radio to facilitate a shift from "a nearly exclusive focus on sight singing to a mixed approach that included listening and performing, vocally and with newly available toy instruments" (Humphries, 2012). Record players also supported an emerging approach to music education, promoted chiefly by Carl Seashore, which emphasized standardization and the quantitative assessment of musical achievement (Bennett, 2012).

The development of magnetic tape allowed music educators to record within their own classes, not only the voice and traditional instruments, but newly available electronic instruments. Commercially available synthesizers, while complex by today's standards, were within financial and technical reach of music teachers by the 1960s (Holmes, 2014). In 1968, *Music Educators Journal* published a special issue on electronic music which detailed developments across a number of fields including recording, electronic synthesis, and amplification (Gary, 1968). That issue featured two accounts from teachers who founded courses in “electronic composition,” courses that can be considered direct predecessors to those under investigation in this dissertation and are discussed in detail in the following section (Hagemann, 1968; Modungo, 1968).

The broadest interpretation and definitions of technology present challenges to researchers, and greatly complicates the objectives of this study. Bauer (2014) stated that, “a pencil is technology, as are automobiles, the lighting and heating systems in our homes, food processors, and myriads of other devices that are part of our daily lives” (p. 5). Viewed this way, every object in a music classroom, even the classroom itself, could represent a technological advance in one form or another. However, most practitioners and scholars now interpret technology to mean electronic, digital, or computer-based devices with origins in the late 20th century. King and Himonides (2016) concisely articulated this interpretation as, “a contemporary view of [music technology] in music-making is centralised around the microprocessor” (p. 1). The National Association for Music Education (NAfME) similarly defines music technology as “the application of technology, such as computers and software, to the creation and performance of music” (Swain, 2017).

The specific uses of technology, with this delimited definition, what Bauer (2014) described as “computers and related digital tools” (p. 5), has been the central subject of recent literature. According to Hitchcock (2017), music educators not only bring technology into their classrooms, they carefully consider its use in in four categories: education, administrative, social, and music technologies. Educational technologies are used to facilitate the “learning and assessment” processes and can include online quizzes, discussion boards, and learning management systems (p. 657). Administrative technologies are deployed to manage “people, circumstances, and resources” (p. 657) necessary for the support of classes and programs and can include financial software and student administration portals. Social technologies enable social interactions, often but not necessarily in real-time. Blogs, social networks, and video conferencing software are examples of social technologies. Lastly, music technologies include any technology used “in the creation of music that requires electricity to operate” (p. 657). Hitchcock added that hardware and software for music engraving, audio capture and manipulation, sound design and synthesis, and performance using electronic technologies could be considered as further subcategories within music technology.

Some music educators would come to see the potential of digital technology not only for educational, administrative, social, or musical uses in their own hands, but as powerful tools in the hands of their students. Dorfman (2022) explained how music educators progress from personal familiarity to the facilitation of student use in a “topography of technology integration” (p. 5) model. According to Dorfman, a music educator’s personal technological journey necessarily begins when that individual chooses to enter the “technical basin,” where “teachers learn to use available technologies and when they acquire fluency with those technologies” (p. 5). At the “practical plane,” teachers apply their knowledge of technology in service of administrative tasks such as preparing lessons or generating worksheets. The practical plane and technical basin are both characterized by teacher-centered uses. Ultimately, technology use shifts when teachers design experiences in which students engage with the tools as a means to learn and practice musical concepts and skills at the “pedagogical summit,” the “most sophisticated level of educational technology” (p. 7).

Recognizing the value of technology in the hands of students, many school systems have adopted a one-to-one approach in which every student in a particular grade or an entire school building is issued a laptop, tablet, or similar mobile computing device (Gunner, 2007). These initiatives promise "no more waiting for the computer lab or the computer stations in the classroom" (Gunner, 2007, p. 3), and have greatly increased the potential of student technology use in the music classroom. McCready (2019) investigated the experience of a middle school music teacher shortly after that teacher's school adopted a one-to-one initiative. Using participant interviews, class observations, and artifact collection in a single case study design, the researcher concluded that, overall, the "program has enhanced [the participant's] teaching approaches and has expanded curricular possibilities within the music program" (p. v).

Dorfman (2016) also investigated one-to-one initiatives, conducting a four-case study utilizing the concerns-based adoption model. Participants in Dorfman's study experienced benefits with one-to-one devices, such as digital sheet music distribution. However, participants also articulated a frustration with their district's administration and technology support of the devices as well as a lack planning time to integrate the new tool into classroom instruction (p. 172). In both of their studies, Dorfman and McCready identified Chromebooks, a portable computer heavily dependent on the internet and web-based applications, as the specific device purchased for one-to one initiatives.

Dorfman's (2022) previously mentioned topography of technology integration model described how teachers and their students interact with technology for various purposes. At the pedagogical summit, teachers "design experiences in which students engage directly in activities with hardware and software" (p. 6). Hitchcock (2017) similarly sorted technologies based on use, but in a manner that suggested how certain characteristics inherent within each technology lend themselves more strongly to one or more use categories. It is at the nexus of Dorfman's pedagogical summit and Hitchcock's music technologies where one can find an opportunity for a new form of music class. Much in the same way that band, wind ensemble, concert band, symphonic winds, and other permutations describe a commonly understood curricular music experience, new classes with names such as audio recording, music production, electronic music, songwriting, and digital music are emerging as instructional paradigms in which students listen, perform, compose, remix, record, and share music on and through technology. The next section includes descriptions of such classes found in the literature.

The Phenomenon of Technology-Based Music Classes

Accounts of what "may very well have been the first public school music technology classes in the country, if not the world" (Freedman, 2017, p. 367) were published in a special issue of *Music Educators Journal* in 1968 covering electronic music in the classroom (Gary, 1968). Narratives by founding instructors Ann Modungo and Virginia Hagemann, working in separate schools in separate states, described new technology classes at a senior high school and a junior high school. Modungo (1968) detailed "electronic music" (p. 87) classes at Greenwich High School in Greenwich, Connecticut. Students used a variety of equipment in weekly class meetings including "sine- or square-wave generators" (p. 89) and effects including reverb or tape speed change. Even in the first year, Modungo described how classes had a substantial influence within the school.

> Students in the humanities and physics classes discussed electronic music and utilized it in their final projects; the drama coach requested electronic music to enhance a production of Orwell's Animal Farm; students participating in the film festival, sponsored by the art department, found that electronic music intensified the visual effects. From the music department, six original electronic compositions were selected and performed in a program along with original traditional compositions. A light show accompanied the electronic compositions and added another emotional dimension. (p. 90)

Modungo stated that the "principal objective" of electronic music classes at Greenwich High School "is to develop creativity through a contemporary medium" (p. 87).

Virginia Hagemann (1968) founded a similar program in 1967 by securing a grant for "$316 from the superintendent of schools to establish an electronic music laboratory" (p. 86). Students at the Masterman School in Philadelphia, Pennsylvania, were scheduled for one period each week, but the laboratory was in operation "five days a week, sometimes until 4:30 P.M., although the actual working time is dependent on the regularly scheduled music activities, which vary from day to day" (p. 86). Enrollment in the laboratory class was limited to students who "(a) play an instrument, (b) indicate an interest in music composition, and (c) express a serious desire to explore the realm of electronic music and to learn the techniques involved in writing for this medium" (p. 86). In addition to the scheduled class meeting, students could use the laboratory when it was "convenient for them to be excused from other classes" (p. 88) Hagemann's students took an interest in pursuing state of the art technology, including building their own instruments and seeking assistance from pioneers in electronic music.

> William Serad, age thirteen, submitted a technical report, complete with schematic diagrams, on the possibility of using an analog computer for writing electronic music. William thought that his computer would be useful in the writing of such compositions as "Study in Square Roots" or "Cube Root Canon." His report was later discussed with Robert A. Moog, president of the R. A. Moog Company, Trumansburg, New York, manufactures of electronic equipment, who agreed that this idea was feasible. With his encouragement, William constructed a four-sound, push-button switch, serial sequencer, which he used in writing an electronic canon. He has since made a working model of a tri-amplitude mixer module. (p. 90)

Accounts from both Modungo and Hagemann described learning environments that fit Hitchcock's (2017) definition of music technologies and Dorfman's (2022) pedagogical summit and are therefore excellent examples of pioneering TBMC. Stated another way, electronic music classes at Greenwich High School and Masterman School are examples of TBMC because both emphasized student composition in a class setting that required the use of specialized music technology. In addition to being pioneering programs, these two accounts are also noteworthy due to their differing approaches to enrollment, scheduling, and other considerations. Later music educators would find themselves similarly challenged with decisions relating to lesson design, assessment, funding, scheduling, prerequisites, and other aspects of curriculum.

Moving to the Present

A key difference between the pioneering electronic music programs of the mid-1960s and the TBMC of today has been the development of the personal computer. Webster (2002) organized the past 500 years of music technology into five phases. Hagemann and Modungo's classes began in what Webster defined as Phase 4. Table 1 includes the names, dates, and defining characteristics of each historical phase. *Phase 4: Transistors* began in the mid-1950s and was characterized by the "development of the transistor and the semiconductor" (p. 40). A number of technologies were developed in this period, including many mentioned specifically by Hagemann and Modungo. Webster, like Freedman (2017), identified this time period as the beginning of technology-based music classes (p. 40).

Phase 4 ended and Phase 5 began in the late 1970s when the invention of integrated circuits enabled "the growth of small, but powerful, personal computer systems" (p. 41). Webster (2002) detailed improvements to the musical capabilities in computers and also reminded readers of the importance of the MIDI (Musical Instrument Digital Interface) protocol developed in the early years of Phase 5 and still in widespread use today.

Table 1

Phases of Music Technology Development According to Webster (2002)

Phase Number and Name	Start and End Dates	Characteristic Developments
1—Gears and Levers	1600s to mid-1800s	Music boxes, player pianos, calliopes, and other music machines that used pneumatic and spring-driven power (p. 39)
2—Electricity	mid-1800s to early 1900s	The addition of electrical power to instruments and the first mass communication technologies (e.g., telephone and telegraph) (p. 40)
3—The Vacuum Tube	early 1900s to mid-1950s	Phonographs, tape recorders, jukeboxes, and electronic instruments such as the Hammond Organ, Theremin, and Ondes Martenot (p. 40)
4—Transistors	Mid-1950s to late 1970s	Facilitated the reduction in computer size from mainframes to smaller minicomputers. Inexpensive sound synthesis now possible (p. 40)
5—Integrated Circuits	late 1970s to the present	Significant reductions in cost and gains in computing power. Software now as important a consideration as hardware (p. 41)

A case could be made that a sixth phase began sometime in the early 21st century with the development and adoption of mobile computing platforms and social media services; however neither Webster (2002) nor other scholars have updated the timeline since its publication. According to Webster, the common characteristic of innovative music education practice in Phases 4 and 5 is an emphasis on teaching philosophy and curricula.

> In the last ten years, music educators have used technology in a more "constructivist" context. Students are encouraged to "construct" their understandings of music through their experiments while being expertly guided by teachers… With today's affordable personal computers, even the youngest children can play along with the computer, make increasingly complex decisions about the composition of the music, or listen to music in new and exciting ways. It is not just the multiple media that are significant, but their use in allowing children to think and feel musically. (p. 43)

It is important to note that although the development of personal computers has been appreciable in terms of speed, reliability, cost, and other factors, the fundamental use of computers as tools to "allow children to think and feel musically" (p. 43) has remained the central pedagogical consideration from the beginning of Phase 5 to today. One should also note that the students and children to whom Webster (2002) was referring were not always actual, formally or informally observed children in real classrooms. Rather, hypothetical classrooms and students are frequently used in an aspirational discourse that makes up much of the literature on technology-based music classes. Descriptions of technology-based music classes in the literature, often referred to as music technology classes, computer-based technology classes, or other permutations, can be organized into two categories: theoretical and actual. A later section includes definitions and examples from the literature in both categories. The following section includes an overview of music educator demographics across K-12 specializations.

Demographics and Music Educator Profiles

According to the most recently published data from the National Center for Education Statistics (NCES, 2022), approximately 3.5 million teachers work in US public schools. Roughly 1.8 million work in secondary schools, which corresponds to the grade levels most representative of the teachers participating in this study. NCES reported that 64% of secondary teachers are female and 36% are male. Of all K–12 teachers, 1% reported their race as American Indian/Alaska Native, 2% Asian, 7% Black, 9% Hispanic, 79% White, and 2% two or more races. Approximately 37% are in their first decade of teaching, 40% in their second, and 23% in their third.

Disaggregated demographics for music educators are not provided by NCES. However, Elpus (2015) obtained demographic data for 20,521 pre-service music educators who took the Praxis II music licensure exam between 2008 and 2012. That exam is the most common test among states requiring an exam to enter the profession. Elpus found that 56% of candidates reported their gender as female and 44% as male. Less than one percent reported their race as Native American, Alaska Native, or Multiracial, 2% self-identified as Asian, 7% Black, 2% Hispanic, and 86% White. Since this dataset was drawn from preservice teachers, years of experience were not provided. After comparing exam candidate demographics with the best available national level data, Elpus concluded that

> Music teacher licensure candidates are not representative of the population of American adults, not representative of the population of currently working public school music teachers in the United States, not representative of the population of U.S. undergraduate students, and not representative of the pool of high school graduates who had persisted in music through the entirety of their high school careers. (p. 329)

Prior to this study, the demographics of TBMC teachers was unknown. Theoretical work on technology, culture, and gender representation suggests that the population of TBMC teachers will include more male teachers than the general music teacher population. Armstrong (2011) noted,

> Traditionally, music, and particularly some realms of music performance, was viewed as a feminine domain, although composition is historically associated with masculinity. Consequently, with the introduction of technology, also traditionally perceived as a masculine domain, another layer of symbolic masculinity is added to an already gendered music classroom, where teachers perceive boys as having greater "natural" ability for both technology and composition. (p. 7)

One of the most important interventions to address this issue is, according to Armstrong, fairly easy to implement. Teachers of TBMC should turn to their communities and identify role models reflective of the diversity beyond the classroom walls who, by working with students, can help dismantle "masculine connotations of computers and music software" (p. 134). Literature on gender and technology in the music classroom, including the perspectives of students, will be explored in a later section.

Elpus (2015) noted a lower licensure exam pass rate for female and racial minority preservice music teachers. While the root cause of those disparities is unknown, and should be researched, one immediate intervention proposed by the author is targeted support and exam preparation, including review sessions lead by music teacher educators. More research is needed at the broadest general education level, in music education, and in technology-based music education to understand the causes of demographic disparities where they occur. The present study included demographic items, the results of which will be compared to statistics from this section in chapter five. The following section includes summaries of literature describing proposed and enacted TBMC classes.

Descriptions of Technology-Based Music Classes

The first category of literature includes descriptions of proposed classes from a hypothetical, theoretical, or generalized point of view (Bissell, 1998; Dorfman, 2022; Kassner, 1998; Reese & Davis, 1998; Ruthmann, 2012; Seawright, 1968; Walzer, 2016; Watson, 2011; D. A. Williams, 2019). The second category includes descriptions of specific, existent classes written by researchers or by the teachers themselves (Albert, 2020; Fiano, 2020; Forest, 1995; Freedman & Reeder, 2019; Giotta, 2015; Hagemann, 1968; Modungo, 1968; Tracy, 2018; D. B. Williams & Dammers, n.d.). Tables 2 and 3 summarize the settings, hardware used, software used, and representative student assignments or projects for each publication, with Table 2 addressing proposed classes and Table 3 addressing observed or teacher described classes. The literature included in these two sections is representee, not exhaustive. The small sample of publications included in this literature review were chosen due to their being frequently cited across TBMC literature and to be representative of a variety of publication types including scholarly and trade journals, books, and dissertations.

Table 2

Characteristics of Proposed TBMC in Selected Music Education Literature

Study	Setting	Hardware	Software	Student Work
Seawright (1968)	None Specified	Signal generators, filters, mixer, recording device	None specified	Composing and recording electronic music
Bissell (1998)	Grades K-8	Computer, portable battery-powered keyboards	Band-in-a-Box, MiBAC Jazz	Explore sounds, improvise, record performances, compose and notate music, arrange music
Kassner (1998)	Grades K-8	Computer, MIDI controller	None specified	Composing
Reese & Davis (1998)	Middle or high school computer lab	Computer, MIDI enabled sound card or interface, 5-octave keyboard controller, headphones	Cakewalk, Band-in-a-Box, Sound Forge, MiBAC Jazz	Composing, theory exercises, keyboard proficiency, practice with automated accompaniment
Watson (2011)	K–12 elective music class	Computer, recording equipment, MIDI controller	GarageBand, Pro Tools, Cubase, SONAR, Digital Performer, Logic	Podcasts, arrangements, improvisation, composing
Ruthmann (2012)	Middle school	Computer, iPad, mobile phone	Noteflight, Audacity, Mixcraft, GarageBand	Music videos, remixing, composing
Walzer (2016)	Middle or high school computer lab	Computer, keyboard controller, tablet or laptop	Audacity, GarageBand, Pro Tools, Logic, Cubase	Composing, template-based projects, sound design
D.A. Williams (2019)	K–12 assumed	Computer, recording equipment, MIDI keyboard	None Specified	Produce a commercial, compose, remix
Dorfman (2022)	K–12	Computer, MIDI keyboard, audio interface, recording equipment	GarageBand, Logic, Pro Tools, Mixcraft, Acid, Finale, Ableton Live, Noteflight, Sibelius Protools, Audacity, Band-in-a-Box, MusicFirst, Soundtrap	Composing, arranging, remixing, improvising, critical listening

Note. Web services such as YouTube and social media platforms were not included in the Software column due to their general availability to all students and teachers using internet equipped devices. Reese & Davis (1998) listed 27 software titles in their article, many of which are no longer available. For the purposes of this study, only active, commercially available titles are listed here.

Table 3

Characteristics of Enacted TBMC in Selected Music Education Literature

Study	Setting	Hardware	Software	Student Work
Hagemann (1968)	Junior high school	Signal generators, filters, mixer, recording device	None specified	Composing, recording electronic music, building music equipment
Modungo, (1968)	High school	Signal generators, filters, recording device	None Specified	Composing accompaniment for stage production, composing music, notating electronic music
Forest (1995)	Elementary curricular and after-school clubs	Computer, MIDI controller, headphones	Piano Partner, Music Time	Composing, notation literacy, active listening
Giotta (2015)	High school	Computer, MIDI controller, headphones, microphone	Ableton Live	Composing, study history of electronic music, record audio
Tracy (2018)	High school	Computer, recording equipment, MIDI controller, Makey	GarageBand, Logic, Ableton Live, Audacity	Composing, sound recording, electronic instrument building
Freedman & Reeder (2019)	High school	Computer, MIDI Controller	Not Specified	Composing
Albert (2020)	8th grade music technology class	Laptop, Chromebook	Mixcraft, Soundation, GarageBand	Composing
Fiano (2020)	Middle school composition club	iPad, Chromebook, headphones	GarageBand, Google Music Lab, Beepbox	Composing, study history of electronic music

Note. Web services such as YouTube and social media platforms were not included in the Software column due to their general availability to all students and teachers using internet equipped devices.

Technology-based music classes have been proposed and outlined for all K–12 grade levels. Bissell (1998) and Kassner (1998) described developmentally appropriate technology experiences for elementary school students. Both authors emphasized the role of computer-assisted composition, with Bissell also mentioning the many possibilities surrounding experimentation with the "properties of musical sound" (p. 37) and technology-assisted improvisation on classroom instruments. However, most proposed classes would take place at the middle or high school level.

Over 30 software titles are recommended by authors to teachers of middle and high school TBMC. Many of the recommendations come from Reese and Davis (1998), and having been written over 20 years ago, are no longer supported through software updates or are commercially available for purchase. Currently available titles mentioned across this set of literature include GarageBand, Audacity, Pro Tools, Logic, Cubase, Noteflight, Mixcraft, Acid, Cakewalk, and SONAR, with GarageBand being the most often recommended title.

Nearly all authors assumed the use of a computer. With the exception of Seawright (1968), the classes proposed in this set of publications were designed during Webster's (2002) fifth phase of music technology. That era, beginning approximately in the late 1970s and continuing to the present, is marked by steady improvement to personal computers and the software. Other hardware mentioned included keyboards, either standalone battery-powered models (Bissell, 1998) or MIDI enabled keyboard controllers that work in conjunction with a computer (Dorfman, 2022; Kassner, 1998; Reese & Davis, 1998; Ruthmann, 2012; Walzer, 2016; Watson, 2011; D. A. Williams, 2019). Four authors also mentioned recording equipment (Dorfman, 2022; Seawright, 1968; Watson, 2011; D. A. Williams, 2019), a category that includes microphones, mixers, digital audio converters, and similar devices.

A variety of class projects and assignments were described, but all authors stated or implied that the primary experience of the class would be musical composition and the primary purpose of the class would be to develop students' skills as composers. Assignments, activities, or projects organized around sound recording were also mentioned (Bissell, 1998; Seawright, 1968; Watson, 2011; D. A. Williams, 2019).

The curricular aims and examples of student assignments as well as the hardware and software needed varies in proposed TBMC literature. The most important factor influencing curriculum appears to be the grade level of the class. Improvising and playing with accompaniment were mentioned, for example in Bissell (1998) and Reese and Davis (1998). However, the teachers of elementary students in those proposed scenarios may include instrumental and vocal experiences alongside technology in what could be described as a technology-assisted elementary general music class.

Now that many music educators have designed and taught TBMC in schools, descriptions of those courses are being published in academic and trade journals, books, master's theses, and doctoral dissertations. These accounts of enacted classes comprise the second category of research and are the focus of the remainder of this section. Some descriptions were written by the teachers themselves (Fiano, 2020; Forest, 1995; Hagemann, 1968; Modungo, 1968), while others were written based on the observations of others (Albert, 2020; Freedman & Reeder, 2019; Giotta, 2015; Tracy, 2018). A summary of the characteristics of these classes can be found in Table 3.

These publications share many similarities in setting, hardware, software, and student work with the proposed TBMC literature. Most teachers described courses at the middle or high school level. Forest (1995) detailed music technology experiences at Ortega Elementary School. The school, where the author served as music teacher, used music technology to facilitate after school music clubs and technology-facilitated "experiential music centers" (p. 36) during general music classes.

Reflecting both the proposed TBMC literature and Webster's (2002) Phase 5 emphasis, computers are the primary piece of hardware in all accounts published after the late 1970s.

Albert (2020) and Fiano (2020) mentioned their use of Chromebooks for student assignments. As discussed in the previous section, many school systems have purchased these inexpensive portable computers for the entire population during one-to-one initiatives. While the Chromebook may be adequate for some uses, Fiano stated they, “did not have enough processing power” (pp. 27-28) and supplemented their use with iPads. Similarly, Albert (2020) augmented Chromebooks with “HP laptops” (p. 386). Forest (1995), Giotta (2015), Tracy (2018), and Freedman and Reeder (2019) also included MIDI keyboard controllers as a necessary piece of hardware.

GarageBand was the most frequently mentioned software, as it was in the proposed course literature. However, Ableton Live was mentioned by Giotta (2015) and Tracy (2015) and does not appear in the proposed literature. Authors of proposed TBMC may exclude Ableton Live due to its cost. Unlike GarageBand, which is included with ownership of an Apple device, a single seat of Ableton Live can range from $79 to $599 depending on the desired features and capabilities (Ableton Live, n.d.). Other software titles in use included Audacity (Tracy, 2018), Beepbox (Fiano, 2020), Google Music Lab (Fiano, 2020), Logic (Tracy, 2018), Mixcraft (Albert, 2020), Music Time (Forest, 1995), Piano Partner (Forest, 1995), and Soundation (Albert, 2020).

All authors indicated that composition was the primary goal of the TBMC, again reflecting the proposed class literature. Fiano (2020) described the experience of starting a middle school music technology and composition club. Among the many challenges was developing curriculum. Fiano stated that “software specific” (p. 48) and “activity based” (p. 48) lessons made the experience function “more in the style of a manual than a unit” (p. 48), and that generalized composition lessons were preferable. For Fiano, hardware and software should serve the musical goals of the course, not function as the goal themselves. Giotta (2015) reported a similar attitude in an observation of a student struggling with learning new software.

