Traditions and Ways Forward for Music Teacher Education Technology in the United States

Music teacher preparation must account for the combination of executive and expressive skills, the artful weaving of prescribed methodology with student-centered pedagogy, and many other aspects to achieve the goal of preparing well-rounded, thoughtful teachers for the profession. Scholarly self-examination of our work as we integrate technology into teacher education, and thus into music classrooms, is essential for improving the ways in which we approach that integration. In many ways, scholarship in music education echoes the concerns of other subjects. Technology integration, in particular, is a component of music teacher preparation for which researchers have examined concerns similar to those of our general education counterparts. Teacher educators are obligated to continually re-examine the foundations of practice so that we can maintain the integrity and aesthetic basis of our chosen subject while integrating new, research-based approaches that may benefit our students. We must regularly confront “the tacit nature of our practice” (Keast & Cooper, 2012, p. 66) and preserve self-awareness regarding the curricula we implement.

I began teaching technology-based music classes as a high school teacher in the late 1990s, and the possibilities for basing music learning on technology have fascinated me since. My perspective is that of an American schoolteacher who transitioned into the role of scholarly researcher, though I maintain an active role as a technology-based music teacher at the university level, and occasionally in K-12 classrooms. I have studied, using various lenses and methods, interactions between students and technology, and teachers’ attitudes toward and practices with technology integration. Based on those experiences, in this chapter I offer my views regarding the interplay between music teacher education, technology skill development, pedagogical
knowledge and implementation, faculty modeling, and long-lasting influences of each. While this chapter is based on much previous research in music education and technology, the conclusions I will draw here are my opinions based on my years of experience as a teacher and researcher, not on any new data collection or analysis. Central to the argument of this chapter is my concern that students in music teacher preparation programs must acquire both the skills to use technology and the pedagogical techniques to base their future teaching on it. Through self-study of programs and courses, we can determine the effectiveness with which those two related sets of skills are reaching our future educators.

There are practical concerns to be considered as teacher education curricula are examined, but it is similarly important that we address the theoretical foundations of integrating technology into music teacher preparation, and later into music instruction. Berry (2007) articulated several justifications for teacher educators to engage in self-study: (1) to check for consistency between practical approaches and philosophical beliefs; (2) to scrutinize individual aspects of pre-service preparation; (3) to develop models of critical reflection, and; (4) to evaluate our practice in ways that are more valuable than typical, institutional evaluations might be. By inspecting the traditions of thought and practice in pre-service music teacher technology-based learning, perhaps we can begin to promote self-study, and to “encourage the kinds of flexible understanding our youth and our teachers need to engage creatively with technology” (Caillier & Riordan, 2009, p. 490). Rather than a comprehensive review of the issues that plague pre-service programs as they integrate technology, I hope that this chapter will represent an initial step toward outlining a few elements of technology integration into teacher education that are ripest for scrutiny. I close this chapter with suggestions for research that may help us to
examine rooted approaches to technology integration, and some concerns that may help propel this subgroup of our profession.

TECHNOLOGY AND TRADITIONS OF MUSIC TEACHER EDUCATION

For several years, teacher education scholars have recognized that technology must be infused into the content and pedagogy classes typically found in teacher preparation curricula (Darling-Hammond et al., 2005). Within the milieu of music teacher preparation, traditions divide the kinds of courses students take into standard types. As will be described here, courses often serve specific, isolated purposes. As a result, technology skill development and its related pedagogical techniques can be left in a problematic, undefined position. In this section I explicate the lack of definition that results from program structures, and suggest resolutions to the problem.

TECHNIQUES VS. METHODS

Having studied and worked in several music teacher preparation programs, I am concerned about the place of technologically enhanced studies that occur in them. My specific concern is regarding the models that exist for integrating technology, and the fact that technology often does not fit easily into a mold that has existed for a long time. Examining most traditional music teacher training curricula in the United States will lead quickly to a generalization that that there are essentially two kinds of classes that students are expected to take: (1) Techniques classes are those in which students learn performance skills on unfamiliar instruments. Students typically take a sequence of classes in woodwinds, brass, strings, percussion, and voice, and sometimes in classroom and folk instruments. Depending on the rigor of these courses and the inclinations of their instructors, they may not focus on practices related to the teaching of these instruments; instead they focus on providing students with performing experiences to develop
beginning proficiency. (2) Methods classes, which students typically take in the later years of their program, focus on pedagogy, usually of large-group instruction, and frequently in the settings of band, orchestra, choir, and elementary general music. Since techniques classes are taken earlier, methods classes assume functional skills with instruments. Methods classes often include peer-teaching activities, which are designed to simulate the classroom environment and to let students practice teaching, relying on each other to mimic the performance of younger students. Methods courses also may carry an expectation that students spend time in the field, observing teachers in their classrooms, and perhaps participating in limited teaching activities.