> Throughout Natalie's experiences working with Ableton Live, she ran into several obstacles related to her familiarity with the software. Natalie recalled an incident in which she thought that she saved her project file, but she used the incorrect save feature resulting in the loss of her video from the project . . . When asked about her process for solving problems like this, Natalie responded, "Sometimes I don't know how to undo something in Ableton, so I just forget about what I'm doing and I come up with a brand new idea." (p. 68)

Descriptions of TBMC in the literature are written from two perspectives. One perspective, summarized in Table 2, is written as a proposal for classes yet to be developed. These pieces, usually published in trade journals or as books, suggest readily adoptable classes in settings most music teachers would recognize. The other perspective, summarized in Table 3, recounts the actual experiences of students and teachers in their own voice or through the interpretation of a researcher. When viewed together, literature from both perspectives elucidates a generalized technology-based music class: students, usually in middle or high school, composing original music with specialized software on computers. Descriptions of these classes are becoming more frequent in the literature; however, very few studies have investigated the phenomenon at the national level.

Dammers (2012) conducted one of the only published studies with the goal of determining number of TBMC in the United States and the nature of such classes. Data were collected in two phases. The first phase included a survey of randomly selected public high school principals which asked, mainly, about music offerings in their schools. According to principals, 14% of their schools offered TBMC. Dammers estimated that approximately 2,500 total public high schools offered at least one TBMC, noting that most of those classes were formed within the five years preceding data collection.

Data for the second phase were gathered through a separate survey of the TBMC teachers themselves. Participant recruitment was facilitated by principals who were instructed to forward the survey to teachers. Unfortunately, this recruitment strategy generated a low number of completed teacher surveys. Of 1,830 principals initially contacted, 528 responded. Those 528 identified and forwarded the survey to 58 music educators. Only 29 music educators completed the teacher survey. Nevertheless, the results of Dammers' study (2012) provide valuable information from an early stage in the development of TBMC. The teacher survey was used with modification in the study reported in this dissertation. The procedures and rationale are discussed in the next chapter.

Dammers asked teachers for information in several categories related to TBMC, the students, and demographic items. When asked about the curricular nature of their classes, teachers said that creating, listening, performing, and vocational skills (recording) were important or very important. Of six music genres, rock was the most frequently represented in class. Enrolled students generally did not participate in other traditional music offerings, and most teachers (68%) strongly agreed with the statement "reaching nontraditional music students . . . is an important consideration in the planning and execution of your technology-based music class" (p. 79). Most respondents identified as male and most were in their third decade of teaching.

The teacher survey also asked participants to report on the computer software and hardware in their classrooms. TBMC were taught in dedicated classrooms (36%), shared spaces with band, choir, or orchestra (23%), or a shared non-music class (32%). Most labs included Macintosh computers and students used GarageBand (77%) as their primary software application. Additionally, most classes were outfitted with MIDI controllers (86%), microphones (73%), and LCD projectors (59%).

This section included literature which describes the curriculum and design considerations of TBMC from several perspectives. The following two sections of this literature review discuss some of the proposed benefits of TBMC and some concerns voiced over their implementation.

The Promise of Technology-Based Music Classes

Benefits of the use of music technology in classrooms have been described in a wide variety of domains including notational literacy (Willett & Netusil, 1989), collaborative learning (King, 2008), self-assessment of performance (Silveira & Gavin, 2016), improvisation (Addessi et al., 2017; Seddon & Biasutti, 2010), assistive technology for students with disabilities (Cano & Sanchez-Iborra, 2015), aural recognition of music concepts (Hopkins, 2002), and instrumental technique development (Orman, 1998). In addition to these direct musical benefits, TBMC have also been identified as a way to address a perennial problem of student nonparticipation in elective music offerings.

Participation rates have been a concern within the music education profession for at least a century. Heidingsfelder (2014) conducted a review of literature on the history of the longtime National Association for Music Education slogan "music for every child; every child for music" (p. 47). This phrase, with some permutation, has been used throughout the 20th and 21st centuries as a call to arms to strive toward the highest ideal of the profession, specifically, universal access to instruction provided by expert musician-teachers. Heidingsfelder found evidence of the phrase at various historical moments and inflection points for the profession and the nation including World War II, the Civil Rights Act of 1964, the passage of The Education for All Handicapped Children Act in 1975, and the Vision 2020 symposium. Low public school music class participation rates at the beginning of the 21st century led Kratus (2007) to wonder if the profession was indeed at a tipping point, on the brink of collapse due to a lack of public support.

D. B. Williams (2011) used data from eight studies spanning nearly 30 years to estimate that approximately 20% of US secondary school students participate in traditional elective music ensemble courses. That figure prompted Williams to inquire about "the other 80%," a coinage that appears frequently in the TBMC advocacy literature. According to Williams, these non-traditional music students (NTMs) can be characterized as follows:

1. Are in the sixth through twelfth grades (middle and high school in the United States or Levels 2 and 3 using the UNESCO standards)
2. Do not participate in traditional performing ensembles
3. Have a music life independent of school music
4. May sing or play an instrument (if so, likely drums, guitar or keyboard)
5. May not read music notation
6. May be unmotivated academically or have a history of discipline problems
7. May be a special needs student [*sic*]
8. May aspire to a career in music recording or music industry. (p. 137)

Increasing access to music technology in music classrooms has been identified as a strategy to reach NTMs. Prior to his tenure as president of NAfME, Scott Shuler (2001) predicted that technology would play an important role in diversifying music class offerings and increasing overall participation in the 21st century. That publication was revisited 13 years later by Tobias (2014) who wrote a vivid portrait of near-term possibilities. In this vignette, Tobias offered a description of a proposed TBMC, much like the authors reviewed in the previous section. As in those accounts, Tobias mentions improvisation and composition as main musical activities.

Although the TBMC curricular format has been shown to be an effective method of teaching musical skills and a viable way of reaching underserved students, some have taken issue with certain aspects of this relatively new practice. The next section includes literature that outlines some concerns over the implementation of TBMC in schools.

The Perils of Technology-Based Music Classes

McLain (2014) also authored a response to Shuler (2001), questioning the outsized role technology has come to play in the lives of teachers and students and the quality of that experience relative to time off screen.

> How much time does society spend consuming digital art? I do not intensively study artistic products available on the Internet. I do not gaze for more than a few seconds at great paintings or photographs; I scan them. I often do not listen to the entire digital musical performance; I listen to only a minute or two of the performance. I often work on multiple devices, using my laptop, my computer, and my cellular phone simultaneously in a steady stream of multitasking. This change in consumption is disruptive to arts education. (p. 17)

Apart from mere distraction, differential equity and access, particularly across gender identities, is a major concern reported in the literature. Comber et al. (1993) surveyed 278 students aged 11–18 from four schools in Leicestershire, UK, and found disparate levels of confidence with technology. When asked whether or not they consider themselves “better at music technology” (p. 129) than their same-age peers, younger students tended to place themselves at or near the average. Older students, perhaps having adopted cultural attitudes concerning gender and technology, responded very differently. Fully 87% of older boys believed they were better than other boys and 82% believed they were better than other girls. Only 18% of girls believed they were better than other girls and 13% believed they were better than other boys.

Shibazaki and Marshall (2013) found similar patterns of differences in confidence in a qualitative study of 10–11-year old TBMC students. Boys, the authors found, viewed “failure as being related to the equipment or the software program whilst girls tended to again blame their own ability" (p. 357). Armstrong (2003/2014; 2008) has found similar results in a series of studies and has published a detailed, book length treatment of the issue (2011).

Technological determinism, or the belief that "technologies themselves [are] agents of change or action" (Ruthmann et al., 2014, p. 123), has also been identified as a challenge facing the future of TBMC. As technology use expands and, ultimately, becomes an indissoluble part of new class formats, considerations of the humans involved are often pushed aside.

> Where are students and teachers in your discussion? Where is the broader community? Where are parents and administrators? How do you frame the purposes, possibilities, and pitfalls of technologies? Where is agency and action attributed? (p. 123)

In this passage, Ruthmann et al. (2014) challenged the determinist position that technology *happens to* people, rather than technology *being used by* people. The authors cited John Philip Sousa's now infamous indictment of the phonograph as perhaps the earliest widely read articulation of determinist concerns.

Among the more recent instantiations of technological determinism include the compulsion for schools and teachers to pursue the latest "must-have educational gadget" (Savage, 2017, p. 153) often while ignoring more systemic issues such as staffing, teacher pay, student mental health, and other pedestrian improvements. Savage also cited "joyless" (p. 153) learning management systems and the "dictum, 'if you can't open it, [you] don't own it'" (p. 153) as areas for concern in the future of TBMC. Issues of equity, technological determinism and the recentering of agency, and more general concerns over an increasing techno-mediation in many facets of public and private life underscore the urgent need for research in the emerging field of TBMC development and design.

This literature review began with an overview of the history of technology use in schools and in music education settings specifically. While an argument could be made for an expansive definition of technology, in the context of this dissertation, conceptions of technology are limited to Bauer's (2014) definition of "computers and related digital tools" (p. 5). Those using technology, be they teachers, students, or both, and for which specific purposes were described by Dorfman (2022) and Hitchcock (2017). When viewed together, a concise definition of TBMC emerges from the intersecting notions of these three authors. Technology based music classes are courses where music concepts and skills are introduced, reinforced, and assessed primarily through student use of computers and related digital tools.

Several authors have published accounts, real and hypothetical, of TBMC in schools. These accounts are summarized in Tables 2 and 3. All but a few examples emphasize the central role of the computer, and only because those earliest examples were published before the advent of personal computing. Typical student projects in TBMC included composing and arranging music, improvising, building electronic instruments, and recording, with composing original music being the most frequently mentioned.

Teachers designing TBMC are responding both to the direct musical goals of technology-based instruction as well as the potential of these classes to attract students and increase overall music participation. Teachers and researchers are also concerned with issues of equity and access, technological determinism, and the future direction of the specialization. The successful navigation of these issues is vital to the future of TBMC and should be the subject of additional research. This study is primarily concerned with the current state of TBMC curriculum design. The next section reviews literature related to the factors influencing the curriculum choices of music educators as they propose, plan, design, consider content standards, utilize existing curriculum guides, and deliver instruction in the TBMC context.

Perspectives on Curriculum

D. F. Walker and Soltis (2004) conceptualized curriculum as more than a list of courses available to students. They defined curriculum to include the "purposes, content, activities, and organization of the educational program actually created in schools by teachers, students, and administrators" (p. 1). When teachers, students, and administrators make decisions about the purposes, content, activities, and organization of educational programs, they are engaging in "curriculum work" (p. 2).

Curriculum work, according to Pinar (2004) must strive to "stimulate self-reflection, self-understanding, and social change" (p. 56). Barrett (2007a) considered Pinar's mandate as it applied to music educators and added that curriculum work in music should achieve those goals "for the purposes of constructing musically rich and meaningful educational experiences for students in school settings" (p. 12). For the purposes of this dissertation, *curriculum* is used according to D. F. Walker and Soltis' (2004) conceptualization, but with the added assumption that the music teachers engaged in curriculum work are responding to numerous intrinsic and extrinsic forces, including but not limited to those foregrounded by Pinar (2004) and Barrett (2007a).

"Curricula," according to Jenkins (2009), "are the practical application of personal beliefs" (p. 103). The processes by which music educators form their beliefs have been discussed through the lens of socialization of music teachers (Randles, 2012) and models of occupational identity (Austin et al., 2012; Haston & Russell, 2012; Isbell, 2008, Pellegrino, 2015). However, it is the rich tradition and associated literature of philosophy in music education that has influenced the beliefs of generations of music teachers.

According to Campbell and Demorest (2008), encounters with the "many great minds" (p. 39) of music education philosophy are frequently considered formative moments for undergraduate music education students as they construct their own philosophies of music education. Campbell and Demorest considered the works of Blacking (1973), Elliott (1995), Jorgensen (1997, 2003), Reimer (2003), Small (1998), and Swanwick (1988) to be among the most influential documents in the undergraduate socialization process and those who would have the greatest influence on in-service teacher curriculum decisions. Perhaps the reason these pieces of scholarship are treated canonically in music teacher education is their general lack of prescriptive suggestions for curriculum. Each of these landmark works represents an important philosophical perspective on music teaching and learning, but importantly, stops short of offering too many answers to the problems of curriculum design. Their evergreen status is owed to their capacity to catalyze the formation and revision of a music teacher's personal beliefs, and for the teacher to apply those beliefs practically during curriculum work.

To date, however, no model has been developed within music education literature to describe music educator agreement with any particular philosophical perspective. Morton (2012) looked to curriculum studies literature, specifically the concept of curriculum orientations, as a way to frame music teachers' enactment of the philosophies emanating from the scholars listed above. The curriculum orientations model help frame this study and is described in the following section.

Curriculum Orientations

Morton (2012) noted a "considerable tension" (p. 473) between the music education profession's "rhetoric lauding music as a pursuit that is essential in the overall education of the public it serves" (p. 472) and a seeming disengagement with the most complex and important problems of the day. “The world has problems” (p. 472), Morton argued, but many teachers seem content with “micro-learning” and “a subject-specific culture of teaching and learning, focused on developing musicianship in one form or another and isolated from other academic domains and other artistic studies” (p. 473). Navigating this tension would require addressing three philosophical questions: (a) “What is education for?” (bb) “What is curriculum for?” and (c) “What is music education for?” (p. 474)

Central to Morton’s philosophical investigation was the foundational work of curriculum scholars Elliott Eisner and Elizabeth Vallance (1974). According to Eisner and Vallance, controversy and disagreements in education philosophy often reflect “a basic conflict in priorities concerning the form and content of curriculum and the goals toward which schools should strive” (pp. 1-2). The authors identified five positions, or *orientations*, in their original essay, one might hold about the purpose of schooling. The five orientations were termed *academic rationalism*, *social reconstruction*, *cognitive process*, *humanistic*, and *technological.*

The academic rationalism orientation is based on Platonic beliefs that knowledge consists of “fixed and stable” ideas and should be mastered “without regard to the interest or needs of the learner, or contemporary societal problems” (Jenkins, 2009, p. 104). Mental discipline and traditional academic study are features of the academic rationalism orientation. Traditional music theory lessons and scale exercises are examples of this orientation in a music class context.

The social reconstruction orientation “promotes the ability of students to solve societal problems and participate in society” (Jenkins, 2009, p. 104). In the United States, this orientation originated with Progressive era politics and its adherents demand that curriculum “must be relevant to both the individual and society” (p. 104). Sellen (1976) described an action research project to determine the efficacy of using music to teach the history of the French Revolution.

Students in that class were engaged in the examination of historical societal problems and encouraged to draw connections to contemporary issues. Present day music educators expressing a social reconstruction orientation may make use of protest songs from a variety of genres to inculcate a sense of social awareness and justice.

The cognitive process orientation is similar to the academic rationalism orientation in terms of mental discipline. However, unlike academic rationalism, the cognitive process orientation refers to the "development of a student's ability to think" (Jenkins, 2009, p. 104). Teachers who hold this orientation support instruction in general cognitive skills that can be applied to a wide variety of new experiences. Lessons involving sight reading or improvisation can afford students an opportunity to develop generalizable musical skills. In a 1985 television interview, Seymour Papert, an early advocate for and pioneer of computers in education, argued that while music should be taught in alignment with the cognitive process orientation, an academic rationalism approach is the norm.

> It's a strange fact about music that while we expect children to be creative in all other domains, we only expect them to reproduce other people's creative work in music. We expect children to make their own drawings, write their own stories, compose their own poems. We don't expect them to compose their own music. (MIT Media Lab, 2018, 0:09)

The use of music technology, for Papert, meant that years of musical training were no longer necessary prior to composition. "With the computer as a musical instrument, it becomes possible to create a piece of music and hear it independently of your own performance skill" (MIT Media Lab, 2018, 0:40).

The humanistic orientation, elsewhere termed the "curriculum for self-actualisation" (Jenkins, 2009, p. 104), is the belief that the purpose of schooling is to foster students' "personal development as unique individuals," and to "create an environment where learning is not directed but explored in an open communicative setting which promotes personal growth" (p.

104). Aspects of this orientation are reflected when teachers promote lifelong musicianship, often using student vernacular or popular music (Kratus, 2019).

The curriculum as technology orientation is so named in consideration of behavioral psychology and the pragmatic application of curriculum to achieve the ends of operant conditioning. In other words, this orientation assumes that an ideal curriculum can be designed to achieve desired outcomes in any scenario. Accountability, outcomes, and “systems to produce learning” (Eisner & Vallance, 1974, p. 8) are terms and notions closely associated with this orientation. Perhaps the most successful and widespread application of this orientation in music education is the jazz play-a-long series developed by Jamey Aebersold. Thibeault (2022) described how Aebersold continuously revised his recording and accompanying book products to create a popular and mass produced “conceptual pedagogical technology” (p. 70). Beginning ensemble method books and elementary music basal series are among the other *technologies* of this orientation. To avoid confusion with other uses of the term *technology* in this dissertation, this orientation is referred to as the behavioral orientation.

Returning to Morton (2012), the author concluded that these “divergent curricular orientations fragment the curriculum” (p. 483), and prevent music educators from considering the interconnectedness of their classroom practice with the wider world. While this may be an important truth for music educators to consider, Morton’s conclusion nevertheless reinforces the salience of these constructs in the minds of music educators. The orientations can serve as a useful framework for understanding music educator beliefs, and given the connection between beliefs and curriculum work, are a useful way of conceptualizing TBMC curricula.

General education researchers Cheung and Wong (2002), building on the philosophical work of Eisner and Vallance (1974), developed a model and accompanying psychometric test to investigate teaching philosophies as articulated through curriculum priorities. Their Curriculum Orientations Inventory (COI) determines a participant's curriculum orientation according to five categories: academic rationalism, cognitive process, social reconstruction, humanistic, and behavioral. Participants are asked to rate their agreement with six statements per orientation. Table 4 includes a representative survey item from each orientation. These items were developed by the researchers based on a review of theoretical literature on approaches and orientations toward curriculum. The COI was further tested by Jenkins (2009) and found that the orientations served as suitable constructs for understanding teacher priorities and philosophies.

Table 4

Curriculum Orientations and Selected COI Agreement Statements

Orientation Name	Sample Agreement Statement
Academic Rationalism	Subject knowledge is the basis for designing a high-quality school curriculum.
Social Reconstruction	Curriculum contents should focus on societal problems such as pollution, the population explosion, energy shortages, racial discrimination, and crime.
Cognitive Process	Methods of inquiry are the most important content for primary and secondary school curricula.
Humanistic (Self-Actualisation)	Teachers should select curriculum contents based on students' interest and needs.
Behavioral (Technology)	Curriculum design should start with stating learning objectives.

Note. These statements were written by Cheung and Wong (2002) for their original Curriculum Orientations Inventory. Six total statements were written for each orientation. Statements included in this table had the highest reliability coefficients in a follow-up study by Jenkins (2009).

Apart from Morton (2012), few music education researchers have framed their scholarship with the curriculum orientations framework, and no published research has used the COI in a music-specific setting. Outside music education, Dean (2016) used the modified-COI proposed by Jenkins (2009) to investigate the influence of science teacher curriculum orientations on grading practices. Dean received completed surveys from 89 participants and found Cronbach's alpha scores for some items were much lower than expected. The findings were also lower than in Cheung and Wong's (2002) or Jenkins' (2009) earlier use of the inventory. Dean attributed this to his much smaller sample size. Nearly 700 teachers participated in Cheung and Wong's study and approximately 300 participated in Jenkin's replication.

Foil (2008) used the COI in a survey of approximately 900 administrators and found stronger measures of reliability. Foil had similar results with Cheung and Wong (2002) and Jenkins (2009) in other areas as well, including generally high mean scores across the entire survey, indicating the favorability of all orientations. An important conclusion from the published uses of the COI is that, like many psychometric tools, it seems to perform better with a larger sample size.

Teacher beliefs about the purposes of education, as modeled in the curriculum orientations framework, are but one of many influences on teacher curriculum work. Content standards, or "specifications of what all learners are expected to know and be able to do within a particular field of study, discipline or subject at different grade levels, ages, or other criteria" (International Bureau of Education, 2013, p. 14) have been drafted and adopted at the state and national level by a number of government and non-profit organizations.

Music Technology Standards and Curriculum Design

The function of content standards in education, and music education specifically, is to codify student performance objectives, with some documents including guidance in valid and reliable evaluation (Dorfman, 2019; Popkewitz, 2004; R. Walker, 2012). A key feature of TBMC, as stated in the literature summarized in Table 2 and Table 3, is individual student choice, demonstrated primarily through composition and performance. R. Walker (2012) argued that individuality, such as the decisions of a composer, confounds notions of objective standards.

> It is, of course, much easier to establish universal standards of student achievement and teaching effectiveness if learning and instruction are technical and predictable. However, if learning involves processes of social construction in which individuals play decisive roles, things become immensely more complex, and things like teacher effectiveness and student achievement are not easily measured, predicted, or controlled. (p. 398)

Despite the challenges presented to the authors of standards documents by TBMC, several organizations and government agencies have published documents with the intention of informing or governing TBMC curricula. Dorfman (2019) examined the National Core Arts Standards (NCAS), the Technology Institute for Music Educators Areas of Pedagogical Skill and Understanding (TAPSU), the National Educational Technology Standards (NETS), and the National Education Technology Plan (NETP) for their suitability and usefulness to music educators in various stages of planning, instruction, and assessment. Dorfman ultimately concluded that no single set of standards has the "potential to govern, or even suggest, guidelines for assessment in music technology" (p. 841) and added that:

> Though planning, implementation, and instruction seem to be sufficiently addressed, especially when the standards are viewed as a group, teachers and designers of technology-based music curricula are still without a complete, vetted document to guide assessment. (p. 841)

In addition to various national-level standard documents, several states have published their own music content standards. In many cases, these documents address technology specifically. The Ohio Department of Education is currently revising its 2012 music content standards. A draft of the revised standards to be published in the near future includes content statements organized in the same four categories as the NCAS: creating, performing, responding, and connecting. Technology is specifically mentioned across all four achievement levels (proficient, intermediate, accomplished, and advanced) in only one performing content statement, the text of which is included in Table 5.

Table 5

2021 Ohio Music Content Standards With Direct Reference to Technology Use

Standard Number	Standard Text
Proficient - HSP.2PE	Incorporate technology and media arts in performing or recording music
Intermediate - HIS.2PE	Incorporate technology and media arts in creating and arranging music
Accomplished - HSAC.2PE	Incorporate technology and media arts in creating, composing and arranging music
Advanced - HSAD.2PE	Incorporate technology and media arts in creating, composing, arranging, promoting and distributing music

Note. Text reprinted from the 2021 draft Ohio Standards (Ohio Department of Education, 2020).

This approach leaves terms undefined and settings unclear, thus sidestepping the complexity that R. Walker (2012) claimed is inherent to student-centered music classes such as TBMC. The Ohio Music Content Standards instruct music educators to “incorporate technology” at appropriate moments as described, but does not define any terms or suggest a specific music education setting in which these standards may apply. For example, this draft does not include an explanation of the difference between creating and composing music or the reasons why the creation of music is to be considered an intermediate skill while its composition occurs at the accomplished level. If it is the intention of the authors to encourage the promotion and distribution of music by including them in the advanced level, they are tacitly asking music teachers to create solutions to the very complex issues associated with public-facing, individual student work: district internet and social media policies, age restrictions on certain online platforms, copyright, anonymous commenting and cyberbullying, and other concerns.

Another approach would be to write a discrete set of music achievement standards specifically for students and teachers in TBMC. The New York State Department of Education has taken this approach, organizing its standards for music with a separate technology strand. The document uses the same categories as the NCAS and each includes three achievement levels: proficient, accomplished, and advanced. Similar statements are written for "composition & theory," "harmonizing instruments," and "technology" classes (The New York Education Department, 2017). Most content statements for the technology strand include the modifier, "through the use of digital and analog tools, digital resources, and digital systems" (p. 28). While this document gets closer at defining terms and informing curriculum work, neither Ohio nor New York standards documents provide sample assessments, example student work, or other features included in some of the national-level documents.

No empirical research studies have been published regarding music educator use of standards in the TBMC context. Two major questions remain unanswered in the literature: (a) Which, if any of the above standards documents are in widespread use? (b) Are music educators using standards documents in planning stages, for assessment, or for other purposes? Given a fractured standards and policy landscape, some music educators appear to utilize published curriculum guides and materials as well as collaborate to establish social media networks to discuss TBMC. The following section presents some of these efforts as demonstrated in the literature.

Extant TBMC Curricula and Peer Networks

Music educators experience significant autonomy in their TBMC curriculum decision processes, and the curriculum orientations of those educators, the specific needs of each school and community, and a lack of standardization in conceptualizations of TBMC may result in classes of vastly different design. All that is not to say, however, that music educators must, or do, work in isolation. Several individuals, groups, and publishing companies have considered the "purposes, content, activities, and organization" (D. F. Walker & Soltis, 2004, p. 1) of TBMC curriculum and have generated free and paid resources for music educators. Other music educators have organized peer networks via social networking platforms. The first half of this section includes an analysis of available books and web-based curriculum resources. The second half of this section describes peer networks dedicated to TBMC.