While other models of music teacher education curricula certainly exist, and new structures are beginning to emerge, the traditional dichotomy between techniques and methods classes leaves technology studies in a state of limbo. For those programs in which music technology topics reside in a stand-alone course, the approach to that course may be unclear. The course might be taught in a manner similar to the techniques approach, in which students are expected to acquire skills, but are not introduced to pedagogical techniques, nor given opportunities to practice those techniques. Conversely, the course might be taught as a methods course in which the focus is on pedagogical technique, but perhaps at the expense of technological skill development. In either case, the concern is that students will receive only partial preparation for technology-based music teaching.

RE-ENVISIONING TECHNOLOGY EXPERIENCES

Solutions to the problematic in-between state where technology courses often sit do exist; they rely on music teacher educators to reframe how students might engage in technology experiences, as I have suggested previously (Dorfman, 2012). One solution is to distribute technology skill development and pedagogy throughout the larger curriculum where appropriate.
Both methods (instrumental, elementary general, etc.) and techniques (woodwinds, brass, etc.) classes could contain streams that address technologies that are connected to the content of the course.

Some problems arise from this model. First, by including technology as a component of other courses, technologies that are not directly related to traditional performance areas may be ignored. Second, this model requires a great deal of collaboration between faculty members to determine which technologies will be addressed in each part of the curriculum. Third, faculty members have to possess the necessary skills to introduce technologies to their own students, which may be difficult to acquire.

A second solution is to maintain the model of a stand-alone technology course, but to re-imagine its structure so that students gain both technology skills and pedagogical experiences. This is difficult because of the limited time allotted for the course (often far less than for any other single area of the curriculum), and often results in dilution of both skills and pedagogy; however, if this is the only possible solution because of practical concerns such as credit distribution and teacher licensure requirements, then this approach is more desirable than simply ignoring either skills or pedagogy.

A final solution is to allot an equitable amount of time to developing technology skills and pedagogy; that is, similar to instrumental and choral segments of the curriculum, perhaps curricula should offer both a technology techniques class and a technology methods class. Doing so would allow students to develop skills for using technology for musical purposes and the pedagogical orientations, approaches, and practices for teaching music with and through technology. Further, investing in study of technology from both practical and pedagogical perspectives allows the technology to become transparent, and for aspiring teachers to critically
evaluate technology and the experiences that may result from its integration (Kirby, McCombs, Barney, & Naftel, 2006; Weiland, 2008).

TECHNOLOGY SKILL DEVELOPMENT

The notion of skill development in music technology is one that might raise some eyebrows because of the inherent link between skill development and behaviorist approaches to education. This is a particularly problematic notion because it relates to some technology-based teaching/learning scenarios that feature drill-and-practice models found in many of the most popular computer-assisted instruction products. Zeichner (1993) reminded us more than twenty years ago that skill development approaches are intrinsically linked to “innumerable attempts during the 1920s and after to break down and analyze the teaching task into its component parts and to build a teacher education curriculum around these bits and pieces” (p. 4). Modern music pedagogy with technology can be designed to lead students through engaging, thought-provoking activities for which they might call on imaginative and creative processes.

Despite the criticism of skill development, we should remind ourselves that technology is a material that we use to convey musical ideas or reach musical goals; it is not the musical content itself. Similarly, the development of technology skills is not the same as the development as teaching skills. Many technologies are designed with discrete components, and learning to use them requires experience (to one degree or another). Developing technology skill is a different thing entirely than developing teaching skills. Developing technology skills, and contextualizing technology within musical and social growth, is an important component of developing a complete professional teacher (Sykes, Bird, & Kennedy, 2010).

As in other segments of music teacher education, there are technology-related skills that pre-service teachers should acquire. Miller and Lambert (2012) showed that the influence of
undergraduate and graduate institutions on technology skill development in arts students was significantly greater than that of high schools; this type of evidence should inspire music teacher educators to feel empowered to include technology skill development as an important component of their curricula. Some recent scholarship has shown that there is a consistently agreed upon set of technology skills that university music students should be able to understand or demonstrate (Webster & Williams, 2011, 2012, 2013); perceptions of the importance of those skills remain relatively stable for a sample of music teachers at various stages of their careers, including pre-service teachers (Dorfman, 2015). Regardless of the skills that teacher educators or pre-service teachers perceive as important, development of those skills should be based on sound educational models that draw upon best practices of sequencing and scaffolding content.

It should be noted that the type of learning in which pre-service teachers (or anyone, for that matter) learns to use the functions of technology (software or hardware) is often referred to as training. I distinguish between educating and training, and hope that the experiences provided in pre-service music teacher programs leans further toward educating than it does toward training. With abundantly available online resources, along with countless brick-and-mortar facilities, just about anyone can obtain training that contains procedural knowledge. They can learn step-by-step processes for accomplishing particular tasks with technology. Educating, however, encourages students to be thoughtful and creative with—and perhaps critical of—the technologies they use. Technology education, as I view it, subsumes training, and compels students to think about inventive ways that technology might be used for teaching. Education in technology encourages future teachers to consider the content first, and explore ways in which the technology might enhance learning experiences that surround the content (Roblyer & Doering, 2012).
Still, pre-service teachers need to learn the procedural elements of technology. When music teacher educators provide training so that pre-service teachers can acquire skills with music technology, they should strongly consider the sequence of presentation of those skills and, similar to learning any sophisticated task, moving from simple to complex can help students succeed. The open-ended nature of many music applications can be overwhelming, so presenting tasks in a logical sequence can help to reduce students’ anxiety and bring some order to potential chaos. For example, when learning to create scores in notation software, a logical sequence would be to begin with relatively simple scores such as single line melodies, piano-vocal arrangements, and those without many advanced symbols. Once students master placement of the common symbols that occur modest scores, they might advance to more sophisticated ones.

Similar considerations for simplicity and complexity might be made when selecting software itself. The market is replete with software titles that accomplish the same tasks as each other, though their levels of sophistication vary. When learning techniques of MIDI sequencing, teachers should question whether a complex piece of software such as Logic or ProTools is necessary, or whether GarageBand or MixCraft would suffice. A key consideration is the usefulness of software that students learn in their pre-service years once they enter the P-12 classroom. Decisions as to the software we employ, and the sequences we use to learn software should be made carefully and intentionally, with an eye toward usefulness in the field and many other factors.

In my technology training classes, a portion of skill development is tied to faculty and program expectations of students in other parts of their pre-service curriculum. While technology can be an effective means of teaching music, in reality, most of the students I teach are more likely to work in traditional settings such as band, choir, orchestra and elementary general music
than they are to teach purely technology-based music classes. Part of my responsibility, then, is to help them develop skills that can be used in those settings. For example, when students take Instrumental Methods courses, they are often asked to prepare materials for beginning instrumental lessons. Technological skills such as sequencing MIDI tracks can support these activities. Recognizing the links between technology classes and the other core components of music teacher training can help us create activities such as this which are relevant; they allow students and faculty to draw close links between classes that might otherwise seem disconnected.

AN EMERGING MODEL OF PEDAGOGICAL KNOWLEDGE

Until quite recently, few theoretical models have existed that helped both music teacher educators and future music teachers to conceptualize the difficult interconnections between music, pedagogy, and technology, and the specific kinds of knowledge associated with each of those domains. Berry (2007) described lack of theoretical work in teacher education in general, but the description seems applicable to technology-based music instruction:

For many teacher educators, the difficulties associated with researching personal practice lie not so much in recognizing the complexities inherent in their own work (these they readily see) but in finding ways of representing that complexity to others. Because so little of the “swamp” has been mapped, it is hard to know how to proceed. (p. 31)

The “swamp” of technology-based instruction had been sorely in need of a map for some time. The emergence of a theoretical framework known as TPACK has staked an influential claim in this realm, and its significance is likely to continue growing. TPACK is an extension of Shulman’s (1986) model of Pedagogical Content Knowledge, which suggests that teachers possess special kinds of knowledge of their subject area and the ways in which students might best learn content. TPACK (Koehler & Mishra, 2008; Mishra & Koehler, 2006), an acronym for
Technological Pedagogical and Content Knowledge, suggests that technology adds a layer of complexity to both content and pedagogy, and causes interesting intersections in the process. The authors depict the model as shown in Figure 1.

< Insert TPACK Image here>

Figure 1. The TPACK Model. Reproduced by permission of the publisher, © 2012 by http://tpack.org.