It is difficult to determine the number of available published curriculum guides and resources for at least two reasons. The first reason is definitional. The total number of publications depends on what one considers to be a valid publication. Some may include web-based resources and blog posts, while others may only consider published books from established firms. Many authors include sample lessons with reproducible assessment checklists and teacher scripts, while others offer suggestions to the music educator in broad terms.

Scope and the boundaries between disciplines present further challenges. Bula (2011) conducted a survey of TBMC teachers to, in part, determine which curriculum materials the teachers used in their planning. Participants recommended books and other curriculum resources that covered a wide range of topics including sound design, audio engineering, and business concepts. One highly recommended book, *Modern Recording Techniques* (Huber & Runstein, 2010), was written for a general audience of musicians and aspiring recording engineers. Drawing the boundaries of this literature review in such a way as to include *Modern Recording Techniques* would necessitate the inclusion of hundreds if not thousands of similar websites, books, videos, and other curriculum resources. Therefore, this review is limited to materials written specifically for in- or pre-service music educators designing and teaching TBMC.

The second complicating factor in a review of this literature is a matter of timeliness and relevance. At some point, curriculum guides are no longer useful to contemporary TBMC contexts and enter the category of historical documents. Many of the websites reported in Bula's (2011) survey are no longer supported or updated and the textbooks may be outdated. This review excludes materials published before the year 2000.

A keyword search of a university library database, the Google search engine, and a manual search of the *I Teach Music Technology!* Facebook group returned several published curriculum guides. The most frequently mentioned are discussed here. Keywords included *music*, *education*, *technology*, *curriculum*, and *guide*, in several permutations. To be included in this analysis, guides and resources must:

1. appear on at least two of the three search platforms, thus suggesting prominence
2. have been published after the year 2000, thus suggesting timeliness and relevance
3. be available to the researcher for analysis, either online or in print. Resources for sale, or otherwise paywalled, that could not be obtained through a library service were not included.

I was able to identify eight published books that fit the above criteria. Texts authored by Brown (2015), Watson (2006), Manzo (2016), and D. B. Williams and Webster (2022) outline music technology concepts for pre-service and in-service music educators. These are not curriculum documents; rather they detail technologies that might be used in the classroom or in an administrative capacity. Dorfman (2022), Freedman (2013), Kuhn and Hein (2021), and Watson (2011) wrote textbooks aimed at practicing music educators which included example units, lesson plans, and assessments. The next several pages outline each book in turn.

The second edition of Brown's (2015) textbook *Music Technology and Education: Amplifying Musicality* was written for "teachers, trainee teachers, and interested parents in the use of the computer for music education" (p. xv). Major sections of the book are organized around an introduction to music technology, creating music with technology, technology as teaching aid, performing music through technology, and technology associated with the administration of a music program. The categories and suggestions for music educators are similar to Hitchcock's (2017) categories of technological use. Each chapter summary includes Teaching Tips that may guide curriculum work, but these would not be considered full lesson plans or example assessments. Teaching Tip examples include such statements as, "like any other instrument, digital technologies need to be practiced, so support that need with appropriate student access and time" (p. 13), and "provide a range of notation input options so that students can find the method that works best for them" (p. 89).

D. B. Williams and Webster (2022) described their textbook, *Experiencing Music Technology*, as "an introductory resource for a wide audience both inside and outside the academic setting" (p. xxv). Major sections, viewports as termed in this text, are organized around musicians' use of technology, computer and internet concepts for musicians, digital audio concepts, music sequencing and MIDI, music notation, and technology as a teaching tool. The most recent update includes many of the most recent advances in music technology including web-based software applications and the widespread adoption of the MusicXML file format. A comparison between this and the previous version, published in 2006, demonstrates the pace of change in TBMC and the challenges facing traditional academic publishing models. Among the more salient examples of the pace of change is a deleted section dedicated to the "mechanics of a scanner" (p. 401), an entire section dedicated to "web surfing and searching" (p. 37), and fully 12 pages which describe optical media, a feature now absent from many desktop and laptop computers.

Watson (2006) edited the *Technology Guide for Music Educators* to serve as "a resource to which [music educators] could turn for listings of software and other technology products to best accomplish their curricular goals" (p. ix). This text is also aligned to an early version of the TI:ME standards. Published in the same year as the previous edition of *Experiencing Music Technology,* this text also illustrates the pace of change in music technology. Most of the recommended products are discontinued, and many software titles are no longer supported or available. *Technology Guide for Music Educators* includes music technology products in six categories: electronic musical instruments, music production, music notation, technology-assisted learning, multimedia, and productivity tools. These categories are reflected in more contemporary TBMC literature and might still be of use, even if the specific recommendations and pricings are not.

Manzo's (2016) *Foundations of Music Technology* is among the more recent textbooks on the topic of music technology for musicians. It is noteworthy for its accompanying elements including a dedicated software program and an online instructor manual which "provides class lecture outlines for a 14-week semester using this textbook" (p. xv). The text makes frequent mention of Ableton Live, however, but Manzo claimed that the concepts covered in this book are applicable to other software applications as well. This text is unique in that it does not include any discussions of specific hardware, MIDI controllers, or other electronic equipment. Main topics are organized around the concepts of acoustics, audio and signals, audio editing software, synthesis, MIDI, music notation software, audio effects, performance through software, technology as a teaching aid, and music programming.

Dorfman's updated *Theory and Practice of Technology-Based Music Instruction* (2022), cited at several points in this chapter, is also included here. The book not only describes, as the title suggests, definitional, theoretical, and philosophical aspects of TBMC, it aims to inform the practice of teaching with technology as the primary teaching tool. Many of the differences between traditional, ensemble-based music education practices and TBMC pedagogy are included in a lengthy chapter on lesson design. In that chapter, Dorfman described a spectrum of lesson content. One side of the spectrum are activities of primarily a musical nature, such as rehearsing a song. The other side of the spectrum includes activities of a primarily technological nature, such as file management. According to interviews with TBMC teachers, Dorfman reported that most lessons "move swiftly and adeptly between ends of the spectrum" (p. 100).

Freedman (2013) published *Teaching Music Through Composition: A Curriculum Using Technology* to provide "practical, tried-and-true lesson plans, student assignments, projects, worksheets, and exercises" (p. vi). The introduction contains an impassioned argument for TBMC and a reference to Ann Modungo who started one of the first TBMC at Greenwich High School.

> Music technology is not a wave of the future. It's here. It's in almost everything we do. Listen around you. If you hear something via a speaker or headphones, anything that was produced or -re-created using electricity, someone had to study what we teach in music technology class for it to be produced. Using technology to teach music is fun, engaging, and cutting edge, it teaches twenty-first-century and critical listening skills, and it's been around for a long time. My school has had music technology classes continuously since 1969! (p. vii)

The book is organized around 28 lessons. Lesson topics include composing with loops, reading and using notation, writing melodies, basic keyboard theory, remixing, chord progressions, and music for video. An extensive appendix includes several resources for teachers to photocopy, project for the class, or enlarge to poster size. Each individual lesson includes a detailed lesson plan that lists skills required, objectives, materials, procedures, example assessments, and extension and modification possibilities. Lessons are also aligned to applicable 1994 National Standards for Arts Education.

Freedman (2013) discussed the advantages and disadvantages of several software titles that can be found in other TBMC literature and teacher resources. This book, however, does not assume the use of any particular software title. Nor is hardware specifically outlined. Freedman was the only author to explicitly state a curriculum objective in terms that allowed for a direct comparison to the curriculum orientations framework. “The curriculum objective of this book is to teach basic musical concepts through the creative process of music composition. The lessons and projects presented here are resources through which learning music can be accomplished” (p. xv). This perspective aligns most closely with academic rationalism, or the belief that curriculum should focus on teaching the fundamentals of established disciplines.

Kuhn and Hein’s *Electronic Music School: A Contemporary Approach to Teaching Musical Creativity* (2021) is intended as a complete guide for teachers designing TBMC. Chapters address reasons for starting a music technology program, materials needed, several example projects, common challenges and solutions in the TBMC setting, and suggestions for building program culture through performance and extracurricular opportunities. Much of the advice in this book is based on the authors’ experiences as TBMC teachers at the high school and collegiate levels and as consultants for music software companies. The authors make an impassioned case for Ableton Live as the ideal music learning software, but do include an analysis of other software programs throughout the text.

The final book identified in the literature search for published TBMC curriculum guides was Watson’s (2011) *Using Technology to Unlock Musical Creativity.* This text begins with a detailed introduction to the “philosophical and pedagogical underpinnings” (p. ix) of TBMC curriculum design. Following those concepts, a series of units with lesson plans is outlined. Lesson plans include suggested grade level, objective, materials and equipment, duration, prior knowledge, detailed procedures, adaptations, evaluation, extensions, and relevant 1994 National Standards for Arts Education. Topics included in the lessons are reflective of the topics included in Tables 2 and 3, centering mainly around composition.

The main challenge facing all traditionally published TBMC curriculum guides, including those discussed above, is the rapid pace of change in technology. Kuhn and Hein (2021) fully explored this problem in a section of their book called *Know When to Retire Your Material* (p. 55). Perhaps in response to the rapid pace of change, thousands of music educators have joined social media groups dedicated to the discussion of TBMC. These groups facilitate instantaneous communication between colleagues across the globe. Chronologically displayed feeds, with some algorithmic manipulation, offer members an easy way to stay current in the ongoing conversation. Among the largest publicly visible peer networks dedicated to TBMC is *I Teach Music Technology!* hosted by Facebook (I Teach Music Technology!, n.d.).

This Facebook group was created in 2010 and aims to address many of the same needs and purposes as the traditional textbook model.

> This group is dedicated to productive and supportive communication by teachers and enthusiasts of music technology education across Facebook! Discuss, related to education or the educator's use, equipment, software, curriculum, funding, or anything else related to our profession in a professional and supportive environment. Help us create a wealth of information and support for those teaching music technology, those who create music through technology, and those who are looking to get into music technology! (I Teach Music Technology!, n.d.)

The group has approximately 4,000 members teaching in numerous countries and educational settings. The range of topics discussed, as well as the identities and stories of those participating, deserves its own dissertation length investigation far beyond the scope of this current project. In a casual analysis based on the present author's membership and participation in the group for several years, no single curriculum orientation is espoused or considered the norm. Each day, posts range from inquiries about starting a TBMC to detailed technology troubleshooting questions, to humorous posts hinting at an emerging shared culture that, again, deserves detailed study.

Websites and podcasts (Wardrobe, 2017-Present) are also emerging to meet the need of TBMC teachers. Musictechteacher.com (Garrett, 2020) is the project of a recently retired Alabama music teacher Karen Garrett. Garrett includes sample lessons, worksheets, sample student work, and other items. Musiccreativity.org (D. B. Williams & Dammers, n.d.) features a repository of nearly 100 TBMC program profiles. Music teachers are encouraged to submit a profile, which includes several aspects of curriculum, program history, and overall objectives. A cursory reading through several profiles provides another dimension of validity to the hardware and software mentioned in literature discussed earlier in this chapter.

The existence of both traditional print publications and social media groups demonstrate a need among music educators for information regarding the implementation, curriculum work, and improvement of TMBC. Both modalities seem to have their advantages and disadvantages. Print resources are edited and often authored by respected leaders in the field. However, the amount of time required to draft a text and bring it to market coupled with the inability to edit after printing means that these books appear antiquated within a few short years. In the case of D. B. Williams and Webster (2022/2006) and Watson (2006), that timeframe is approximately 15 years. The rate of change in music technologies is likely nonlinear, meaning some textbook topics will become outdated more quickly or slowly than others.

Social media groups are built for currency, in every sense of the term. Regarding timeliness, however, any member can make a post at any time. This valuable affordance seems to come at the expense of editing and curation. Readers must sift through thousands of relevant and irrelevant posts while avoiding inaccurate information. Fortunately, search functions make this process easier, but only if one uses the correct keyword. A lack of established terminology among music educators teaching TBMC can make searches difficult. One of the secondary objectives of this research project is to identify which, if any, curriculum guides or resources are in widespread use.

Themes of the Literature

Two main themes have emerged in this review of literature that support the need for this study. First, despite several common features of TBMC classroom practice, no single standardized model has been codified and adopted by teachers. Second, the literature supports the conclusion that educators hold varied beliefs about the purpose of schooling and that those beliefs may influence TBMC curriculum work. This section details the elements of both themes and connects them to the research questions under investigation in this study.

Kuhn and Hein (2021) described TBMC lesson design, often project-based or constructivist in nature, as an “art class for music” (p. 12). Modungo (1968) recounted students’ experiences with discovery learning as they “found that electronic music intensified the visual effects” (p. 90) of a stage production. Hagemann (1968) explained how a letter from a student to Robert Moog inspired the design and construction of a novel electronic instrument. In these examples, and in the ubiquitous composition projects mentioned across TBMC literature, teachers are acting as facilitators of student-directed learning in the music classroom. Teaching and learning is frequently done in “relative isolation” (Dorfman, 2019, p. 847), is specifically tailored to the individual classroom, and is potentially disconnected from "the larger curriculum work being done on state or national levels" (p. 847).

Given a lack of curriculum standardization in the United States and the attendant curricular autonomy afforded to teachers, several questions arise about what, exactly, happens in music technology classrooms. The first research question of this study is: *What are the features of technology-based music class (TBMC) curricula?* The literature summarized in Tables 2 and 3 help address this question, but few studies have surveyed a large number of participants. Various standards documents have been published in an effort to guide curriculum work. The third research question in this study (*How do TBMC curricula align with applicable professional music education standards*?) will help clarify which standards documents are in use and how they are being applied.

The curriculum orientations framework is a model that may prove useful in, first, understanding what music educators believe about the purpose of teaching and learning, and second, how those beliefs are manifested in curriculum decisions. The second research question in this study is: *What are music educators' orientations toward TBMC curricula?* If a teacher's beliefs align with academic rationalism, one might expect curriculum oriented around the fundamental precepts of music theory and analysis, history, and similar music content knowledge. A different teacher may hold beliefs that align with the cognitive process orientation and design lessons that encourage students to develop problem solving skills, and to work to master concepts without direct instruction.

Summary

Most music education researchers and authors interpret technology as "computers and related digital tools" (Bauer, 2014, p. 5). Hitchcock (2017) defined music technology as tools used “in the creation of music that requires electricity to operate” (p. 657). A large and growing body of literature describes the classroom experience of students enrolled in classes designed around student use of music technology. As discussed in this review of literature, these studies and reports are either theoretical (Table 2), or they detail actual classes (Table 3) through observation or self-report. In this still early stage of TBMC adoption, one of the most important curricular considerations reflected in the literature centers around the role of technology in student learning: either as an instructional tool or an educational end in itself.

Informing teachers about music technology concepts and equipment was the explicit aim of texts authored by Brown (2015), Watson (2006), Manzo (2016), and D. B. Williams and Webster (2006). These and similar books facilitate what Rees (2011) described as “the systematic study of tools and techniques for music production, performance, education, and research” (p. 154). Knowledge of these tools helps music educators navigate the topography of technology integration, with student use of music technology as the most important defining characteristic of TBMC (Dorfman, 2022). Composition was the most frequently listed student activity across all studies reviewed in this chapter. Student knowledge of music technology equipment from a recording or engineering standpoint, what Dammers (2012) referred to as the vocational skills of a TBMC, appears far less often.

Another TBMC curriculum consideration is the grade level(s) in which these classes are offered. Elpus (2017) found that TBMC were offered in 2% of US elementary schools, less than 1% in middle schools, and 12% in high schools. Dammers’ (2012) found a similar percentage in high schools using data gathered approximately five years earlier. Over half of all middle schools offered a “general music class,” which may feature a music technology component, but the amount of time spent on or with music technologies relative to other curricular possibilities was not reported. A lack of TBMC in elementary may be due to developmental considerations and the appropriateness of technology-based music curricula at that level. An alternative explanation may center around the reason some of these courses are formed: to reach the "other 80%" (D. B. Williams, 2011, p. 136). Elementary general music classes are offered in most US public schools (Elpus, 2017). It is the middle and high school years in which participation drops, necessitating the need for additional class offerings. Other possible explanations for higher TBMC rates at middle and high schools could be scheduling, funding, staffing, and other factors, but the specific cause or network of causes has not been investigated.

Previous research has concluded that educators of all disciplines hold varying beliefs about the purpose of schooling, and that those beliefs may influence curriculum decisions (Cheung & Wong, 2002; Jenkins, 2009). These curriculum orientations have not been investigated in the context of TBMC. Starting a new TBMC program or class is a difficult process, one marked by numerous decisions at key points (Dammers, 2010; Tracy, 2018). Understanding the curriculum orientations of music educators engaged in curriculum design could help clarify current practice and provide insights into the future of this phenomenon.

At present, content standards for TMBC exist at the state and national level, but it is not known if they influence curriculum design as much as teacher curriculum orientation or other factors. An individual US music educator appears free to select from locally developed standards, state music standards, several national standards developed by various institutions and agencies, or none at all depending on the mandates of teacher evaluation programs or other policy guidelines. An important function of this study was to determine which standards documents are in use and how they are used in curriculum design.

The many unanswered questions arising from literature on music technology, curriculum orientations, and music content standards support the need for this study. Furthermore, the continuous state of innovation and change in technology and education make studies such as this one necessary at regular intervals. To date, no large scale studies have addressed technology-based music class curriculum and teacher beliefs in the United States. The next chapter of this dissertation includes a detailed description of the procedures underway and plans to address these areas of investigation.

CHAPTER III

METHODOLOGY

Introduction

The previous chapter included a literature review and summary of the scholarship currently available to researchers seeking to understand con temporary technology-based music classroom practice in the United States. Presently, these sources include descriptions based on observation (Albert, 2020; Fiano, 2020; Forest, 1995; Freedman & Reeder, 2019; Giotta, 2015; Hagemann, 1968; Modungo, 1968; Tracy, 2018; D. B. Williams & Dammers, n.d.), hypothetical or proposed classes (Bissell, 1998; Dorfman, 2022; Kassner, 1998; Reese & Davis, 1998; Ruthmann, 2012; Seawright, 1968; Walzer, 2016; Watson, 2011; D. A. Williams, 2019), and music technology and curriculum texts for music educators (Brown, 2015; Dorfman, 2022; Freedman, 2013; Kuhn & Hein, 2021; Manzo, 2016; Watson 2011; D. B. Williams & Webster, 2022). Dammers (2012) developed the most comprehensive survey instrument of TBMC curricula to date. That research project influenced the design of this study, the details of which are discussed throughout this chapter.

This study was designed to provide stakeholders with as complete a snapshot of contemporary technology-based music class practice as possible, specifically addressing the following research questions:

1. What are the features of technology-based music class (TBMC) curricula?
2. What are music educators’ orientations toward TBMC curricula?
3. How do TBMC curricula align with applicable professional music education standards?

This chapter begins with a description of and rationale for the design followed by the steps taken to identify and contact participants, and finally, the procedures used to develop and refine the survey instrument, collect and organize data, and analyze results. All procedures and materials have been reviewed and approved by the Institutional Review Board (IRB) at Kent State University. Approval documentation is included in Appendix B.

Design

The exploratory nature of the research questions in this study support the use of a descriptive, survey-based design. Miksza and Elpus (2018) defined descriptive research as "an exploration of what is, what exists, and/or the status of a given topic of interest" (p. 17), and that this design can be useful for "generating a knowledge base that could inform theory development, suggest potential relationships among variables to explore (e.g., behaviors attitudes, beliefs, demographic characteristics, etc.), and/or lead to experimental hypotheses to be tested in the future" (p. 17).

In addition to suggesting potential relationships to explore in future research, descriptive designs can be "descriptive comparative" (Siedlecki, 2020, p. 8) when they include comparisons between "naturally occurring groups, such as gender, education, or age groups" (p. 8). The specific comparison groups used for this study are defined and discussed later in this chapter.

Data for descriptive music education research studies are usually gathered through observation or surveys (Miksza & Elpus, 2018). Answering the research questions in this study through observation could not be completed in a reasonable length of time or include enough participants to yield generalizable conclusions. Surveys, by contrast, can be completed by many participants in multiple locations simultaneously, making this study a unique contribution to the body of literature. Sedransk and Tourangeau (2013) cautioned researchers that the popularity of surveys as research tools may contribute to the "rising tide of nonresponse" (p. 2). The approaches used to mitigate nonresponse bias are discussed in a later section.

A number of general research and survey-specific texts were referenced in the planning stages of this study (Cowles & Nelson, 2019; Drisko & Maschi, 2016; Miksza & Elpus, 2018; Nardi, 2018; Phelps et al., 2005; Wesolowski, 2022). According to Cowles and Nelson (2019), survey researchers must take steps to reduce sampling, coverage, nonresponse, measurement, and postsurvey error. The authors also discussed mode effect, which describes errors arising from different survey delivery methods (i.e., telephone, mail, or web), but does not apply in this online only design. The influences of these authors on design decisions are now discussed in the relevant sections below.

Participants and Recruitment

Previous research on music teacher identity and attitudes suggests that some music educators prefer to use professional identities that correspond to their teaching assignment (i.e., choir director, band director, orchestra director, elementary music teacher) more than the general *music educator* or *music teacher* (Prichard, 2013; Shouldice, 2009). A technology-specific music teacher identity may be emerging. Early anecdotal signs can be found on websites such as musictechteacher.com (Garrett, 2020) and *The Music Tech Teacher Podcast* (Wardrobe, 2017-present). However, technology-specific role identities have not been studied to a sufficient level to confidently justify that role as a delimiting category of participation in this study. Therefore, eligibility to participate was framed using descriptors of the TBMC itself. This approach also has the advantage of increasing the sample size, one of the strategies Cowles and Nelson (2019) recommended for reducing sampling error (p. 39). Individuals were eligible to participate if they (a) taught full-time in a US secondary school, (b) teach or have recently taught one or more technology-based music classes, defined as *a course where music concepts and skills are introduced, reinforced, and assessed primarily through student use of computers and related digital tools*; and (c) agreed to the Informed Consent to Participate statement provided in each email contact.

Prior to this study, only one researcher had investigated the demographics of teachers leading TBMC with a nationwide sample. In a survey of high school principals and teachers about their school's TBMC, Dammers (2012) reported that 77% of the teachers who responded were identified as male. The majority, 59%, were in their third decade of teaching, and 59% reported a winds, strings, or percussion musical background. Fully 91% reported teaching other non-technology classes, a finding that supports the decision to widen the sampling frame to include teachers of multiple music class formats. Participants in the present study were asked to disclose demographic information, performance background, years of overall music teaching experience, years of specific TBMC experience, and teaching state for comparative purposes.

Purposeful and snowball sampling were used to align the sampling frame as closely as possible with the total population of music teachers who met the eligibility criteria. Nardi (2018) recommended purposive sampling, a form of nonprobability sampling, when members of the research population participants have a specific trait or characteristic not present in the general population. Purposive sampling was achieved through the use of the National Association for Music Education (NAfME) survey service selection criteria and distribution to members of music technology special interest Facebook groups. In situations where the total population is unknown, or when participants may be difficult to reach, participants can be invited to forward the survey to others, a procedure known as snowball sampling.

The NAfME research survey assistance program provides "indirect access to the association's membership list using [its] email-transmission platform" (National Association for Music Education, n.d.). NAfME estimates that approximately 50% of all US music teachers are members. Association members who intend to distribute a survey must submit a detailed proposal which includes the project title, IRB approval, abstract, background, purpose, and rationale, research questions, targeted population, procedures, and a statement explaining how the project would benefit NAfME membership. A standard transmission includes email distribution to members based on two selection criteria (e.g., teaching area, grade level, or state). Following NAfME approval, the survey was distributed to all members who listed both music technology as a teaching area and K–12 as their teaching level. Approximately 15,000 members fit that criteria and received an email invitation. Engagement statistics for NAfME recruitment emails is included in Table 6. Over five thousand recipients opened both the initial and follow-up emails. However, less than three percent clicked the link to the survey.

Table 6

NAfME Research Survey Service Recruitment Email Statistics

Message Date	Emails Opened	Survey Link Clicked
March 29, 2022	5,851	126
April 5, 2022	5,775	94

NAfME membership is vast, but not representative of the total music teacher population. To reach non-member music educators and those teaching in states not supported by NAfME, recruitment messages were posted to public Facebook groups dedicated to music education and technology. A keyword search of "music", "music education", and "music technology" was used identify relevant Facebook groups. A list of the six groups identified and their membership totals at the time of survey distribution is included in Table 7. *I Teach Music Technology!*, which has approximately 4,300 members, is unique in that it was created specifically as a music technology special interest group. Their description states:

> This group is dedicated to productive and supportive communication by teachers and enthusiasts of music technology across Facebook! Discuss, related to education or the educator's use, equipment, software, curriculum, funding, or anything else related to our profession in a professional and supportive environment. Help us create a wealth of information and support for those teaching music technology, those who create music through technology, and those who are looking to get into music technology. (I Teach Music Technology, n.d.)

Table 7

Music Education and Technology Special Interest Facebook Groups

Facebook Group Name	Date Created	Approximate Membership at Time of Recruitment
Music Teachers	February 3, 2012	37,200
I Teach Music Technology!	December 9, 2010	4,300
Music Education (a)	May 18, 2016	3,000
Music Education in the Elementary and Middle Schools	July 1, 2018	2,400
Hip-Hop Music Ed	November 7, 2015	2,300
Music Education (b)	July 29, 2017	2,200

Note. Facebook has two groups named Music Education. Facebook displays membership totals rounded to the nearest 100.

For all groups, page administrators were contacted for permission prior to posting recruitment messages and a link to the survey. The third recruitment strategy, mentioned above, was snowball sampling. Participants were encouraged to forward the link to others who they believed might like to participate.

Approximately one month after email and Facebook recruitment began, additional strategies were considered and attempted to increase response. With permission from the Institutional Review Board at Kent State University, a request to promote the study was sent to representatives of each US state music education association and a leading national association dedicated to music technology education. Representatives from the music technology association did not respond. Reaching representatives from state music education associations was complicated by a great variety in the organization and accuracy of each association's online presence. Ultimately, individuals from six states responded to decline the request on the grounds that their associations would only promote research from their own membership ranks. One state did promote the study through social media posts. However, no additional responses came from that state following the additional post as indicated by anonymous survey timestamps.

Dependent on individual email and social media use, participants were contacted between two and five times between March and May of 2022. The informed consent language clearly stated that no incentives were provided for completing the survey other than the knowledge that participation is contributing to the knowledge of the practice. The initial NAfME email and Facebook message is included in Appendix C. Follow-up messages and final reminders were sent at approximately two week intervals. A final message thanked participants who completed the survey and included an invitation to forward the email or post or message to colleagues.

Survey Development and Validation

A literature review was conducted to identify an existing survey instrument that could address features of TBMC curricula, teacher orientations toward curriculum, and the alignment of curricula with educational standards. No single instrument could be identified. However, two previously published surveys separately addressed most topics. These were combined with modification to collect data used to answer the research questions. This new instrument is referred to as the Music Technology Curriculum Inventory (MTCI) for the remainder of this dissertation. Survey items related to TBMC curricula were adapted from Dammers' (2012) "Teacher Survey" (p. 184). Dammers organized questions into five categories. The names and a brief description of each category are included in Table 8.

Table 8

Dammers (2012) TBMC Teacher Survey Question Categories

Category Name	Survey Question Topics
Program Description	The objectives and purpose of the course, the musical background of students, musical genres addressed in the course, and the nature of projects and activities
General Background	The course as it does or does not align with other music courses in the school
Teacher Background	Teacher experience, performance background, other non-technology classes taught, and effectiveness of teacher training programs and professional development
Lab Information	Hardware used, computing platform (e.g., Windows, Mac), the lab space, and software used
Support	Hardware installation, software installation, financial support, and in-service training

Dammers' survey required modification to address research questions one and three, as well as D. F. Walker and Soltis' (2004) definition of curriculum as the "purposes, content, activities, and organization of the educational program actually created in schools by teachers, students, and administrators" (p. 1). Items were removed that did not address the research questions in this study. Other items were removed to shorten the MTCI, a necessity given concerns over total survey length after all elements were combined together. Specific survey questions removed included an open-ended response item that asked participants to "briefly describe the typical student in your class" (p. 86), two items concerning the alignment of this course with others in the school, a six-part item regarding training and professional development, and all questions in the Support category.

Other items were modified to better address the research questions or to use updated language. The Lab Information section included a list of 16 hardware options and an additional open-ended "other" selection. This list was modified to include hardware options mentioned in recent literature, specifically, synthesizers, Chromebooks, headphones, and Makey boards. "MIDI keyboard/controllers" (p. 87) was disaggregated in light of more recently available musical interfaces including the Ableton Push, Novation Launchpad, ROLI Seaboard, and the Linnstrument. Software selections were similarly updated. Titles no longer sold or supported were removed, and more recently published titles were added to the list.

Original items were needed to address research question three, the alignment of the course with educational standards. To achieve consistency with other survey questions and to limit the number of item formats, participants were asked to rate the degree of importance for each standard document according to a same 5-point scale. Participants were also asked at what point in the curriculum design and teaching stages they made use of standards documents. Four demographic items were added to ask participants about their teaching state, gender identity, race/ethnicity, and years of TBMC-specific teaching experience.

In addition to technology and demographic items, participant curriculum orientations were measured using a modified version of Jenkins' (2009) Curriculum Orientations Inventory (COI). Curriculum orientations, or the relationships between philosophical beliefs and educational priorities, may clarify the decision making processes in TBMC curriculum work. Jenkins' instrument contained six statements representing each curriculum orientation for a total of 30 statements. The use of all statements alongside TBMC and demographic items resulted in a prohibitively long survey instrument. Therefore, some COI statements were removed to shorten the MTCI in an effort to improve completion rates. The following process was used to select items for removal.

Chiesi et al. (2018) described how lengthy surveys can be shortened while preserving validity and reliability. The authors found it appropriate in most cases to reduce the number of survey questions within a construct if the remaining items represent the construct accurately. Fortunately, Cheung and Wong (2002) and Jenkins (2009) published item-total correlation scores and reported similar findings for individual statements. Of the six statements for each orientation construct, the three with the highest measures of reliability were retained. The reduced-item COI consists of 15 total statements, greatly reducing survey completion time. Appendix F includes a table of reliability statistics reported by Jenkins. Retained statements are marked with an asterisk.

Following the revisions to the TBMC and COI statements, a draft of the MTCI was developed in Qualtrics, an online survey distribution and data collection service. That draft was then sent to three experts familiar with TBMC and music education research and an expert in statistical analysis. The reviewers were asked to read the survey and recommend changes to wording, question ordering, or other features that may improve the overall validity of the instrument. A copy of the expert review invitation and instructions is included in Appendix E. The reviewers made several suggestions to improve the content validity of the TBMC items and overall survey design. Following expert review, the revised draft was sent to a small group of teachers familiar with TBMC. The procedures for this pilot test are included in the following section.

Pilot Test

A pilot test of the MTCI was conducted in November of 2021 following expert review to further improve reliability and validity, as well as to test the operational performance of the electronically distributed online instrument. Approximately 40 music educators familiar with TBMC were contacted directly by the researcher with an email invitation to complete the survey and respond with any suggestions for revision. Of the initial 40, 31 teachers opened and began the survey. Eight teachers did not complete the survey, resulting in 23 completed responses eligible for analysis. Nine pilot test participants also sent suggestions for revision over email or text message.

Nardi (2018) provided examples of three commonly agreed upon methods to determine the reliability of specific items in a survey (p. 76). These procedures work well for surveys with a large number of items dedicated to a single construct. However, given the exploratory nature of this study and its descriptive design, neither test-retest, alternate forms, nor split-half procedures were deemed appropriate. In the case of surveys in descriptive studies, Miksza and Elpus (2018) recommended verifying if items "are (1) at a reading level appropriate for the population, (2) clear and easy to understand, and (3) unbiased (e.g., do not contain leading language, skewed response options, offensive language)" (p. 26). A baseline reading level was established through the use of items from two previously published surveys. Clarity of existing and new items were subject to both expert review and the reflections of pilot test participants. One expert reviewer and several pilot test participants asked for more clarity in the definition of TBMC. A revised definition was included in the final draft. None of the reviewers raised concerns with potential question bias.

Apart from demographic questions, the two major sections of the survey collected data about participant TBMC curriculum and their individual curriculum orientation. Since TBMC items were descriptive and were not intended to reflect a construct or model, content validity was determined through a review of literature and expert review. This "consensus among researchers" (Nardi, 2018, p. 77) approach was most important for verifying the correct set of software, hardware, and education standards for relevant questions.

The second major section of the survey measured curriculum orientations with items reprinted, with permission, from Jenkins (2009). The total item count for this section was reduced from 30 to 15 by retaining the questions with the highest published item-total correlations. Content validity was established through the successful application of survey items in several published research studies. Statistical tests for reliability were not performed at the pilot stage due to the low response rate.

Data Collection

The greatest challenge to data collection in survey research is the growing trend of nonresponse (Cowles & Nelson, 2019; Sedransk & Tourangeau, 2013). Cowles and Nelson (2019) offered many possible reasons why fewer people are completing surveys.

> We can't do much about the increase in surveys in our society and the fact that some people may have recently been asked to do a survey. We can't do much about the growing trend for people to express doubts about the worth of surveys. But we can do something about the survey itself. (p. 48)

The authors recommended reducing the burden on participants by making the survey as easy to complete as possible. Initial drafts of the modified survey were lengthy. The item reduction measures described above helped to create as brief and incisive an instrument as possible.

The data collection began in March of 2022 following approval from the Kent State University IRB, the dissertation committee, and the NAfME research survey service. Invitations were posted to Facebook groups at the same time as NAfME emails. A reminder message went to NAfME members on April 5th. Facebook reminders occurred throughout the month of April. Responses slowed significantly in May, and the additional strategies described above were implemented to increase participation. Any further recruitment methods, such as contacting participants through social media groups dedicated to specific software applications, risked skewing the data and were not attempted. Data collection ended in June when the survey data was downloaded from Qualtrics. Eligible and complete responses were then imported into RStudio and Excel for statistical analysis. The procedures for analysis are discussed in the following section.

Data Analysis

Participant responses to the MTCI were subject to three phases of analysis. In the first phase, descriptive statistics were applied to all quantitative items from the TBMC section. These included program description, general background, teacher background and demographics, lab information, and standards alignment. A statistics consultant with expertise in educational research was contacted and assisted in analysis in this phase. Given the exploratory nature of this study and the nature of the data from this section, item counts and measures of central tendency are reported. This first phase facilitated cross-group comparisons in the second phase.

Grouping, group demographic analysis, and cross-group comparisons occurred during the second phase of analysis. Participants were grouped according to their strongest agreement to two of five curriculum orientations based on their responses to Curriculum Orientation Inventory (COI) items. Cheung and Wong (2002) described the possibility of complimentary pluralism, a scenario where teachers hold strongly correlated beliefs of two or more orientations. However, Jenkins (2009) repeated the study with teachers from the United States and found only weak to moderate correlations between orientations. One of the objectives of this research study is to determine not only which orientations are preferred among teachers of TBMC, but how those preferences function across the orientation model landscape.

Table 9

MTCI Items for Cross-Group Analysis

MTCI Question Number	MTCI Question Text
2	Please rate the importance of the following: Developing students' skills as . . . performers, creators/composers, listeners, and vocational skills
6	Please rate the frequency with which the following genres/styles of music are addressed in your class . . . classical, folk, hip hop-rap, jazz, rock, world music, EDM/techno, pop, other
7	How strongly do you agree or disagree with these statements: 1. Projects/activities are determined by individual student musical skills. 2. Student listening and creating by ear plays a central role. 3. Projects/activities are determined by individual student interests. 4. Projects/activities are determined by individual student learning styles. 5. Standard music notation plays a central role in the class. 6. Reaching nontraditional music students (i.e., not in band, choir, or orchestra) is an important consideration in the planning and election of your technology- based music class.
10	How do you tend to make use of published music technology materials?
16	Please rate the frequency with which you reference the following standards in your curriculum work… 1. National Core Arts Standards (NCAS/NAfME) 2. TI:ME Areas of Pedagogical Skill and Understanding (TAPSU) 3. National Educational Technology Standards (NETS) 4. State music-specific standards 5. State technology-specific standards 6. Other standards document, please specify

TBMC items selected for cross-group comparison were chosen based on themes emerging from a review of related literature and whether or not the question asked participants about a feature of their class, curriculum, or personal philosophy in a way that may be influenced by their curriculum orientation. The TBMC items identified for cross-group comparison are included in Table 9. The complete text and formatting of each question can be found in Appendix F.

Lastly, open-ended survey items were analyzed in the third phase. The first of three questions asked participants to provide the name for their TBMC. Class names were analyzed with the basic content analysis procedure described by Drisko and Maschi (2016). This type of text analysis "relies mainly on frequency counts of low-inference events that are manifest or literal and do not require the researcher to make extensive interpretive judgements" (p. 25). Data interpretation with basic content analysis is quantitative and is typically presented via descriptive statistics. A similar process was applied to the item regarding curriculum materials and resources. A table of the most frequently used course titles (Table 12) and a table for curriculum materials (Table 20) is included in the results chapter. For both questions, anonymous raw data and results were shared with an expert in qualitative music education research and music technology in classroom settings.

The third open-ended question was included to provide more context for the curriculum specific items in the TBMC portion by asking participants to describe the content and skill objectives for the class. Unlike the first and third open-ended questions, participant responses related to curriculum required more complex analysis. Responses were read independently by the researcher and a research assistant familiar with TBMC classroom practice and qualitative research methods. To maintain participant privacy, the research assistant received lists of comma delimited responses only for that item. According to Drisko and Maschi (2016), "researchers use inductively generated codes when there is no well-established set of applicable codes" (p. 43). Two inductively generated code lists were drafted compared to generate a final code list. A frequency count of participant responses based on the codes followed. That frequency count was returned to the research assistant. A frequency table of content and skill objectives is included in the results section (Table 16).

Chapter 4 includes the results of all three phases of analyses. Phase one includes the descriptive statistics of all MTCI items related to features of TBMC curricula. Data are presented mainly as summary tables, figures, and charts. Phase two involved grouping participants based on their agreement with a curriculum orientation for comparison of TBMC responses. Finally, the results of the three open-ended item analyses are presented with frequency tables and an explanation of codes.

Summary

Technology-based music classes (TBMC), along with other more recent offerings, represent an important innovation for a profession striving to achieve “music for every child” (Heidingsfelder, 2014, p. 47). Many US schools fall short of that goal, with traditional ensemble classes serving as little as 20% of the student body (D. B. Williams, 2011). Classes organized around student use of technology can help reach the other 80%. Previous research on TBMC has found similarities in software and hardware, and has found that most student learning and musical expression is experienced through composition. What is much less understood, however, are the relationships between beliefs about curriculum and the decisions of music educators designing TBMC.

The first research question of this study is: *What are the features of TBMC curricula?* Data to address this question are gathered using the Music Technology Curriculum Inventory (MTCI). The MTCI includes items related to software, hardware, and the curriculum materials currently in use. These findings contributed useful baseline data to further research. Elpus’ 2017 survey of music education practice in the US serves as a model for this line of inquiry and suggests that the findings of this study will be valuable in understanding, questioning, and ultimately advancing TBMC practice.

The second research question is: *What are music educators' orientations toward TBMC curricula?* Previous research corroborates an intuitive notion that teacher beliefs about the purpose of education influence their curriculum decisions. Music educators who align with academic rationalism, for example, may design classes with very different aims and outcomes than educators aligning with the social reconstruction orientation. These potential differences have wide ranging implications for the students music educators serve. To date, this project is the first attempt to investigate music educators beliefs about TBMC curriculum using the curriculum orientations framework originally proposed by Eisner and Vallance (1974).

The third research question asks: *How do TBMC curricula align with professional music education standards?* Dorfman (2019) analyzed several standards documents, concluding that each contains useful guidance but none are complete, particularly with regard to sample assessments and student work. This study will help answer many of the preliminary questions concerning standards use in TBMC curriculum work including: Which standards documents are in use, and, at what point in curriculum work are standards referenced?

This chapter described the creation and refinement of the Music Technology Curriculum Inventory and has outlined data collection and analysis procedures that occurred between March and July of 2022. A descriptive survey-based design was chosen due to the exploratory nature of the research questions and to gather data from as many participants as possible. The MTCI, compiled from two existing instruments with additional items, was drafted and subjected to expert review. The following chapter includes the results of the survey along with specific information about the analytical approach for each item or group of items.

CHAPTER IV

RESULTS

Introduction

The purpose of this exploratory research study was to clarify the current state of music technology teaching practice in the United States, specifically regarding curriculum, educational standards, and teacher beliefs about the purpose of education. A survey instrument, the Music Technology Curriculum Inventory (MTCI), was developed using existing items from two previously published research studies. Additional items were written to address the research questions in this study, and the instrument was validated through an expert review and pilot testing process described in the previous chapter.

This chapter includes the results from MTCI data collection in the spring of 2022. Every attempt has been made to organize the results from each of the 31 items, many of which include multiple response variables, into a concise and useful summary. That said, the following statements may be helpful when reading this chapter. First, rather than report results of each item in turn, data were organized by theme and then by the order in which they appear in the MTCI. The complete survey can be found in Appendix F. Second, tables and figures were formatted to the top or bottom of the page following their discussion in the text. In some cases, a table or figure is not located on the same page as its accompanying text.

Third, due to the use of existing survey items, the MTCI features multiple Likert scale response formats. Various items have four- or five-point scales and some begin with zero while others begin at one. While not ideal for consistency across the instrument, these items were left in their original formats to facilitate comparison between the results in this study and previous research.

Music Technology Curriculum Inventory Response and Participant Demographics

The number of public schools offering TBMC, and by extension the total population of music educators eligible to participate in this study, has been estimated by Dammers (2012) to be approximately 2,500 (p. 81). Elpus (2017) surveyed K–12 music teachers about music offerings in their schools and reported similar findings for high and middle schools. Other evidence for an estimation of the total study population includes the 4,300 member *I Teach Music Technology*, a Facebook group dedicated to the practice. This number should be interpreted carefully, however, as not all US music teachers use Facebook and the group does not require proof of teaching assignment for membership. The highest estimated number came from the National Association for Music Education (NAfME). The NAfME research service reported that approximately 15,000 of its nearly 50,000 members listed technology as a teaching area at the time of survey distribution. The much larger number could be explained by the complicated usage of technology in contemporary education discourse and that NAfME does not define music technology as a teaching area.

The survey was distributed via an email invitation with one reminder to NAfME membership and three invitation posts on relevant social media groups. The names and membership totals of each group were included in Table 7 in the previous chapter. A maximum distribution total which combines NAfME and Facebook populations, while ignoring the very likely possibility of overlap, resulted in approximately 100,000 music educators. In practice, though, this overlap coupled with email fatigue, social media habits, non-educator members of both groups, and other factors had the likely effect of limiting the reach of this recruiting strategy. The final response rate suggests that the actual number of TBMC teachers as defined for eligibility in this study is closer to the low-end estimate of 2,500.

In total, 195 participants clicked the link to participate in the survey. All but one agreed to the terms of consent. From there, the MTCI featured skip logic to filter participants by eligibility. Skip logic is a Qualtrics design element that forces changes to the survey flow based on participant responses. Forty five percent of participants indicated that they do not teach a TBMC and were exited from the survey. This resulted in a total of 107 survey responses eligible for analysis.

Analysis began with a check for completeness. Several participants started but did not complete the survey. This may have been caused by internet connection issues, lack of interest in the topic, survey fatigue, or other reasons. Despite attempts to reduce survey fatigue which included reducing items, pilot testing, and expert review, most participants who discontinued the survey did so at or during the curriculum orientations section. Given this response pattern, surveys were considered complete if participants responded to all items in the TBMC section. Retaining those responses resulted in a final count of $N = 69$, the final total sample used for analysis in this study.

While this approach maximized eligible data for TBMC items, it resulted in some missing data for the later curriculum orientations and demographic sections. Contacting participants to encourage completion was not possible due to the anonymous distribution method and, given the total response size, imputation methods would be invalid and were not used. Curriculum orientation items were analyzed with the data available and are reported in a later section. The remainder of this section includes the available demographic information with the missing data coded as “No Response.”

Table 10 includes totals and percentages for participant demographic characteristics. A majority of the participants who completed the demographic portion of the MTCI identified as male (*n* = *40*) and as non-Hispanic White (*n* = 54). Teaching state was analyzed using regions from the United States Census Bureau (2013). More participants teach in Northeastern states than any other single region. The states with the highest response totals included Connecticut and Virginia (*n* = 5 each) and Massachusetts, New Jersey, Ohio, and Pennsylvania (*n* = 4 each).

Table 10

MTCI Respondent Demographics

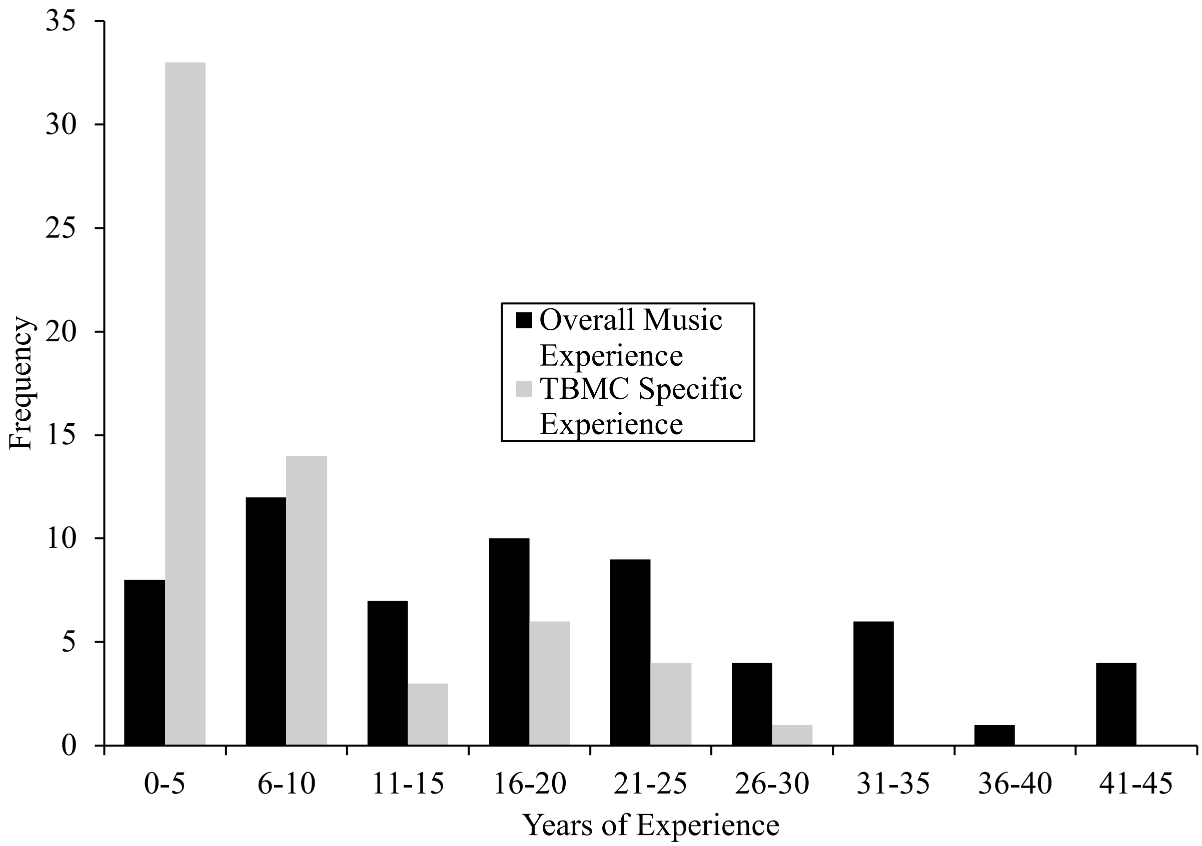
Characteristic	*n*	%
Gender		
Female	19	28
Male	40	58
Non-binary/third gender	1	1
Prefer not to say	1	1
No Response	*8*	*12*
Race/Ethnicity		
Hispanic/Latino Origin (Y)	2	3
Hispanic/Latino Origin (N)	58	84
No Response	*9*	*13*
Asian	1	1
Black	3	4
Two or More Races	2	3
White	54	78
No Response	*9*	*13*
US Region		
Northeast	24	35
Midwest	10	14
South	18	26
West	8	12
No Response	*9*	*13*

Note. *N* = 69 completed and eligible surveys. Percentages were rounded to the nearest whole decimal and may not equal 100 for characteristic category. US Regions based on Census regions of the United States. The MTCI included two separate items for race and ethnicity. Non-response for those items are reported under each subcategory.

Sixty-one teachers shared their years of professional experience. Overall teaching experience ranged from 1–43 years with an average of 18.4 years. TBMC specific experience was much shorter, ranging from 1–28 years with a mean of 7.6 years. More than half of the sample have taught their TBMC for no more than five years. Figure 1 includes a histogram which compares overall with TBMC specific experience.

Figure 1

Participant Teaching Experience



Note. *N* = 61. Eight participants did not complete this item.

Most participants (*n* = 43) hold a winds/percussion performance background. Other backgrounds included voice (*n* = 10), piano/keyboard (*n* = 4), strings and guitar (*n* = 3), and conducting (*n* = 1). Table 11 includes the counts and percentages for TBMC teaching level and other courses taught. High and middle schools combined represent 88% of TBMC settings. The responses from elementary music teachers are included in the aggregate statistics, but it should be noted that the results of this study represent secondary school settings in much greater numbers. Apart from TBMC teaching, band, choir, and music appreciation were the three most commonly mentioned courses. Five teachers (7%) reported teaching only TBMC.

Table 11

MTCI Respondent Teaching Level and Additional Courses

Characteristic	*n*	%
[a]TBMC Teaching Level		
High School	44	63
Middle School	18	26
Elementary School	7	10
No Response	1	1
[b]Other non-TBMC Classes		
Band	32	46
Choir	19	26
Music Appreciation	16	23
Other Class	15	22
Music Theory	12	17
Guitar	11	16
Orchestra	9	13
None (Only TBMC)	5	7
General Music	3	4
No Response	8	12

Note. *N* = 69 completed and eligible surveys.
[a]Total is greater than the number of surveys due to one participant reporting both high school and middle school level teaching. Percentages are reported accordingly.
[b]This characteristic is not mutually exclusive and percentages were calculated from the *N* = 69 total. Most participants taught several other classes.

Features of Technology Based Music Class Curricula

D. F. Walker and Soltis (2004) defined curriculum as the "purposes, content, activities, and organization of the educational program actually created in schools by teachers, students, and administrators" (p. 1). The MTCI included 19 items which asked participants about these important features in their individual TBMC context. Most items were reprinted with permission from Dammers' (2012) Teacher Survey. In that study, items were categorized as Program Description, General Background, Teacher Background, Lab Information, and Support. To better address the research questions in this study, those categories were modified, with some individual items removed and others added.

Items pertaining to TBMC curricula were divided into three categories and their results are presented in the following subsections. The Class category includes descriptive information about the course title, students enrolled, and the history of the class including its origin. The Lab category contains items dedicated to the specific technology available to students as well as the classroom setup. Lastly, items in the Curriculum category address the specific course objectives, nature of student work and activities, application of content standards, and the use of published curriculum materials.

The Class: Title, Enrollment, and History

For the purposes of this research study, a technology-based music class is defined as a course where music concepts and skills are introduced, reinforced, and assessed primarily through student use of computers and related digital tools. This is not a definition most students are likely to encounter. The MTCI included an open-ended response field for the actual TBMC course title. Responses were alphabetized for analysis by frequency count. Some variations were combined based on key words in the title. The most frequently mentioned titles are included in Table 12. Music Technology, including leveled courses, were more common (n = 28) than titles using electronic, digital, or production in the name. A semester class length (n = 35) was the most common format followed by a full year class (n = 24).

Table 12

Most Frequently Mentioned TBMC Course Titles

Course Title	Frequency
Music Technology	14
Music Technology (Leveled, i.e., I-II-III-IV)	14
Music or General Music	10
[a]Electronic Music	5
Music Production	4
[a]Music Theory	4
[a]Digital Music	3
Technology Assisted Music	2

Note. This table includes only course names mentioned more than once.
[a]Includes permutations (e.g., Electronic Music Lab and Electronic Music Composition).

Many advocates of TBMC believe these courses will serve students not typically enrolled in ensemble based music classes (Shuler, 2011; D. B. Williams, 2011). Most participants believe reaching non-traditional music (NTM) students is important. When asked to rate agreement with that proposition, the response average was 2.7 on a scale of 0 = *Strongly Disagree* and 3 = *Strongly Agree*. This priority is reflected in the percentage of students enrolled in TBMC who do not otherwise participate in ensembles. A lower percentage indicates more NTM reach. Responses ranged from 0%–100% with an average participation rate of 32.9%. This average is higher than the median of 20%, due to six participants reporting a full 100% participation rate. However, five of those six reported having 15 or fewer students, making the median a more accurate statistic for the entire group.

Participants who taught multiple TBMC were asked to consider a single class most reflective of their program or teaching philosophy. Unfortunately, that direction was unclear or improperly placed in the survey flow with regard to class enrollment numbers. Some participants reported very large enrollments, which were likely program totals. The range for this item was

3–600 students, with the two highest enrollments reported by elementary and middle school music teachers. Median enrollment for all participants was 22 students with 68% of teachers reporting 30 or fewer students.

The age of TBMC ranged from 1–30 years in their current form with the median course having existed for four years. Given the wide range of class history and concentration of responses from the Northeast US, course age was analyzed by region. TBMC age is similar across regions with averages between 7.5 and 8.3 years. Most courses were proposed and developed by the instructor (*n* = 28). Most of the remaining courses (*n* = 19) were proposed by someone else, that is, an administrator, but developed by the instructor.

The Lab: Configuration, Hardware, and Software

In a similar format to TBMC described in the literature, the teachers in this study indicated that their classes are primarily taught in a dedicated lab (*n* = 25) or a room that also holds ensemble classes (*n* = 26). A variety of operating systems were reported across all lab and classroom configurations. MacOS was the most frequently reported (*n* = 39) followed by ChromeOS (*n* = 34) and Windows (*n* = 26). Thirty-six percent of teachers reported having access to multiple operating systems. For a majority of those teachers (*n* = 17) ChromeOS was available alongside either Windows or MacOS. Chi-square tests did not result in significant differences between classroom configuration and operating system with the exception of ChromeOS as the sole operating system used by teachers with portable laptop carts (*n* = 3). Given the small number of participants in various categories, often fewer than ten, additional significance testing was not performed.

Students enrolled in the TBMC described in this study have access to a wide variety of hardware. Participants were asked to select the hardware available in their labs from a list of 19 categories based largely on Dammers' (2012) Teacher Survey. The 10 most reported categories are included in Table 13 alongside software titles. The full hardware data is included in Figure 2. As a combined category, laptop computers, desktop computers, and Chromebooks were the most available hardware (*n* = 114). MIDI keyboard controllers were the most reported (*n* = 50) non-computer hardware category. All but three teachers reported having access to multiple categories of hardware with an average of eight unique categories per participant. In addition to researcher defined categories, participants were asked to share other types of hardware they may have. One participant stated, "too many to list." Another shared, "at least 10 different types."

Table 13

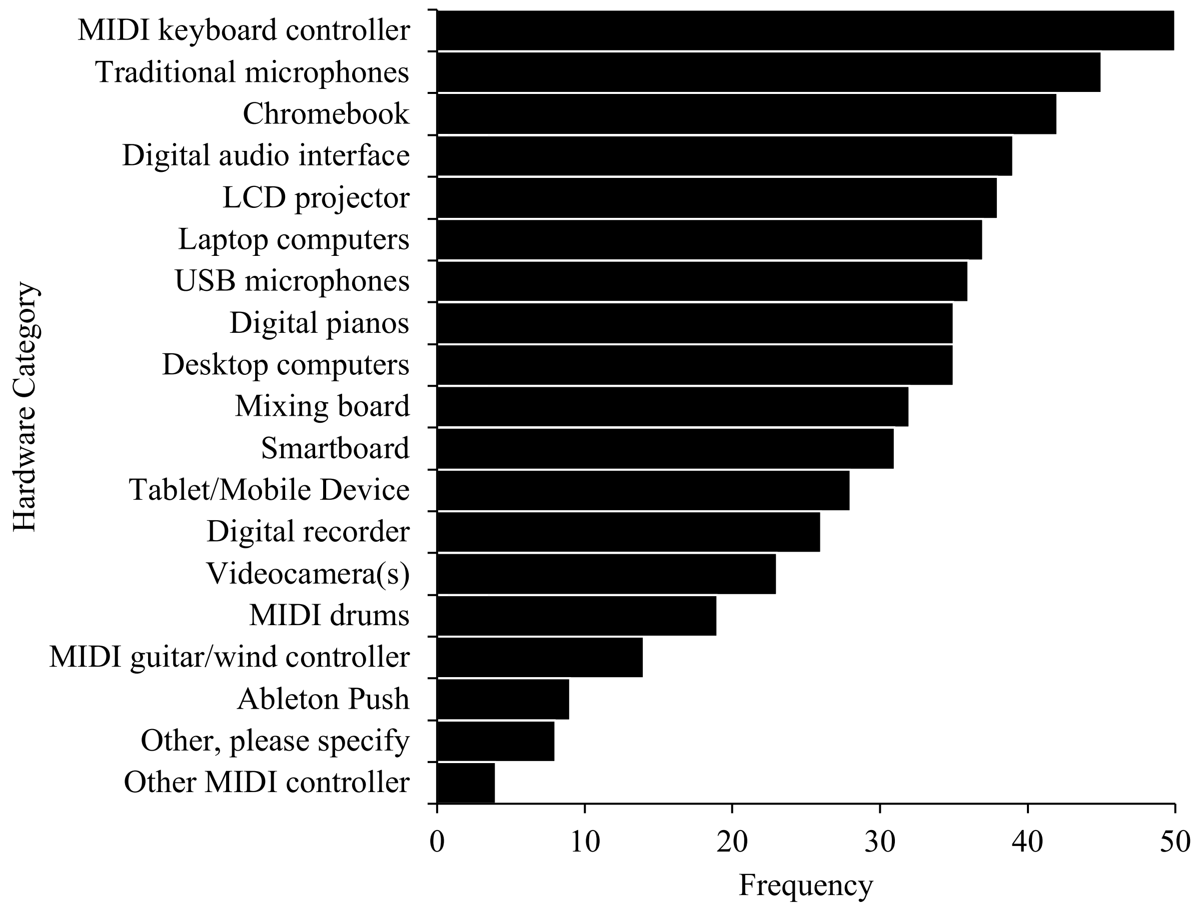
Hardware and Software Available to Students

Hardware Category	*n*	Software Title	*N*
MIDI keyboard controller	50	Soundtrap	40
Traditional microphones	45	GarageBand	34
Chromebook	42	Noteflight	26
Digital audio interface	39	Audacity	19
LCD projector	38	Finale	17
Laptop computers	37	Logic	17
USB microphones	36	Sibelius	15
Desktop computers	35	Musescore	14
Digital pianos	35	Pro Tools	13
Mixing board	32	Ableton Live	13

Note. *N* = 69. This table includes the 10 highest mentioned hardware and software options.

Figure 2

Frequency of Available Hardware Categories

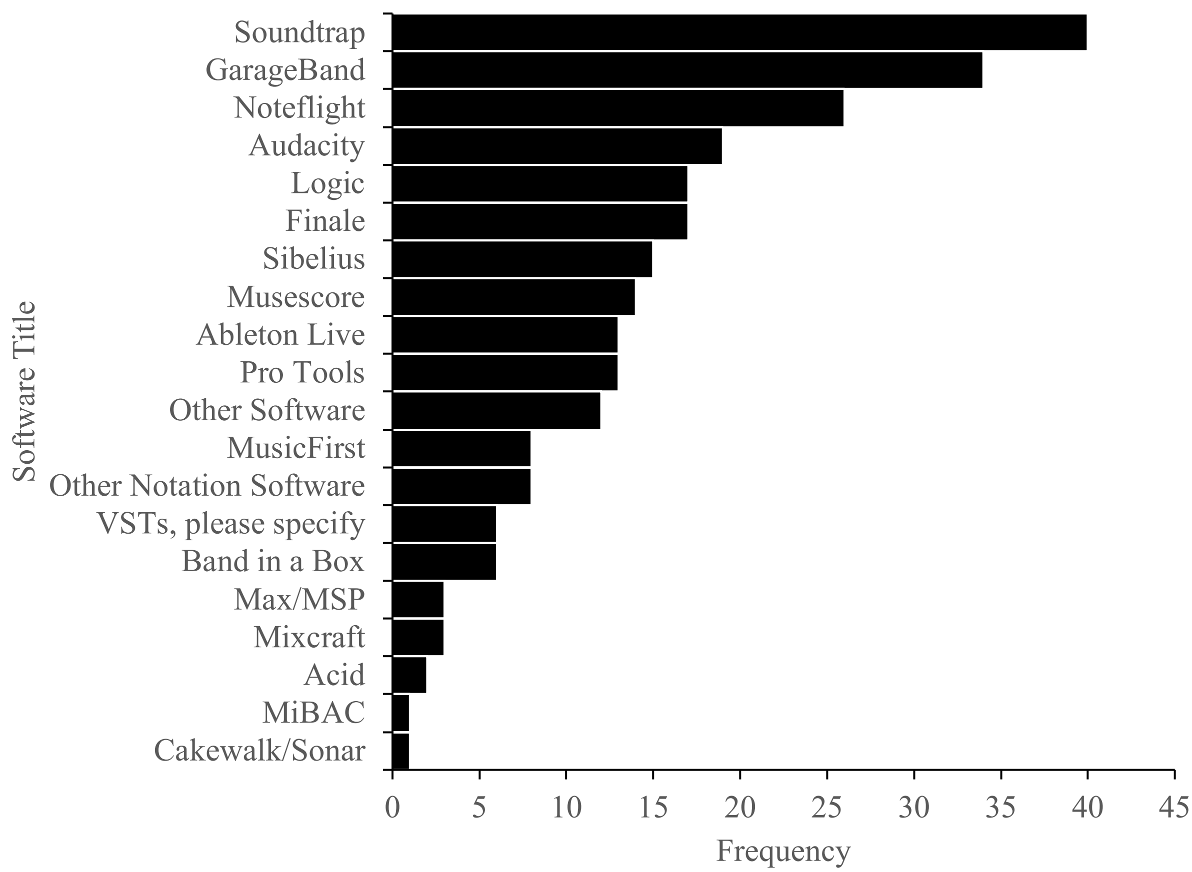


Note. N = 69. The "other hardware" list included headphones and a theremin. The "other MIDI controller" list included APC and Maschine.

A similar item was included in the MTCI for software. The list available to participants was also based on Dammers' (2012) survey but was updated to include more recently published titles. A frequency chart of results to this item is included in Figure 3. Digital Audio Workstations (DAWs) are software applications designed for recording, composing, and editing music. The DAWs reported in this item were Soundtrap (n = 40), GarageBand (n = 34), Audacity (n = 19), Logic (n = 17), Pro Tools (n = 13), Ableton Live (n = 13), Mixcraft (n = 3), Acid (n = 2), and Cakewalk/SONAR (n = 1). DAWs account for seven of the 10 most frequently listed software titles and 57% of all software mentions. Music notation programs were the next most frequently listed category with Noteflight (*n = 26*), Finale (*n = 17*), Sibelius (*n = 15*), and Musescore (*n* = 14) receiving the most mentions accounting for 28% of all software. Flat.io, a web-based notation program, was not included in the MTCI list but was mentioned by four participants. Similar to hardware, most participants (*n* = 57) have access to more than one software title with an average of four titles per teacher.

Figure 3

Frequency of Available Software Titles



Note. N = 69. The "other software" titles included Bandlab, Reason, Studio One, and Chrome Music Lab. "Other Notation Software" included flat.io and Hyperscore.

The Curriculum: Course Objectives, Activities, Standards, and the Use of Curriculum Guides

The previous section, The Class, described who might be enrolled in TBMC, the title of the class, and other features of its structure and history. In The Lab section, results were centered around the classroom itself, specifically the type of room and the hardware and software available. This section addresses what musical and technological skills and understandings participants believe their students should master well as some influential materials in the curriculum decision making process.

A range of music genres are included in participant curricula. Table 14 includes the average scores on a 0–3 scale of frequency of use for eight genres. Pop, hip hop/rap, and rock are the three most frequently addressed. Classical, folk, jazz, and world music received lower average scores, but each of those genres still received "very frequent" use ratings from an average of six teachers each. Participants could also share genres not included in the list. Three participants listed film scores and two listed country. Single listed genres included gospel, blues, soul, disco, and video game soundtracks.

Table 15 includes the results of an item asking participants to rate the importance of developing certain TBMC specific skills. Creating/composing, listening skills, and vocational skills, which would include an understanding of music equipment and the music industry, were rated positively with average agreement 2.2 or higher on a 0-3 scale. No participants in this study rated creating/composing and listening skills as unimportant. Performance skills were rated the lowest with fully 18 participants believing the skill to be unimportant.

Table 14

Frequency of Music Genres Used in Class

Genre	*M*	*SD*
Pop	2.1	0.7
Hip Hop/Rap	2.0	0.8
Rock	2.0	0.6
EDM/Techno	1.9	1.0
Jazz	1.3	0.8
World	1.3	0.9
Classical	1.0	1.0
Folk	0.9	0.9

Note. *N* = 69. Scores based on participant responses to a rating scale with 0 = *Infrequently* and 3 = *Very Frequently*.

Table 15

Curricular Priorities of TBMC Teachers

Skill Development Category	*M*	*SD*
Creators/Composers	2.6	0.6
Listeners	2.6	0.6
Vocational Skills (Music Production)	2.2	0.8
Performers	1.2	1.0

Note. *N* = 69. Scores based on participant responses to a rating scale with 0 = *Unimportant* and 3 = *Very Important.*

In addition to rating their level of agreement with those four skill objectives, participants were asked to list the most important objectives for musical content/understanding, musical skill, technological content/understanding, and technological skill in an open-ended response field. These responses were analyzed using the basic content analysis approach described by Drisko and Maschi (2016). That procedure began with downloading all responses into separate documents for each objective. Lists were generated by grouping identical or similar responses into researcher titled categories. Both the categorized lists and the original responses were shared with a consultant with expertise in qualitative research methods and music technology. The consultant made recommendations to adjust category titles and move some responses from one category to another. Table 16 includes the final categories and frequency counts.

Table 16

Most Important Course Objectives

Musical		Technological	
Content/ Understanding	Skill	Content/ Understanding	Skill
Music Theory (*n* = 13)	Composing (*n* = 9)	Software Specific Knowledge (*n* = 20)	Software Specific Skill (*n* = 21)
Appreciation (*n* = 11)	Rhythmic Competency (*n* = 6)	Acoustics (*n* = 2)	Music Production Equipment (*n* = 4)
Form (*n* = 11)	Listening (*n* = 5)	Composition (*n* = 2)	Recording (*n* = 4)
Composition (*n* = 2)	Applied Music Theory (*n* = 4)	Hardware Knowledge (*n* = 2)	Audio Editing (*n* = 2)
Notation (*n* = 2)	Beatmaking (*n* = 3)	History of Music Technology (*n* = 2)	Audio Effects (*n* = 2)
	Instrumental Technique (*n* = 3)	Mixing (*n* = 2)	Professional Portfolio (*n* = 1)
	Keyboard Skills (*n* = 3)	Sound Design (*n* = 1)	
	Notational Literacy (*n* = 2)	Signal Flow (*n* = 2)	
	Audiation (*n* = 1)		
	Aural Transcription (*n* = 1)		

Note. Several responses in each list were unclassifiable as they did not address the prompt. These were categorized as "*Unknown/Unclassifiable*," verified as such by the expert research assistant, and omitted from reporting.

The most important musical skills and knowledge objectives listed by participants included music theory, composition music appreciation, and rhythmic competency. Skills and knowledge needed for participation in performance ensembles, such as notational literacy and instrumental technique, were mentioned less frequently. Beatmaking was mentioned, as "creating beats" or "making beats," by three participants.

The most important technological skill and knowledge objectives related to operating music composition software, regularly referred to as Digital Audio Workstations (DAWs) by participants. More statements were made under this category than the remaining objectives combined. Specific software titles mentioned included Soundtrap, GarageBand, and Ableton Live. Most participants framed their technological objective as being facilitated by software, reinforcing the "student use of computers" aspect of the definition of TBMC in this study. Examples included "use a DAW to edit audio," and "record and mix using a DAW."

Another source of input for the curriculum work of music teachers designing TBMC is professional music education standards. A list of standards documents commonly found in general music education and TBMC specific literature was compiled and participants were asked to state how often they use each document on a five-point rating scale. The full results of that item are summarized in Table 18. Average ratings for all standards documents fell short of a frequent use rating. The National Core Arts Standards (NCAS) for music, developed in partnership with NAfME, along with state music-specific standards were rated the highest. Other standards documents mentioned that were not a part of the list included the International Society for Technology in Education (ISTE) standards and local school district music standards, although these were only mentioned by one teacher each.

Table 17

Professional Music Education Standard Use

Standards Document	*M*	*SD*
NCAS/NAfME	2.6	1.4
State music-specific	2.6	1.5
State Technology specific	1.6	1.5
TI:ME	1.3	1.4
National Educational Technology Standards	1.1	1.3
Other standards document	0.7	1.3

Note. *N* = 69. Scores based on participant responses to a rating scale with 0 = *Never* and 4 = *Very Frequently*.

To add more clarity to the use of standards documents, participants were asked how they utilize the documents in their curriculum work. Table 18 summarizes responses to five statements using a five-point rating scale (0 = *Strongly Disagree*, 4 = *Strongly Agree*). Two curricular purposes, determining what to teach and evaluating students, were as similarly rated as the more pragmatic purpose of satisfying a teacher evaluation program. Most teachers reference standards documents, even if for very different purposes. Only 11 teachers agreed or strongly agreed with the statement "I do not reference standards."

Table 18

Specific Application of Standards Documents

Application	*M*	*SD*
Evaluate students	2.7	1.0
Satisfy teacher evaluation program	2.6	1.2
Determine what to teach	2.5	1.1
[a]Use for some other purpose	1.8	1.5
I do not reference standards	1.4	1.3

Note. Scores based on participant responses to a rating scale with 0 = *Strongly Disagree* and 4 = *Strongly Agree*.
[a]*n* = 29 participants did not make a selection for this item. Four participants utilized an open-ended response box to clarify their other purpose use. These responses tended to comment on standards use generally. For example, one participant stated, "to bring validation of the class for those concerned with curriculum."

Specific standards documents represent just one of many sources of information music teachers use when designing TBMC. According to the Common Core State Standards Initiative, "education standards . . . are not a curriculum. Local communities and educators choose their own curriculum, which is a detailed plan for day to day teaching" (Core Standards, n.d.). The MTCI includes three items which ask participants about the materials they reference during curriculum work. The first item was a yes/no format question which reads "do you use one or more published music technology curriculum guides? If so, which ones?" Most teachers (*n* = 47) answered no, and their responses were excluded from analysis of the follow-up question regarding use of materials, which is summarized in Table 19. The most common usage style involves adapting the material or supplementing from another source or sources.

Table 19

Use of Published Curriculum Guides

Curriculum Design Approach	*M*	*SD*
Use but adapt to fit needs	3.5	0.7
Use but supplement lessons with other materials	3.3	0.9
Use sparingly	2.6	0.9
Follow as closely as possible	2.5	0.8
Some other way	2	1.3
[a]I do not use	1.4	1.2

Note. *N* = 22. Scores based on participant responses to a rating scale with 0 = *Strongly Disagree* and 4 = *Strongly Agree.*
[a]This statement was included to validate the previous yes/no response item. Among teachers who said they did not use published curriculum guides, the average agreement rating for this statement was 3.7 out of 4.

Many more participants (*n* = 56) reported using other curriculum materials, which can include websites, social media groups, podcasts, and other similar resources. The distinction between published guides and other materials was made to recognize the affordance and constraint tradeoffs of both categories, specifically curation and quality versus speed of distribution. Table 20 includes published curriculum guides and other materials mentioned by participants. Most of the other materials are web-based resources, such as YouTube and Norton Online's Shed the Music. These two lists include TBMC-specific, general music, and non-musical resources. The features and curricular implications of the resources identified by participants are discussed in the next chapter.

Table 20

Most Frequently Mentioned Curriculum Materials

Published Curriculum Guides	Other Materials
[a]*Alfred's Basic Adult Piano Course*, Various, (n.d./various)	Ableton Learn Audiotool
The Musician's Guide to Theory and Analysis, J. Clendinning and Marvin (2020)	Copyright.gov EarSketch
Electronic Music School, Hein and Kuhn (2021)	GamePlan/West Music MusicFirst
Foundations of Music Technology, J. Manzo (2016)	Shed The Music/Rewire Music Theory Sweetwater Resource Articles
Music Technology 101, Edition Not Specified	Syntorial Theta Music Trainer
Music Technology Cookbook, A. Bell (2020)	WhoSampled.com Shed The Music/Rewire Music Theory
[a]*Spotlight on Music Series*, McGraw Hill, (various)	YouTube
Teaching Music Through Composition, B. Freedman (2013)	
[a]*The Music Technology Project Bundle*, Digital Music Innovations (n.d.)	
Using Technology to Unlock Musical Creativity, S. Watson (2011)	

[a]Participants identified the entire collection for each of these series.

Music Educator Curriculum Orientations

In addition to collecting and organizing exploratory data about the design of TBMC curriculum, this study also sought to determine what music educators believed about the purposes of education. The curriculum orientations model is predicated on the assumption that teachers hold beliefs that may align with five specific areas of emphasis, and that those beliefs will influence the curriculum decisions of teachers. The five areas of emphasis, based on original work from Eisner and Vallance (1974), are termed academic rationalism, humanistic, cognitive process, social reconstruction, and behavioral orientations. The definitions of each orientation are included in Appendix A. A detailed explanation of each orientation is included in Chapter 2.

Cheung and Wong (2002) developed and tested a 36-item survey for the model. Their Curriculum Orientations Inventory was further tested and refined by Jenkins (2009). The MTCI included a shortened version of the COI with three items for each orientation. The procedures for selecting those items are described in Chapter 2. Participants rated their agreement on a five-point scale. Table 21 includes the orientation-level Cronbach's α scores reported in those studies alongside results from Dean (2016) and, lastly, the results of this study. RStudio (RStudio Team, 2022) was used to perform the statistical tests in this section and to render graphical representations of the data. Table 22 includes a COI item correlation matrix.

Table 21

Comparison of COI Reliability Coefficients

	Research Study			
Curriculum Orientation	Cheung and Wong (2002) *n* = 648	Jenkins (2009) *n* = 308	Dean (2016) *n* = 89	[a]Current Study *n* = 60
Academic Rationalism	.78	.66	.52	.78
Cognitive Process	.77	.61	.59	.76
Behavioral	.83	.74	.87	.84
Social Reconstruction	.78	.85	.65	.81
Humanistic	.79	.76	.78	.85

[a]The three previously published studies utilized the full version of the COI. The number of items in this study was reduced to three per orientation due to the overall length of the MTCI.

The mean agreement with each orientation ranged from 2.93 to 3.13 on a five-point scale (1 = Does not represent my views, 5 = Represents my views exactly). One-sample *t*-tests were performed on each orientation against a neutral agreement score of three. No significant differences were found between participant responses and neutral agreement, indicating only nominal agreement with the academic rationalism, humanistic, behavioral, and cognitive process orientations and disagreement with the social reconstruction orientation. Social reconstruction items correlated negatively with the rest of the items and that orientation had the lowest internal consistency.

A correlation matrix using Spearman's Rho was performed in R Studio. Responses for academic rationalism, humanistic, behavioral, and cognitive process orientation items correlated approximately as well across orientations as they did within each, suggesting that most participants did not perceive or value a meaningful difference between these four orientations. The three highest correlations were between academic rationalism and behavioral (A2:B2, r(60) = .85, $p < .001$; A2:B3, r(60) = .77, $p < .001$) and cognitive process and humanistic (CP2:H3, (60) = .77, $p < .001$). This is not to say that some participants did not value one orientation over

Table 22

MTCI COI Item Correlation Matrix

COI Item	COI Item														
	A1	A2	A3	H1	H2	H3	B1	B2	B3	CP1	CP2	CP3	SR1	SR2	SR3
A1															
A2	.37**														
A3	.68***	.62***													
H1	.03	.59***	.41**												
H2	.3*	.52***	.5***	.66***											
H3	.13	.65***	.41***	.7***	.64***										
B1	.42***	.54***	.49***	.27*	.3*	.46***									
B2	.4**	.85***	.69***	.55***	.49***	.59***	.58***								
B3	.27*	.77***	.56***	.56***	.46***	.67***	.59***	.73***							
CP1	.17	.67***	.44***	.68***	.69***	.7***	.38**	.56***	.59***						
CP2	.27*	.79***	.54***	.58***	.62***	.77***	.47***	.69***	.71***	.74***					
CP3	.35**	.39**	.44***	.24	.31*	.45***	.54***	.42***	.58***	.36**	.47***				
SR1	-.04	-.52***	-.28*	-.39**	-.23	-.4**	-.29*	-.43***	-.52***	-.3*	-.41**	-.02			
SR2	-.16	-.46***	-.3*	-.21	-.11	-.25	-.33**	-.33**	-.45***	-.29*	-.34**	-.06	.84		
SR3	-0.19	0	-.2	.23	.12	.31*	-.02	.01	0	.18	.15	.15	.38**	.54***	

*$p < .05$. **$p < .01$. ***$p < .001$

another, however. The next section describes the process for identifying these participants, forming groups, and comparing their responses on selected MTCI items from the TBMC section.

Assigning Exploratory Groups

No significant differences between group response and a neutral attitude were identified for any orientation. Therefore, the theoretical considerations of the curriculum orientations model were used to identify two groups of participants whose responses to TBMC items could be compared. Academic rationalism, the orientation with the highest mean agreement, holds that the most important objective of learning is the mastery of discipline-specific content. “To the academic rationalist," Morton (2012) stated, "it is self-evident that teaching music is the purpose of music education" (p. 480). Morton was critical of this orientation, claiming that its disconnected nature ignores "education's moral obligations to promote social justice and ecological sustainability" (p. 479). Those concerns would be most associated with a social reconstruction orientation. Not only are academic rationalism and social reconstructionism theoretically opposed, but they also received the highest and lowest agreement means among participants in this study.

From the total group of participants, two sub-groups were identified based on their agreement with either academic rationalism or social reconstructionism. A list of teachers rating one or the other orientation sub-scale total at 10 or above ($n = 27$ for both) was created. Some teachers fit both groups by rating academic rationalism and social reconstructionism above the threshold. Cheung and Wong (2002) and Jenkins (2009) noticed a similar pattern which they termed complimentary pluralism. To clarify any potential difference between the two exploratory groups, these individuals were excluded from analysis resulting in two groups of $n = 19$ each. It should be noted that this approach has statistical limitations introduced by the low internal consistency of the social reconstruction orientation, the small group sizes, and the exclusion of an interesting but confounding group, and should therefore be considered exploratory and ungeneralizable.

Select Item Comparison Between Participant Groups

Five TBMC items were identified as being the most likely aspects of curriculum to vary depending on an individual teacher's curriculum orientation. The items addressed course outcomes, the music genres used in class, the use of published music technology materials, and the standards documents referenced during curriculum work. Given the exploratory nature of this research project and the statistical limitations introduced by the comparison groups, nonparametric tests were not performed. Instead, mean agreement scores for each item are represented visually for participants assigned to the social reconstruction (SR) group, academic rationalism (A), and the full sample of *N* = *69* teachers.

Responses across the two comparison groups and the full sample appear to be strikingly similar. The widest range in response occurs in the item related to the use of published curriculum guides represented in Figure 7. For all other items, the difference between group means of agreement is less than 0.5. Figures 4, 5, 6, 7, and 8 visualize the group comparison data with one figure for each item. The complete text for each item can be found in Table 8 and Appendix F.

Figure 4

Group Comparison of MTCI Question 2—Skill Development

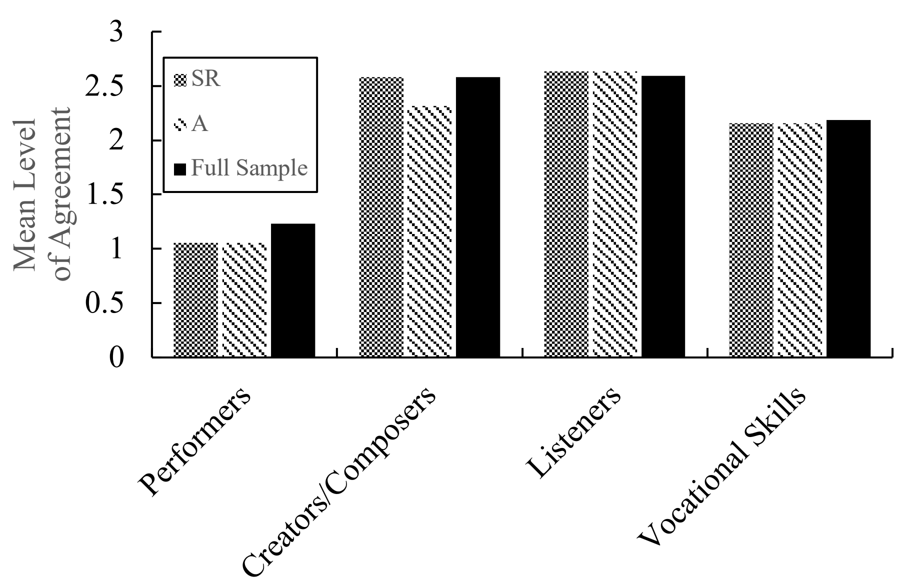


Figure 5

Group Comparison of MTCI Question 6—Music Genres Used in Class

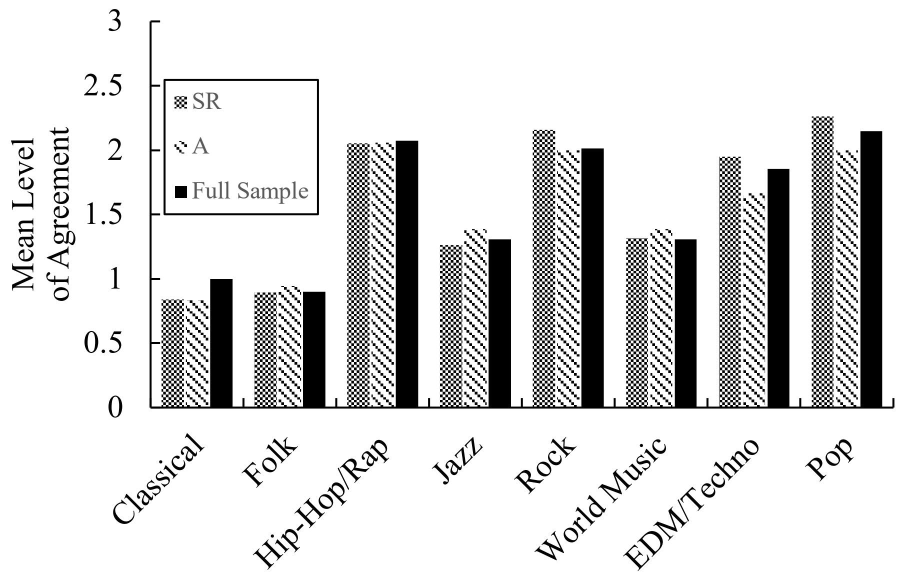
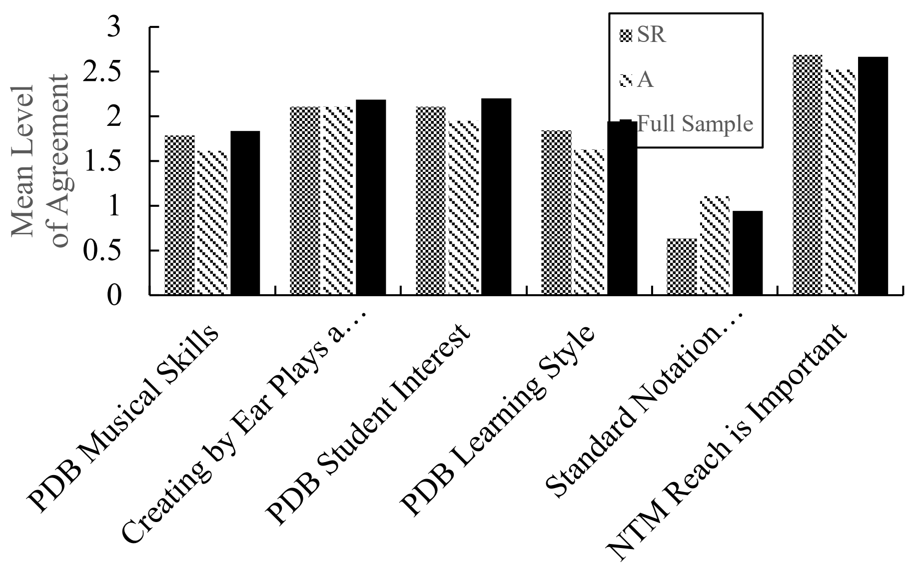


Figure 6

Group Comparison of MTCI Question 7—Class Activities



Note. PDB is an abbreviation for Projects Determined By… NTM is an abbreviation for non-traditional music students.

Figure 7

Group Comparison of MTCI Question 10—Use of Published Curriculum Guides

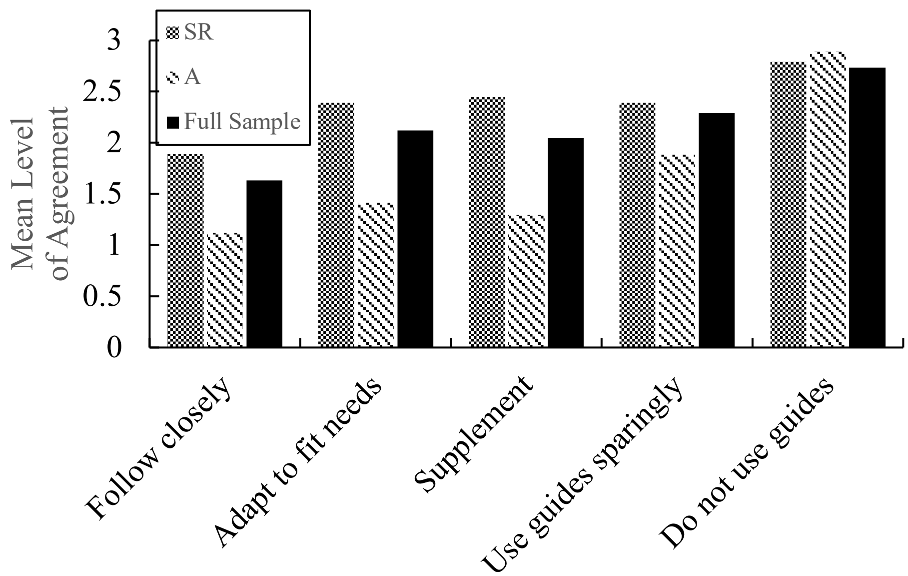


Figure 8

Group Comparison of MTCI Question 16—Standards Document Use

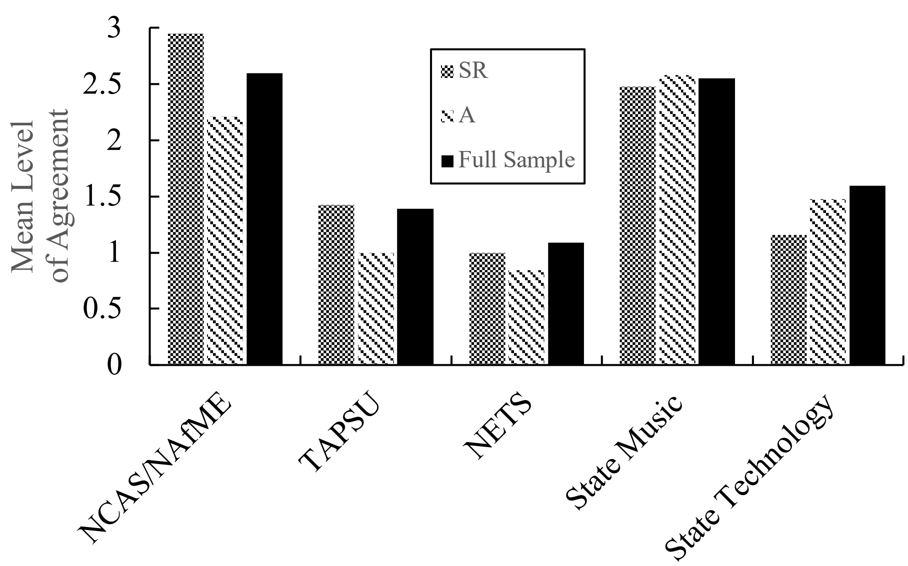


Table 23

Index of Results

Section	Topics
Demographics	Participant gender, race/ethnicity, teaching state, years of experience, performance background, teaching level, and courses taught
TBMC	
The Class	Course title, length, non-traditional music student involvement, enrolment, and years in existence
The Lab	Classroom setup, computer operating system, hardware, and software
The Curriculum	Music genres addressed in class, overall course objectives, specific musical/technological content and skill objectives, standards documents, curriculum guides
Curriculum Orientations	Agreement with each orientation, inter-item correlations, exploratory groups, TBMC item comparison between groups

Summary

This chapter summarized the results of MTCI responses collected in the spring of 2022. Survey items correspond to one of three categories: demographics, TBMC, and curriculum orientations. An index of each category, the topics included, and page numbers is included in Table 23. While responses were varied for select demographic items and nearly all TBMC items, participants in this study indicated a high degree of similarity in their attitudes toward the curriculum orientations. A comparison between a subset of teachers ($n = 19$) who favored academic rationalism and a subset who favored social reconstructionism yielded nearly identical agreement on selected TBMC items, not only between the two groups but also with the total sample. This response pattern, along with responses in the demographic and TBMC categories, raises important implications for the future of music technology classes. These implications as well as a discussion of each research question are included in the following chapter.

CHAPTER V

DISCUSSION

Introduction

The descriptive design of this exploratory research study was chosen to inform stakeholders about a novel and expanding curricular practice, namely, technology-based music classes (TBMC) in the United States. Many research studies and other publications addressing this phenomenon report or describe individual classes. Therefore, a need was identified for a national survey of current practice. This chapter includes comparisons between the results and similar research studies in the literature, a discussion of the specific questions under investigation in this study, study limitations and delimitations, themes and implications, and suggestions for further research.

TBMC Items and Dammers (2012) Teacher Survey

A key distinction between Dammers' (2012) study and this research project can be found in the recruiting method. The exact procedure for this study is detailed in Chapter 3, but can be broadly described as non-random purposeful and snowball sampling via email and social media recruitment. Dammers, in contrast, recruited TBMC teachers (n = 29) through a convenience sampling process in which the survey was sent to teachers first identified by school principals. Both approaches have their advantages, disadvantages, and modes of sampling error. However, the use of these identical items with data collected approximately 10 years apart represents a unique contribution to the literature.

An author's note in Dammers' (2012) publication stated that "some of the results of this study were presented at the 2010 Association for Technology in Music Instruction Conference" (p. 83), indicating that the data were collected at least as early as that year. Nevertheless, for the remainder of this section, results from the two studies are referred to as Dammers (2012) and Thompson (2022). This section begins with teacher background, then moves to musical genres used in class, course objectives, and the lab including available hardware and software.

Table 24

Comparison of Music Participant Demographics 2012–2022

Characteristic	Dammers (2012)	Thompson (2022)
Gender (%)		
Male	77	58
Female	-	28
Non-binary/third gender	-	1
Prefer not to say	-	1
No Response	-	12
Overall Teaching Experience (%)		
0–9 Years	9	21
10–19 Years	31	26
20+ Years	59	40
No Response	-	13
Performance Background (%)		
Winds/Strings/Percussion	59	66
Keyboard	18	6
Vocal	18	14
Other	5	-
No Response	-	12
Courses Taught (%)		
TBMC and other music classes	91	81
TBMC only	9	7
No Response	-	12

Note. A dash indicates either non-reported data or irreconcilable analysis categories.

Table 24 includes a comparison of available teacher demographic and background data. The sample in the present study reflected a slightly more gender diverse group of teachers, and more teachers were in their first decade of teaching. Dammers did not ask participants to share their race/ethnicity. Fewer teachers in 2022 held a keyboard performance background. The variance in experience could be attributed to recruitment procedures. If social media activity skews young, then more teachers responding to the online survey would be in the earlier stages of their careers. Alternatively, changes in education and employment policy including early retirement buyouts, alternative paths to classroom teaching such as Teach for America, and other factors may have influenced the demographics represented in the two studies.

Rock, classical, and jazz were the three most frequently addressed genres in 2012. Classical and jazz were not included frequently by music teachers in the present study. Table 25 lists participant frequency of use for the two studies. The highest rated genres in 2022 were pop, hip-hop/rap, rock, and EDM/Techno. This difference could be attributed to the curricular priorities of teachers in the present study. Mercado (2019) conducted a review of literature on the field of "popular, informal, nontraditional, out-of-school, and vernacular music" (p. 30) in music education settings from 2012 to 2019. Several authors cited in that literature review found that popular music genres are especially relevant in the instruction of composition and improvisation. Composing was the most frequently listed musical skill objective form participants in this study. Beatmaking, a compositional practice most closely identified with hip-hop/rap and related genres, was also mentioned.

Table 25

Comparison of Music Genre Used in Class 2012–2022

Genre	Dammers (2012)	Thompson (2022)
[a]Classical	>1.5	1.0
Folk	<1.5	0.9
Hip Hop/Rap	<1.5	2.0
Jazz	>1.5	1.3
Rock	2.2	2.0
World	-	1.3

Genre	Dammers (2012)	Thompson (2022)
EDM/Techno	-	1.9
Pop	-	2.1

[a]Some genre totals were reported only as above or below the scale midpoint of 1.5.
Note. Scores based on participant responses to a rating scale with 0 = *Infrequently* and 3 = *Very Frequently*. A dash indicates either non-reported data or irreconcilable analysis categories.

Participants in the two studies shared similar rates of agreement with various course objectives and curriculum decisions. Notational literacy and performance skills, often associated with classical music in classroom contexts, were not valued as highly as composition by the teachers in both studies. Creating, listening, and vocational skills were rated important in both groups. A majority (89%) of teachers valued reaching non-traditional music (NTM) students in 2012. Support for that aim was nearly ubiquitous in 2022, with 96% of teachers agreeing or strongly agreeing that reaching NTM students is an important consideration.

Recent technological developments are reflected in the 2022 responses. Among them include the release, and subsequent adoption by many school systems, of the Chrome operating system in 2011 (McCready, 2019). MacOS was still the most commonly mentioned operating system in 2022 as it was in 2012, but more teachers in 2022 reported using Chrome-based computers (Chromebooks; $n = 34$) than computers running Windows ($n = 26$). This hardware shift had important implications for the software category.

With the new availability of Chromebooks, teachers appear to be embracing free and web-based software applications. GarageBand, a digital audio workstation (DAW), and Sibelius, a notation program, were the two most reported software titles in 2012. Both of these programs require a standard installation on a traditional computer. In the case of GarageBand, that computer must run MacOS. Chromebooks cannot locally install any application. Instead, these computers allow users to access the internet and run web-based applications. The most frequently reported music software in 2022 was Soundtrap. This inexpensive, web-based application released in 2013 allows users to compose and edit music in an interface similar to GarageBand and other DAWs, but can be run on any computer with an internet connection including inexpensive Chromebooks (Soundtrap, n.d.). Noteflight, a web-based notation program, is available in almost twice as many classrooms than Sibelius in 2022.

When viewed together, teachers in 2012 and 2022 shared similar curricular priorities and course objectives but disagreed on the most important music genres. Other major differences between the two groups are in demographics and the resources available in the classroom, especially in the software available to students. More early-career teachers responded to the survey in 2022. Web-based software titles and Chromebooks, the web-based computing platform, which were not available in 2012 are in widespread use today. The TBMC items in the MTCI performed well and can be used in future studies to track developments in curricula. The following section compares the results of the Curriculum Orientation Inventory (COI) items in this study with results from Jenkins (2009).

Curriculum Orientations Inventory Items and Jenkins (2009) Survey

Eligibility to participate in this study was limited to US public school music teachers who teach at least one TBMC. Jenkins' (2009) sample of teachers was heterogeneous, including teachers of a range disciplines in elementary and secondary classrooms. That sample included teachers from six states representing all geographic regions of the United States. Although Jenkins received more completed surveys (n = 308), the sample size in this study may be greater, assuming a population total of approximately 2,500 teachers.

Jenkins outlined several conclusions about the teachers surveyed and the COI itself. The most relevant to the phenomenon under investigation in this study was that complimentary pluralism was not supported by the data. Mean orientation responses from teachers in that study ranged from 3.22 to 3.92 with 3 representing a neutral attitude. Correlations between orientations were weak to moderate. The teachers of TBMC sampled in this study responded in a similar pattern. Responses were only slightly lower, ranging from 2.93 to 3.13, and correlations were likewise weak to moderate also rejecting complimentary pluralism. The narrow range in response resulted in significant inter-item correlations at very low *p*-values.

Jenkins (2009) used demographics, specifically gender, school level, subject area, and teaching experience, as independent subject variables to measure their effects on curriculum orientation. Some significant differences were found for those variables, particularly with the humanistic orientation. In the present study, orientation agreement was used to compare selected TBMC curriculum decisions. Surprisingly, no significant differences were found in any of the TBMC items between teachers supporting either academic rationalism or social reconstruction orientations.

The curriculum orientations initially proposed by Eisner and Vallance (1974) have proven useful to scholars for nearly 50 years as a theoretical model of approaches to curriculum. The curriculum orientations inventory was developed more recently to measure agreement with those orientations, and it seems to perform that function adequately. However, if measured differences in orientations do not result in varied curriculum outcomes, as was the case in this study, perhaps the COI is not well-suited for music education research. The implications of this finding are explored further in the section addressing research question two. The next section begins a discussion of the results as they relate to each specific research question in turn.

Discussion of Research Question One

What are the features of technology-based music class (TBMC) curricula?

The features of technology-based music class (TBMC) curricula include what D. F. Walker and Soltis (2004) listed as the “purposes, content, activities, and organization of the educational program actually created in schools by teachers, students, and administrators” (p. 1). The TBMC items included in the MTCI, reprinted with permission from Dammers (2012), addressed these features. Participants in this study described curricula not dissimilar from portrayals of classrooms in previous scholarship. Among the strongest areas of similarity were the ubiquity of the computer as the central technological hub, an emphasis on composition as the primary class activity, and a reduced emphasis on music performance skills and notational literacy objectives.

The most commonly included musical genres include popular music styles such as hip-hop/rap. The stated course objectives of rhythmic competency and beatmaking align with this choice of musical material. Soundtrap, the most frequently mentioned music software application, includes over 20,000 musical phrases that can be arranged in a process called loop-based composition (Kuhn & Hein, 2021). The loops in Soundtrap are organized into categories based on instrumentation and genre. The music genres listed in Soundtrap include pop, rock, EDM, hip-hop, and R&B, and these correspond to genres mentioned by participants in the study. GarageBand, another frequently listed DAW includes a library of over 15,000 loops. Genre categories in GarageBand are more musically diverse than Soundtrap, but still feature more popular genres. For example, the hip-hop/R&B category in GarageBand contains 4,426 loops while the jazz category contains just 45.

Results to some of the classroom equipment items will have important implications for the growth of TBMC in the near future. Looking at the half-century history of TBMC in US public schools, one explanation for slower than anticipated growth at the beginning of the 20th century might be cost. In 2012, Dammers reported that that GarageBand and Sibelius were the two most popular software applications and MacOS was the most common operating system. Participants in the present study make more frequent use of less expensive web-based software applications such as the aforementioned Soundtrap and Noteflight, as well as Chromebook computers. In the case of Chromebooks, the participants in this study may be taking advantage of building-wide computer purchase programs, further alleviating budget concerns. More TBMC classes might be created in response to this cost-effective alternative.

One of the most commonly mentioned goals of TBMC in music education literature is to reach students not traditionally served by ensemble-based music classes. These non-traditional music students represent approximately 80% of all secondary students (D. B. Williams, 2011). Fully 96% of teachers in this study agreed or strongly agreed that reaching NTM students is an important priority with only two participants in disagreement. Stated support of this priority was further corroborated by enrollment statistics. Approximately 80% of students do not also participate in ensemble-based classes, a key descriptor of NTMs and an indicator that the goals of teachers are being realized in their classrooms. The implications of this conclusion will be discussed in a later section.

Discussion of Research Question Two

What are music educators' orientations toward TBMC curricula?

Participant agreement with five theoretically distinct curriculum orientations was measured using a reduced-item Curriculum Orientations Inventory (COI). The construct validity of the instrument was assessed during expert review and pilot testing, and the instrument has been used previously in published general education research studies. Music education scholars have referenced the five curriculum orientations in philosophical literature. However, this study marks the first application of the COI in music education scholarship. Previous uses of the COI examined relationships between teacher demographics and curriculum orientation. A unique aspect of the analytical approach in this study is that curriculum orientations were compared against participant music technology curriculum decisions.

Mean agreement levels were slightly above neutral for academic rationalism, humanistic, cognitive process, and behavioral orientations. Social reconstructionism (SR) received slightly below neutral agreement levels. Paired sample *t*-tests showed no significant difference between agreement among any two orientations. Researchers have observed significant differences in orientations based on teaching area, so it was surprising to find that no orientation or orientations were strongly preferred or rejected by the participants in this study. The nominal difference between SR and the remaining orientations could be attributed to the wording of items in that construct. Among the 15 items used, the three associated with SR were the only ones to include specific details about curriculum decisions. Crime, pollution, the population explosion, and other suggested areas of focus may not have resonated with participants.

TBMC curriculum decisions are not influenced by curriculum orientation. More research is needed to determine if this results from an emerging TBMC curriculum archetype in which individual teacher curriculum orientations operate in a narrowing choice frame. Alternatively, meaningful curriculum differences exist that the curriculum orientations model was not able to capture. Open ended responses to the most important understanding and skills item suggests that teachers of TBMC do hold varied priorities, particularly along the musical-technological spectrum described by Dorfman (2022). More theoretical work is needed to understand movement along that spectrum, and to identify any other factors that may add dimensionality to a model of music technology curriculum perspectives.

Morton (2012) asked three increasingly specific questions about the ends of education, curriculum, and music education. Extending that to line of inquiry to the phenomenon under investigation in this study, some might ask, *what is music technology for?* This question was not included in the MTCI. However, several participants listed composition as the most important musical skill objective in their course. Many more responses were included under the technological category, and participants agreed that vocational music production skills such as recording were more important that music performance skill.

Several questions follow from these findings, each of which could serve as research questions in future studies. Which teachers and class curricula emphasize composition more than others? Which teachers and class curricula, if any, emphasize technology-assisted performance? Which teachers and class curricula emphasize recording techniques, broadcast audio, and music industry skills? Why are teachers making these decisions? The curriculum orientations model, by design, cannot answer these questions. It seems to perform best at one or more levels of abstraction higher than these discipline-specific concerns. Suggestions for researchers are detailed below.

Discussion of Research Question Three

How do TBMC curricula align with professional music education standards?

Music educators in the United States operate in a fractured policy landscape. Teachers in this study mainly reference the National Core Arts Standards (NCAS) and state-level music standards. Since many states have or are in the process of modeling their standards after the

NCAS, this is a vital document which informs TBMC curriculum work. In addition to satisfying teacher evaluation programs, participants indicated they most often use standards to determine what to teach and to evaluate students.

The NCAS were published in 2015 and include dance, media arts, music, theater, and visual arts (National Coalition for Core Arts Standards, 2015). Standards for each discipline are included under four anchors: creating, performing, responding, and connecting. Separate sets of standards exist within music for PK–8 general music, composition/theory, music technology, guitar/keyboard/harmonizing instruments, and ensemble classes. Each separate music technology standard includes proficient, accomplished, and advanced achievement levels.

The most visible point of alignment between the NCAS and TBMC curricula described by participants is in the deemphasized role of traditional notation and music reading skills relative to other music class formats. The NCAS Music Ensemble standards include music reading skills throughout the Performance anchor. Students achieving the advanced level in the *Performance: Analyze* standard must use reading skills to examine, evaluate, and critique aspects of a performance. By contrast, the Music Technology standards mention music reading skills once, and only as a way to develop criteria for selecting music for performance. In other words, if the music technology student has no music reading skills, teachers are instructed to select accordingly.

Participants stated that they use standards, especially the NCAS, to evaluate their students. The high level of agreement with that use statement in conjunction with the specific standards document was unexpected since the NCAS do not include any assessments or specific indicators of achievement. It is possible teachers were referring to Model Cornerstone Assessments (MCAs) developed alongside the NCAS. The music technology MCA takes the form of a nineteen page lesson plan, replete with procedures for instruction, reproducible worksheets, evaluation rubrics, and other supplementary materials. One possible use for the MTCI moving forward would involve a comparison of TBMC category items with student work samples collected for the MCA.

Perhaps the largest difference between TBMC curriculum design and the NCAS is in the language of the standards compared to the vernacular of participants in this study. When asked to state the most important musical and technological objectives of their class, the participants in this study used relatively terse, direct language. “Composing” and “composing original music” is one such example of a frequently mentioned musical skill objective as stated by participants. A prerequisite to that objective is included in the Music Technology NCAS. However, the language is much more complicated and requires the use of a separate glossary to decode terminology.

> MU:Cr2.1.T.IIIa Select, develop, and organize multiple melodic, rhythmic and harmonic ideas to develop into a larger work that exhibits unity, variety, complexity, and coherence using digital and analog tools, resources, and systems.

It is not clear that this statement clarifies, or is an improvement upon, “develop ideas that may become song.” Melodic, rhythmic, and harmonic ideas are mentioned specifically in the standard. However, this degree of specificity leaves out form, instrumentation, timbre, and every other musical element a composer might need to consider. Other terminology is redundant, as is the case with *unity* and *coherence*. A strict reading of this standard requires that every “larger work” use a digital tool, digital resource, digital system, analog tool, analog resource, and analog system. This implies that a music teacher starting a new TBMC should invest in a fully analog audio system. If one suggested that this component of the standard is optional, it would call into question the remaining text as well. This would place the NCAS in the curious position of having standards comprised of non-standard, nonobligatory elements.

Of the three areas included in this exploratory study, the application of professional music education standards in TBMC settings remains the least discussed in the literature. Identifying the most frequently referenced document and collecting baseline data on the nature of use were necessary starting points. However, much more work in a variety of domains including research, policy, and advocacy is needed to promote the development, refinement, and use of enriching content standards for TBMC.

Limitations and Delimitations

The purpose of this study was to contribute to the literature an accurate summary of TBMC curricula, teacher curriculum orientation, and standards use. The MTCI was successful in providing accurate data with which to answer each research question. However, eligibility to participate is a major delimiting factor that should be observed when considering the conclusions of this study. Participation was limited to US K–12 teachers. This decision was based on a review of related literature and the specific research questions, but it necessarily excluded community and non-school institutional music education settings, university programs, and a growing cohort of bedroom music studio autodidacts. The teaching and learning experiences of these groups and individuals are worthy of investigation, but were beyond the scope of the current project.

Several important limitations should be considered when reading the claims and suggestions described throughout this chapter. First, the sample size, while large enough for valid descriptive statistical analysis, is small enough to raise concerns about generalizability to the population. It is still not known how many music educators teach one or more TBMC. Estimates and sources of evidence do not point toward a single best guess. They vary by an order of magnitude. Evidence for the highest number was provided by NAfME. Association members can list their teaching area, and more than 15,000 listed music technology at the time of recruitment. Several confounding and competing possibilities can be inferred from the less than one-percent response rate. One, the invitation to participate did not resonate with potential respondents. Two, the invitation was sent during an inopportune season when other professional tasks held greater priority. Three, music educators are over-surveyed. Four, association members hold an integration model of technology use, meaning that any music educator using technology in any setting might select music technology as a teaching area. Five, and very unlikely given evidence to the contrary, there are actually far fewer teachers of TBMC than even Dammers' low-end estimate of 2,500. Regardless of the causes, the sample size in this study is likely between 0.4% and 2.7%. Conclusions should be interpreted accordingly.

The second major limitation of this study is the capacity of this experimental, descriptive research design to address research questions one and two with the degree of verisimilitude offered by case studies and self-reported descriptions from teachers of TBMC. This was a deliberate design choice as few studies have investigated TBMC practices at the national level through survey methods. Regardless, future uses of the MTCI could include an option for participants to submit photographs of their classrooms/labs in addition to describing them in the relevant items. Participants could also volunteer to participate in follow-up interviews and focus groups, combining the benefits of broad scale surveys with qualitative methods.

A third limitation emerged as actual participants completed the MTCI. Despite a rigorous expert review and pilot testing process as well as the use of previously published survey questions used in several research studies, some items performed less well than others. Most issues arose as a result of the unanticipated number of participants teaching more than one TBMC. Although instructions did specify that participants with multiple classes were to consider the one most representative of their program, this was not as simple in practice. Responses to items related to class total, the title of the class, and important musical and technological objectives suggest that participants had difficulty isolating information about one class from their overall program practice and philosophy. Future applications of the MTCI should account for teachers with multiple classes and the roughly ten percent of teachers with wholly-TBMC programs. Survey distribution software, such as Qualtrics, can be formatted to replace boilerplate text with the name of a specific class mentioned earlier by participants. For example, instead of the directions mentioned above, participants would see the name of a specific course on each subsequent page of the survey. Alternatively, questions can be reworded to ask about class/classes/program, avoiding the issue altogether.

These limitations and delimitations are worth considering in the context of this survey as well as in ongoing TBMC research. As with all social science and education research, the healthiest bodies of literature will ask research questions best addressed through multiple paradigms and research traditions. This study represents a unique contribution to TBMC literature, especially the empirical research consisting mainly of case study designs. The next section of this chapter includes the major themes of the results and their implications.

Themes and Implications

Chapter 4 included a summary of the results of this study. The previous sections of this chapter utilized those results for a discussion of each research question in turn. This section includes a discussion from the broadest view of the data, research questions, and conclusions to draw out some important themes and their implications. The next several pages include what Miksza and Elpus (2108) believed as the major contribution of descriptive research design: the suggestion of “potential relationships among variables to explore.” This list is not exhaustive.

Readers are invited to bring their own perspectives and areas of interest within the TBMC context to interpret the results of this study accordingly. That is to say, the following themes should be considered as possible points of departure for any number of research agendas not considered here.

The first theme to explore involves the degree to which participants value musical versus technological objectives in their classes. Early in the analysis process, it became apparent that these concepts appear to be on unequal footing in the minds of participants. Based on course titles, items addressing course objectives, and open-ended responses to the most important skill and content objectives, music teachers considered technological outcomes more than musical ones. While participants were not asked to rate the comparative importance of musical and technological outcomes, the volume and complexity of technological responses was much greater than that for music. This is concerning for some of the reasons mentioned in Chapter 2, including problems associated with technological determinism; gendered conceptualizations of technology skill; limitations of contemporary software to support non-western, non-duple music; and an algorithmic bias toward ephemeral and superficial content.

Regaining a balance between music and technological outcomes may be fairly simple in practice. One can imagine a scenario where students and teachers participate in nearly identical classroom experiences to the participants in this study, but where course titles like *Hip-hop Group, Rock Band*, *Music Composition*, or *Songwriting* help foreground music concepts. Technological skills and content would still be developed, but in service to musical aims. Unfortunately, the very title and framing of this study may be contributing to a discourse that decenters music as TBMC expands.

Teacher professional role identity is likely also a factor in the balance between music and technological objectives. As secondary socialization occurs in undergraduate music teacher education programs, an effort should be made to provide experiences, and frankly the permission, for those individuals to identify as songwriters and/or composers. Music education programs in institutions with a composition degree track should recruit composition majors alongside their traditional performance-focused music education students. Institutionally accepted performance styles need to be expanded as well. The specific musical skills these students develop will matter as well. Within a few years, hip-hip and rock will have been a part of US musical culture for at least as long as was jazz before it entered the academy. One wonders for how much longer music teacher education programs will continue to ignore the most popular music genres in the US, genres that also happens to be the most common musical styles in TBMC curricula.

Complicating the previous, another theme involves to the nature of composition in TBMC curricula. Interestingly, while participants rated compositional outcomes highly and made frequent mention of composition skills and knowledge in the open-ended item, they rated notational literacy as unimportant. Those findings in light of the frequent use of popular genres and the most available software (i.e., more DAWs than notation programs) support the conclusion that students are creating music according to the notions of *postperformance* outlined by Thibeault (2012). These descriptions are contrary to the traditional, notation-heavy expectations of undergraduate composition majors and courses in composition for music education majors.

In the modern postperformance context, musical works are often composed as sounds in and of themselves, bypassing notation altogether. Traditional western notation, already strained by developments in extended performance technique, fails completely to represent equalization, reverb, compression, pitch correction, and most other expressive elements mentioned by the participants in this study. As Papert noted, "with the computer as a musical instrument, it becomes possible to create a piece of music and hear it independently of your own performance skill" (MIT Media Lab, 2018, 0:40). Many participants in this study would likely agree, and given their attitudes toward performance skills, might extend Papert's statement to include music heard independently of any performance. Yet, performance skills continue to be the primary emphasis of undergraduate teacher education programs.

A third theme draws from the results of curriculum orientation items compared to the TBMC items on course objectives. The participants in this study shared remarkably strong and similar attitudes toward the music and technological objectives of their TBMC along with notably tepid attitudes toward the curriculum orientations. It is possible that the homogeneity of this sample of music educators resulted from selection bias caused by the recruitment language, strategy, or some other factor. If this group is a representative of the population, however, the results of this study suggest that a shared set of beliefs and practices is emerging among teachers of TBMC. If this is the case, then Dammers' (2012) call for "vigorous and challenging discussions" (p. 82) in the formative stages of TBMC development is increasingly urgent.

One major concern stemming from a standardization of TBMC curricula is the threat to the cultivation of diversity described by Shevock (2017). Certainly, TBMC has been successful in reaching non-traditional music students, thereby including more students and diversifying the rosters of music classes within a school. However, the teacher of a standardized TBMC with standardized hardware and software is still responsible to the local musical cultures of their classrooms, schools, and communities. Perhaps future music teachers will meet the needs of their communities through locally developed music technologies.

Each software title mentioned by participants was written by an individual or team making deliberate design choices at every stage. Future software applications or plugins, the smaller pieces of software that run inside applications, could be coded by students and teachers themselves. Instead of purchasing a MIDI controller, students might design and build their own using 3-D printing and low-cost electrical components. These activities risk further tilting the curricular balance toward technology, but if they resulted in greater student understanding of the origins of technology, the capacity of students to invent technological tools to meet their individual needs, a reduced environmental impact from mass produced technology, and a Cambrian like increase in the diversity of technology available, that would certainly be a tradeoff worth considering. Ample precedence exists for musicians designing, building, and maintain their instruments. Few players of double reed instruments are rebuked for the time they invest in reed making, for example.

The final theme considered in this section is concerned with apparent music educator disinterest in completing COI items. Since the survey was fully anonymous, reasons for participation drop-off at the COI section can only be inferred. Explanations other than disinterest are not supported by the response pattern, though. For example, internet connectivity issues would have caused more random completion percentages than the ones concentrated at the COI in this study. Assuming that drop-off in the COI section was related to the items themselves, two considerations should be made for future applications of the MTCI.

First, the results from this section indicate that music teachers do not hold significantly different curriculum orientations. This was an important conclusion to reach, but moving forward, simply removing these items would improve MTCI completion rates without the loss of meaningful findings. Second, there are important differences in TBMC curricular approaches that the COI did not and cannot capture. A new model specific to TBMC curriculum should be identified or developed. Some options are discussed in the next section.

As mentioned earlier, the results of this study are best applied in the formation of new research questions. Each of the three MTCI sections (TBMC, COI, demographics) are rich for further study. For example, qualitative research on the application of music education standards could help clarify why the participants in this study rated *satisfying a teacher evaluation program* slightly higher than *determining what to teach.* Do music teachers actually consider these valuable documents in their curriculum work? Or, would they prefer to draw from other resources in the absence of an evaluation framework that compels the use of standards document? The next section of this chapter explores some additional research possibilities and suggestions for music educators.

Suggestions for Practice and Further Research

According to Miksza and Elpus (2018), descriptive studies in music education are necessary to "inform theory development, suggest potential relationships among variables to explore (e.g., behaviors attitudes, beliefs, demographic characteristics, etc.), and/or lead to experimental hypotheses" (p. 17). The results of this study suggest several possibilities for teachers and researchers of TBMC. Findings related to class curricula and available technology raise important questions related to music genres, the incorporation of new technological developments, and access and inclusion.

Music teachers appear to include popular music genres more often that classical, jazz, folk, and world music traditions in their TBMC curricula. This is likely viewed as a positive development among advocates of student vernacular music in classrooms. In the US school music context, performance ensemble classes program extensively from classical music and jazz. Therefore, in schools with TBMC, the inclusion of popular music establishes some balance between the music familiar to teachers and what is familiar to students. However, this study also confirmed that a majority of students enrolled in TBMC do not participate in ensemble classes.

Several questions for future research arise from this situation. How might newly enrolled students react to curricula which included more traditional academic music genres, those that Kratus (2007) termed "school music"? Studies can be designed to investigate the factors influencing musical style in curriculum work. Music educators may make ready use of popular styles because of their inherent musical characteristics, the informal teaching and learning practices associated with popular music, the tendency of music software applications to include popular music loops, or other reasons. Related to the previous, differences in overall curriculum objectives between musical and technological goals might influence which factors educators respond to most.

In earlier periods of TBMC development, the cost of music technology equipment was considered a major challenge, especially for underfunded school systems and students from low socio-economic backgrounds (Rosen et al., 2013). Access to and affordability of digital devices continues to improve. The music teachers in this survey utilize free or inexpensive web-based DAW and notation programs. Many students in their classrooms have access to inexpensive Chromebook computers, and smartphones facilitate life-long participation through an already rich ecosystem of music making apps. The increase in technology access has profound implications for music educators and their students.

Between 2015 and 2019, the percentage of 13- to 18-year-olds who have their own smartphone increased from 67% to 84% (Rideout & Robb, 2019). This percentage has probably increased since. Individually school issued laptops, tablets, and Chromebooks increased in high schools from 66% to 90% in 2021, largely to meet the needs of remote learning and COVID-19 related school closures (Klein, 2021). Any critiques of TBMC expansion based in student technology access, at least within the school walls, are now thoroughly unfounded. Consequently, the opportunities for music educators in an era of ubiquitous student technology ownership and use are difficult to overstate. Music educators should start, as Dorfman (2022) suggested, by first familiarizing themselves with smartphone and computer based music making. Then, teachers of all music class formats including TBMC can introduce these tools to students. Preservice music educators should likewise be encouraged to demonstrate musicianship with technology alongside their primary instrument.

As cost continues to recede as a challenge to TBMC advocacy, issues of equity and access along other aspects of identity remain understudied. If the demographic profile of participants in this study reflects the population of all TBMC teachers, efforts must be made to recruit and retain a more diverse teacher corps. Student demographics will likewise need to be studied through a research agenda including the evaluation of enrolment statistics, continued theoretical work about the underlying causes of disparate access to classes, and interventions for teachers, schools, and other stakeholders. The results of TBMC advocacy based on increasing access and diversifying classrooms must be verified by comparing class enrolment with school-wide demographics.

As mentioned earlier, the results of this study suggest that demographic patterns in general education and music specific populations are also found among this music specialization.

Any curricular reform or new paradigm holds possibilities for improving outcomes, but it is important to recognize limitations. That is to say, both what TBMC can and should accomplish as well as what it cannot and should not. What music technology classes can do, especially in consideration of the genres used and an emphasis on composition, is appeal to students not currently enrolling in ensemble classes. Recruiting efforts based on the unique features of music technology classes may result in broader, and likely more diverse, class enrolments.

Research and advocacy efforts in this vein should be conducted carefully, however. A major risk at this point in the discourse is for middle and high school TBMC to be considered not as an alternative to ensemble classes, but as a second-best option for students. Worse still, some may begin to view music technology classes as a track for a certain *kind* of student. Williams (2011) identified several characteristics of students not participating in ensembles which may include students who are "unmotivated academically or have a history of discipline problems" (p. 137). A pernicious but not necessarily large step in logic reverses cause and effect to suggest that some students *should* be in ensembles. The rest, according to this position, can "be served" by music technology classes. This might be the most consequential mistake to be avoided by the music education profession in the near to medium term. The ultimate goal of identifying "the other 80%" should be to reduce, not reify divides and unequal access.

Another consideration for future research involves the theoretical model used in this study. The performance of the COI in this specific music education setting indicates that more suitable models of curriculum perspectives need to be developed, identified, or refined. Dorfman (2019) noted that the technological pedagogical and content knowledge (TPACK) model is a promising option for better understanding music technology skill development. Several inventories are under development and validation to measure the factors described in TPACK.

Perhaps musical items could be added which would include dimensions of performance, composition, and attitudes toward the primacy of music or software in TBMC. Currently, no single theoretical model helps explain the varied choices an educator might make when engaging in TBMC curriculum work. Recall that most participants in this study did not agree or disagree with any one curriculum orientation more than others, and curriculum choices did not vary among those that did agree strongly with the two most theoretically opposed orientations.

A final concern, especially for advocates of TBMC moving forward, is in the very pragmatic consideration of school budgets, staffing, and class size. Median enrolment for participants in this study was 22 students. This number is similar to other academic classes in schools, but it is far lower than what some high and middle school administrators might be used to from ensemble-based classes. Benham (2010) made a case for music advocacy largely based on the comparative *value* of a music teacher to teachers of other disciplines. School leaders can reduce class sizes elsewhere if music teachers enroll more students. “An advanced calculus class may have only fifteen students, while a typical music performance class may have fifty or more” (p. 133). New advocacy approaches, possibly connected to earlier considerations of enrollment and student diversity, might help overcome objections based on smaller relative class sizes.

Next Steps for the Technology Based Classroom

The implications and recommendations outlined in this chapter were written for a broad audience of teachers, administrators, researchers, music teacher educators, and other individuals and organizations interested in the current state of technology-based music class curriculum. This section was written specifically for secondary school music teachers interested in starting their own music technology classes. The following questions and answers are based on the results from this study, and are written in a more conversational tone suitable for advocacy.

Aren't music tech classes just the latest fad in education? Music classes where students compose their own music on state of the art equipment have been a part of public schools since the 1960s. Currently, technology-based music classes are taught in a majority of states including every region of the United States. That said, the ground is still fertile for new and innovative classes. Educational fads, trends, and bubbles are usually imposed from the top down. Music technology classes are mainly proposed by their instructors, and nearly all classes have been developed by instructors, locally, to meet the needs of students in the school.

Our school already has a stellar music program. Why would you want to threaten recruitment and the budget by starting this class? Almost 90% of music technology classes are taught by otherwise full-time band, choir, and orchestra directors. Those teachers have found that their enrolment comes from the nearly 80% of their student body not already participating in ensemble classes. Expanding course offerings diversifies the curriculum, including more composition and music theory instruction. As for budgets, most schools already equip their students with devices. Adding the technology-based music class would then only require a location and a music software application. Most music teachers use their existing rehearsal space, and several high-quality online music software titles are now available at little to no cost.

Don't you have to be an expert in technology to start a music technology class? Technology might be the primary tool for teaching and student work, but the main objectives are musical. There are plenty of resources to help increase technological knowledge and support classroom practice including numerous social media groups, published books, podcasts, websites, and more. Fortunately, many students own their own devices or use school issued technology. Today, almost 90% of US teens own their own smartphone or laptop. Fewer than 5% of them regularly use those devices to make their own music, however. What they need is an expert musician and teacher to model contemporary musicianship to establish the foundational confidence and competency of lifelong music making.

Concluding Thoughts

Thought-provoking statements by two TBMC scholars initially inspired the focus area that became the specific research questions in this study. Dammers (2012) compared the growth of music technology to an earlier era of music education.

> Since the technology-based music-class movement appears to be in a similar place that the school band and orchestra movement was in during the 1920s and 1930s, a vigorous and challenging discussion of learning objectives and pedagogical practice is necessary during the formative stages to ensure that the establishment of a solid foundation of pedagogy will serve us well through the century, (p. 82)

About the direction of TBMC in the future, Savage (2017) asked,

1. Does anyone know which way we are going?
2. Does anyone know where we want to go?
3. Does it matter where we end up? (p. 149)

Both of these authors write from a position of interested concern, of *getting it right.* Ideally, the findings in this dissertation will help in that regard.

For far too long, the music education profession in the United States has tacitly rejected its own claim of “music for every child, every child for music.” Americans, on average, have a fifth or sixth grade music education. How many more would lead lives enriched by music if education continued through the high school years, and, facilitated by a growing online community, supported into adulthood? Success in this area will require solutions to the two main problems raised by the results of this study.

First, the results of this study support an emerging standard for music technology classes. *Music technology* is the most common course title, courses are taught similar labs with similar equipment and software, and teachers hold similar beliefs about the curricular objectives of their courses. The primary advantage to standardization is the network of professionals engaged in similar work. Numerous social media groups are already established for the purpose of exchanging curriculum, troubleshooting technology issues, and discussing other topics of interest. The main disadvantage to standardization, discussed in greater detail earlier in this chapter, is the risk to curricular diversity and responsiveness to local musical cultures. Future classes and programs will need to balance common elements with the needs of individual students and local communities.

Second, an inventory based on the major theoretical framework from general curriculum scholarship did not capture any meaningful differences in the curricular beliefs of participants in this study. A more relevant model for this specialized population of music teachers will need to account for differences in musical versus technological objectives. It is too early to render a judgment on the appropriate balance between the two, but theorizing and model development is needed now to inform the conversation. The technological pedagogical and content knowledge (TPACK) model is an excellent candidate for this task. Replacing COI items in the MTCI with questions written to illuminate aspects of the TPACK model could prove very helpful in this regard.

This dissertation provides much needed baseline data on the state of TBMC in US schools. However, as with any exploratory study, it raised more questions to be investigated in ongoing work than were answered here. The findings from those studies will be added to the accumulated knowledge of this area of practice and constitute the substance of the "vigorous and challenging discussions" Dammers (2012) called for. Moving forward, music educators designing TBMC, the researchers investigating practice and offering theory, and stakeholders supporting and advocating for students will be collaborating on what could be thought of as the largest live loop-based performance in history. Ideally, it will be song that will go on for many years to come.

APPENDICES

Appendix A

Key Terminology

The following list of terminology is provided to help clarify the usage of select terms from the technology, curriculum, and music education literature. All definitions were written by the author unless quoted with citation.

Ableton Live—A digital audio workstation designed to facilitate live performance.

Academic Rationalism Orientation—A belief that the most important goal of curriculum is to impart the facts and understandings of a specific discipline often "without regard to the interest or needs of the learner, or contemporary societal problems" (Jenkins, 2009, p. 104).

Acid—A digital audio workstation.

Administrative Technology—Used to manage "people, circumstances, and resources (Hitchcock, 2017, p. 657)."

Audacity—A free digital audio workstation.

Band in a Box—Software for generating accompaniment tracks.

Behavioral Orientation—A belief that the most important goal of curriculum is to teach according to learning objectives or standards. This behavioral orientation is similar to the academic rationalism orientation but allows for individualized instruction according to the needs of the learner and under the assumptions of behavioral psychology and operant conditioning.

Cakewalk/Sonar—A digital audio workstation.

Chromebook—An inexpensive web-based computer that runs ChromeOS.

Cognitive Process Orientation—A belief that the most important goal of instruction is to teach students how to think and solve problems.

Curriculum—The "purposes, content, activities, and organization of the educational program actually created in schools by teachers, students, and administrators" (D. F. Walker & Soltis, 2004, p. 1).

Curriculum Orientations—What one believes about the purpose of instruction. The five curriculum orientations used in this dissertation were originally described by Eisner and Vallance (1974) and further revised by Cheung and Wong (2002) and Jenkins (2009).

Curriculum Orientations Inventory—An instrument first developed by Cheung and Wong (2002), later modified by Jenkins (2009), that measures participant agreement with five curriculum orientations using a 5-point scale. Results are reported as mean scores for each orientation with a participant's preferred orientation having the highest mean score.

Curriculum Work—The decision-making process and subsequent action of generating or refining curriculum.

Digital Audio Converter—Devices that convert analog signals (microphones and instruments) to digital signals suitable for recording and editing in a digital audio workstation.

Digital Audio Workstation (DAW)—Computer software that enables the recording and manipulation of sound.

Education Technology - facilitate the "learning and assessment" processes and can include online quizzes, discussion boards, and learning management systems (Hitchcock, 2017, p. 657).

Electronic Music Class—Generally used to describe TBMC before the widespread use of personal computers.

Finale—A computer music notation application.

GarageBand—A popular, free digital audio workstation available on Apple computers.

Humanistic Orientation—A belief that the most important goal of instruction is to "provide students with opportunities to foster their personal development as unique individuals" (Jenkins, 2009, p. 104).

Logic—A digital audio workstation, available only on Apple computers.

Loop—A prerecorded musical phrase, typically two, four, or eight bars in common time, included with many digital audio workstations. Composers can combine and edit loops quickly and easily to create music.

MiBAC—Computer software for music learning, no longer supported as of 2012, but still commercially available.

MIDI—Musical Instrument Digital Interface, a protocol originally designed to facilitate the interoperability of music technology equipment. Most digital audio workstations include a graphical representation of MIDI events, known as a piano roll, for users to manipulate rhythm, pitch, dynamics, and other variables.

MIDI Controller—A device for inputting MIDI signals to music software.

MIDI Keyboard—A playable digital keyboard that sends pitch, volume, and other data to music software.

Mixcraft—A digital audio workstation.

MuseScore—A popular, free computer music notation application.

Music Technology—Any technology used "in the creation of music that requires electricity to operate" (Hitchcock, 2017, p. 657).

MusicFirst—A learning management system designed for K–12 music classrooms.

Non-traditional Music Students—Students who, according to Williams (2011), do not participate in traditional ensemble music classes for a variety of reasons. Importantly, this group represents approximately 80% of all students. Supporters of TBMC believe that these classes will attract and retain these students.

Noteflight—A popular, free computer music notation application.

One-to-One Initiative—A digital device, often a Chromebook, issued to every student in a school.

Pro Tools—A digital audio workstation.

Sibelius—A computer music notation application.

Social Reconstruction Orientation—A belief that the most important goal of instruction is to help students "solve social problems and participate in society" (Jenkins, 2009, p. 104).

Social Technology - Enable social interactions, often but not necessarily in real-time.

Technology—Mainly "computers and related digital tools" (Bauer, 2014, p. 5).

Technology-Based Music Class—A course where music concepts and skills are introduced, reinforced, and assessed primarily through student use of computers and related digital tools.

Virtual Studio Technology (VSTs)—Also known as audio plug-in software. Programs that run inside digital audio workstations to expand the capabilities of the software.

Appendix B

IRB Approval

KENT STATE UNIVERSITY

Office of Research Compliance

800 E. Summit St. | Kent, Ohio 44242

Project Title: Music Technology Curriculum and Development in the United States

Researchers: David Thompson, Craig Resta, PhD

We have assigned your application the following **IRB number: 21-298**. Please reference this number when corresponding with our office regarding your application.

The Kent State University Institutional Review Board has **reviewed and approved** your Application for Approval to Use Human Research Participants as Level I/Exempt from Annual review research. Your research project involves minimal risk to human subjects and meets the criteria for the following category of exemption under federal regulations:

Exemption 2: Educational Tests, Surveys, Interviews, Public Behavior Observation

This application was approved on **September 13, 2021**.
***Submission of annual review reports is not required for Level 1/Exempt projects. We do NOT stamp Level I protocol consent documents.

John McDaniel | IRB Chair |330.672.0802 | jmcdani5@kent.edu
Kevin McCreary | Director | 330.672.8058 | kmccrea1@kent.edu

Appendix C

Participant Invitations

Dear Member,
The following research opportunity is being sent as a public service on behalf of a legitimate researcher by the National Association for Music Education. Your e-mail address has not been disclosed to any third party, and any information you supply as part of this survey is optional.

Dear Music Educator,
You are being invited to participate in a research study titled Music Education Technology Curriculum and Development in the United States. This online survey is part of a dissertation by David Thompson at Kent State University. This study has been approved by the Kent State University IRB. Here is a link to the survey, which should take about ten minutes to complete and can be completed on your phone, tablet, or laptop.
https://kent.qualtrics.com/jfe/form/SV_3kQaw8gEMBJmUf4?Source = NAfME

You will be asked to describe your music technology class and your beliefs about curriculum and the purposes of schooling. Insights from this study will help inform future music technology policy and advocacy. Participation is anonymous and can be discontinued at any time.
Please consider forwarding this email to any colleagues you feel may be interested in participating. The link above will take you to a detailed consent/information page and the survey.
Thank you for your time and if you have any questions feel free to contact us at dthomp63@kent.edu or cresta@kent.edu

Sincerely,	Craig Resta, PhD
David Thompson, PhD Candidate	Professor, Music Education
Kent State University	Kent State University

Note: This invitation is sent as a service to the profession by NAfME, as part of our ongoing efforts to support research in music education. The sending of this invitation does not constitute endorsement of the content or quality of the research project for which this invitation is sent by NafME or its component Societies or Councils.

Facebook Invitation

Music teachers—do you teach or know someone who teaches a music tech class in the United States? If so, I am conducting a research project to help us all better understand the curricular landscape of these classes and the beliefs about education teachers of those classes hold. The attached link will direct you to a survey that takes about 10-15 minutes to complete. The survey has been approved by the Kent State University IRB, and the results will be anonymously reported in a PhD dissertation later this year. Please consider taking the survey yourself, if applicable, or sharing this link with a music tech colleague. Thank you for your time and please reach out over FB or email if you have any questions or concerns. David Thompson dthomp63@kent.edu

Appendix D

Jenkins (2009) Standardized Factor Loadings

Table 26

Jenkins (2009) Standardized Factor Loadings

Item no.	Academic	Cognitive	Social	Humanistic	Behavioural
*10	.64				
*13	.72				
16	.38				
*20	.61				
26	.60				
30	.18				
1		.27			
4		.42			
9		.45			
*18		.55			
*23		.50			
*27		.57			
5			.60		
*14			.78		
17			.68		
*24			.83		
*31			.77		
33			.60		
7				.33	
12				.43	
*19				.72	
22				.53	
*32				.61	
*34				.78	
2					.55
*6					.55
11					.50
*21					.68
*28					.70
35					.55

Note. Reprinted with permission. *Indicates items with the highest CFA fit indices that were used in this study.

Appendix E

Expert Review Instructions

Hello Dr. ______,

My name is David Thompson. I am a PhD candidate currently completing my dissertation under the supervision of Dr. Craig Resta at Kent State University. The title of my dissertation is *Theory, Design, Orientations: Music Education Technology Curriculum and Development in the United States*. The purpose of this research project is to clarify features of music technology curricula and to investigate the beliefs of music educators as they engage in curriculum work. This study is framed through the curriculum orientations model as described by S. Jenkins (2009). I am reaching out to you in light of your expertise in both quantitative research methods and music technology. Any insights you provide is greatly appreciated and will improve the validity of this instrument and research overall.

Most items from this survey were drawn from Dammers' (2012) TBMC Teacher Survey and Jenkins' (2009) Curriculum Orientations Inventory. Some items were removed or altered, and I wrote additional items to help address the specific research questions under investigation in this study. Data will be analyzed in two phases. In the first phase, responses regarding features of curricula will be reported via descriptive statistics. In the second phase, individual participants will be grouped according to their curriculum orientation, and key features of the curriculum design will be compared between groups. To reach the largest number of participants, I intend to distribute through the NAfME research survey service and the Facebook group *I Teach Music Technology* and will encourage participants to forward freely to their colleagues.

You will find a copy of the dissertation abstract and the survey itself attached to this email. The survey is formatted through Qualtrics and rescales to fit the reader's screen. Please ignore the sporadic page breaks in this draft PDF version.

<u>Drawing on your expertise, would you let me know if:</u>

1. The directions to participants are clear and easy to understand?;
2. Survey items are easily readable and clear to the participant/s?;
3. Survey items address specific research questions under investigation?;
4. Survey items are appropriate for descriptive statistical analysis?;
5. Language is neutral, bias-free, and does not influence participant responses?; and
6. Any other concerns or revisions you feel will improve intent or validity?

Thank you very much for your consideration and input. I plan to submit the proposal to my committee this Fall 2021. If possible, would you please return your feedback within three weeks? Your expert commentary will be an invaluable part of this project, and do let me know if you need any additional information.

David Thompson
PhD Candidate in Music Education
Kent State University

Appendix F

Survey Instrument

This appendix includes the final version of the Music Technology Curriculum Inventory following the expert review process as described in Chapter 2. Skip logic and dynamic formatting for various devices were employed which could not be represented here in text form.

KENT STATE
UNIVERSITY

Theory, Design, Orientations: Music Technology Curriculum and Development in the United States

David Thompson, PhD Candidate

Thank you for your willingness to participate in this survey on technology-based music class curriculum. I appreciate your time and insight on this important topic. Please note that your participation is voluntary and you may discontinue the survey at any time. The survey should take approximately 10-15 minutes to complete. Please read the information below before proceeding. Please contact me at dthomp63@kent.edu with any questions.

You are being invited to participate in a research study. This consent form will provide you with information on the research project, what you will need to do, and the associated risks and benefits of the research. Your participation is voluntary. Please read this form carefully. It is important that you ask questions and fully understand the research in order to make an informed decision. A link to participate is included at the end of this consent form.

Purpose: The purpose of this study is to gather information about the emerging practice of technology-based music classes, also referred to as music technology classes. In addition to information about the nature of class curricula, this study also asks participants about their beliefs about curriculum and the purposes of schooling.

Procedures: Should you decide to participate, you will be directed to an online survey titled the Music Technology Curriculum Inventory. This can be completed on a computer, tablet, or cell phone. The survey should take approximately 10-20 minutes to complete. No additional information is collected beyond what you provide, and your responses will be aggregated with all others and reported anonymously. This survey contains open-ended response items. Your individual written response(s) may be quoted in whole or in part in the research report. Statements will be attributed anonymously as: “One participant stated...”

Benefits: Participation in this study will not benefit you directly. However, your participation will help us better understand the phenomenon of technology-based music classes in ways that could inform future research and advocacy.

Risks and Discomforts: There are no anticipated risks beyond those encountered in everyday life.

Privacy and Confidentiality: Your privacy is very important. At no time will you be asked to disclose your name or specific teaching location. Your individual survey response will be issued a numeric ID tag that will help in data analysis. All survey responses will be downloaded and stored on a password protected computer. Your responses will be reported in aggregate with the responses of others, with the limited exception of open-ended responses.

Future Research: Your de-identified information may be used by or shared with other researchers without your additional consent.

Compensation: You will not be compensated for your participation in this study.

Voluntary Participation: Taking part in this research study is entirely up to you. You may choose not to participate. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. You will be informed of any new, relevant information that may affect your health, welfare, or willingness to continue your study participation.

Contact Information: If you have any questions or concerns about this research, you may contact Craig Resta, PhD at cresta@kent.edu or at 330-672-4803. This project has been approved by the Kent State University Institutional Review Board. If you have any questions about your rights as a research participant or complaints about the research, you may call the IRB at 330-672-2704.

Consent Statement: I have read this consent form and have had the opportunity to have my questions answered to my satisfaction. I voluntarily agree to participate in this study.

- o I have read the consent statement and would like to participate.
- o I do not wish to participate.

For the purposes of this survey, a technology-based music class (TBMC), also referred to as a music technology class, is defined as a course where technology is the major medium by which music concepts and skills are introduced, reinforce, and assessed. Do you teach one or more TBMC?

- o Yes, I teach a TBMC at the high school level
- o Yes, I teach a TBMC at the middle school level
- o Yes, I teach TBMCs at both the high school and middle school level
- o Yes, I teach a TBMC at the elementary school level
- o No, I do not teach a TBMC at any level

TBMC Items

If possible, please answer the following questions as if this was a typical school year, either before the changes brought about by the COVID-19 pandemic or a time after. If you teach more than one TBMC, please consider the single class most representative of your program and teaching philosophy.

1. What is the title of your class?

2. Please rate the importance of the following:

	Very Important	Important	Somewhat Important	Unimportant
Developing students' skills as performers				
Developing students' skills as creators/composers				
Developing students' skills as listeners				
Developing students' vocational skills (music production)				

3. How many students are in this class?

4. Of these students, what percentage also participate in the school's music performance classes (band/choir/orchestra)?

5. What is the length of the class?

- Full Year
- Semester
- Quarter
- Other, please specify

6. Please rate the frequency with which the following genres/styles of music are addressed in your class:

	Very Frequently	Frequently	Less Frequently	Infrequently
Classical				
Folk				
Hip Hop-Rap				
Jazz				
Rock				
World Music				
EDM/Techno				
Pop				
Other, please specify				

7. How strongly do you agree or disagree with these statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
Projects/activities are determined by individual student musical skills.				
Student listening and creating by ear plays a central role.				
Projects/activities are determined by individual student interests.				
Projects/activities are determined by individual student learning styles.				
Standard music notation plays a central role in the class.				
Reaching nontraditional music students (i.e., not in band, choir, or orchestra) is an important consideration in the planning and election of your technology- based music class.				

8. Please list the most important content and skill objectives for your class according to the categories below:

Musical Content/Understanding	
Musical Skill	
Technological Content/Understanding	
Technological Skill	

9. Do you use one or more published music technology curriculum guides? If so, which ones?

- No
- Yes, please specify

10. How strongly do you agree or disagree with these statements about your use of published music technology curriculum materials?

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I try to follow published curriculum guides as closely as possible.					
I use a published curriculum guide, but adapt materials to fit my class.					
I use a published curriculum guide, but supplement lessons with other materials.					

I use published curriculum guides sparingly.					
I do not use any published curriculum guides.					
I use published curriculum guides in some other way. (Please explain)					

11. Do you use any other curriculum materials? These can include books, websites, social media groups/pages, podcasts, etc.

- o No
- o Yes, please specify

12. Please check the hardware that is available in your lab(s):

Desktop computers	MIDI drums	Traditional microphones
Laptop computers	MIDI guitar/wind controller	Videocamera(s)
LCD Projector	Mixing board	Tablet/Mobile Device
Smartboard	Digital recorder	Chromebook
Digital pianos	Digital audio interface	Ableton Push
MIDI keyboard controller	USB microphones	Other, please specify
Other MIDI controller, please specify		

13. Please check the operating system(s) that are used in the lab

- o Windows
- o MacOS
- o ChromeOS
- o Android iOS
- o Other, please specify

14. Is the music technology lab...

- o in a dedicated room (music technology only)
- o in a room shared with performance ensembles (band, choir, orchestra)
- o in a lab shared with nonmusic classes
- o on a portable laptop cart
- o other, please specify

15. Please check the software that is available in your labs:

Finale	Logic	VSTs, please specify
Sibelius	Acid	Max/MSP
Noteflight	GarageBand	Musescore
Other Notation Software, please specify	Mixcraft	MusicFirst
Pro Tools	Band in a Box	Soundtrap
Audacity	MiBAC	Other, please specify
Cakewalk/Sonar	Ableton Live	

16. Please rate the frequency with which you reference the following standards in your curriculum work:

	Very Frequently	Frequently	Less Frequently	Infrequently	Never
National Core Arts Standards (NCAS/NAfME)					
TI:ME Areas of Pedagogical Skill and Understanding (TAPSU)					
National Educational Technology Standards (NETS)					
State music-specific standards					
State technology-specific standards					
Other standards document, please specify					

17. How strongly do you agree or disagree with these statements?

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I use standards to determine what content to teach					
I use standards to determine how to evaluate students					
I use standards to satisfy my teacher evaluation program					
I use standards for another purpose, please specify					
I do not reference standards					

COI

18. How well does each statement represent your general views about curriculum?

	Does not represent my views at all	Minimally represents my views	Represents my views somewhat	Represents my views fairly well	Represents my views exactly
Teachers should select curriculum contents based on students' interests and needs.					
Methods of inquiry are the most important content for primary and secondary school curricula.					
Students' interests and needs should be the organizing center of curriculum.					
Curriculum organization should be governed by the ordering of learning objectives.					
The most important curriculum contents for primary and secondary school students should be subject knowledge.					

19. How well does each statement represent your general views about curriculum?

	Does not represent my views at all	Minimally represents my views	Represents my views somewhat	Represents my views fairly well	Represents my views exactly
For curriculum design, the main function of instructional assessment is to find out the extent to which students have attained the intended learning objectives.					
Existing problems in our society, such as pollution and population					

explosion, should be the organizing center of curriculum.					
It is important to assess the extent to which students have acquired the basic subject knowledge.					
Curriculum contents should focus on society problems such as pollution, population explosion, energy shortage, racial discrimination and crime.					
Assessing students' levels and forms of thinking as well as their ability to explore knowledge is most important.					

20. How well does each statement represent your general views about curriculum?

	Does not represent my views at all	Minimally represents my views	Represents my views somewhat	Represents my views fairly well	Represents my views exactly
Subject knowledge is the basis for designing a high- quality school curriculum.					
In addition to academic achievements, instructional assessment should also emphasize students' personal development such as self-confidence, motivation, interests, and self-concept.					
The most important goal of the school curriculum is to foster students' ability to critically analyze social problems.					

Curriculum design should start with stating learning objectives.					
Curriculum should require teachers to teach thinking skills systematically.					

Demographic Items

21. How many years have you taught music in total?

22. How many years have you taught your music technology class?

23. How did this class begin?

- Proposed and developed by me (current instructor)
- Proposed by someone else but developed by me (current instructor)
- Proposed and developed by someone else
- Some other arrangement, please explain

24. How many years has this class existed in its current form?

25. What is your primary performance background?

- Piano/Keyboard
- Strings
- Vocal
- Winds/Percussion
- Other, please specify

26. What other nontechnology-based classes do you teach?

- Band
- Choir
- Orchestra
- Music Theory
- Guitar
- Music Appreciation
- Other nonmusic class, please specify
- None (I only teach music technology)

27. In what state do you teach?

28. How do you describe yourself?

- Male
- Female
- Non-binary / third gender
- Prefer to self-describe
- Prefer not to say

29. Are you of Hispanic or Latino origin?

- Yes
- No

30. What is your race/ethnicity?

- American Indian or Alaskan Native
- Asian
- Native Hawaiian or Other Pacific Islander
- Black
- White
- Two or more races

Thank you for completing the Music Technology and Curriculum Inventory. Your responses will help us better understand the current state of practice in this vital area of music teaching and learning, and they will be summarized in a dissertation on the topic of TBMC and curriculum. If you have any questions about the project or would like a copy of the dissertation when complete, please email David Thompson at dthomp63@kent.edu. Again, sincere thanks, and have a wonderful rest of the school year!

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