Complete explanations of the TPACK model are available elsewhere (e.g. Bauer, 2013, 2014; Dorfman, 2013); for the purposes of this chapter, I will focus on the most complex of the intersections, the center section that depicts the TPACK construct itself. Essentially, TPACK for music captures the ways in which technology influences the musical content that teachers know, and the ways in which they teach that musical content to students. TPACK has emerged as both an approach to preparing teachers for entering the technology-based music class, and as a means for measuring their preparedness or level of accomplishment.

The outer dashed circle of the model suggests that the model considers various contexts. Contexts might include constructs such as socio-economics, gender balances, grade levels, students’ and teachers’ expertise over the content, and many other factors. Here, I will assume the context of TPACK to be music teaching in general, while acknowledging that music teaching scenarios vary greatly.

TPACK provides us with a way of thinking about how to navigate the swamp of technology-based music teaching. As we prepare teachers, the model helps us to remember that content, pedagogy, and technology are distinct; when these three elements overlap, more sophisticated teaching may result (Dorfman, 2013). An assumption that can be extracted from this model is that teacher knowledge, in all the permutations that the model suggests, eventually
is applied to the pedagogical choices that teachers make in their classrooms. If this is the case, then the model further supports my previous assertion that pre-service preparation for technology-based music instruction must include emphases on both skill development and pedagogy, so that teachers can shape their technology-based music instruction practice. Only by doing so can we properly position future teachers to build sophistication in their teaching.

**THE ROLES OF FACULTY**

Mere exposure to technology does not guarantee that pre-service teachers will later be successful implementers of technology into their teaching. We must consider the limitations of technology, and we should not assume sustained access, support, or changes in teaching practice as a result of technology experiences in the pre-service program (Wang, Spalding, Odell, Klecka, & Lin, 2010). The onus falls to faculty to design technological learning opportunities, and to model behaviors. Music teacher education faculty members play a pivotal role in the development of technology skills and pedagogical understanding for their pre-service students. In my estimation, the primary difficulty related to furthering the use of technology in the music classroom is the hesitation of music teacher education faculty to embrace technology and emphasize it as an effective means for teaching music. By modeling reasonable uses of technology in their own practice, music teacher educators may have a profound influence over the students’ thinking about using technology in their later teaching.

Perhaps the most prevalent sophisticated technology available on most college campuses in the online learning management system (LMS); popular examples include Blackboard, Moodle, Edmodo, and Canvas. While these systems vary in design and feature sets, most include the ability to post class documents, host discussion boards, manage student grades, host media, and manage communications between members of classes. Learning management systems are
becoming more popular in the P-12 environment as well, and teachers frequently rely on the assessment and communication portions of these applications for their daily work. By modeling good uses of learning management systems, music teacher education faculty can set an example of technology uses for their pre-service students. While the software is sophisticated, most LMS packages are relatively simple to use, and help faculty to accomplish tasks they would do anyway. Using academic technology is merely one example of modeling technology use that will set an example for future teachers.

Faculty might also consider the ways that their own collaborative behaviors can influence technology integration into their programs. Faculty can make decisions regarding how best to include technology in the curriculum. Structuring technology experiences as a stand-alone class, as opposed to distributing them throughout various classes, should be a faculty decision, and faculty who determine the approach that their program takes will adjust according to the outcomes or consequences of that determination. Faculty can collaborate on this decision and implement what they think is the best strategy for their program. If they choose to distribute technology experiences throughout multiple courses, then they should collaborate further to determine which skills are most appropriately addresses in each of component of the curriculum. Collaborative acts further model the structures often found in innovative technology uses at the P-12 level. Personally, I remain torn on this issue because neither approach (nor any permutation thereof) has been shown in the research or pedagogical literature to be superior or inferior to any other. My experiences have been only in the isolated class model, though recent discussions in my work environment may change that. I will return to this issue in my suggestions for research at the end of this chapter.
An important influence that music teacher education faculty can have toward the goal of technology integration in their students’ later work is to encourage reflection. In my teaching, I regularly engage students with technological tools and methods for reflecting on their own work. For example, when students in Instrumental Methods classes participate in microteaching activities, they are video recorded. Those recordings are uploaded to a streaming video service such as YouTube, and the students are required to access the video and create reflections, often using a blog post or a journal entry in the university’s learning management system (BlackBoard). I use the same techniques for microteaching experiences in my technology classes. I also have my students watch video recordings of teachers in technology-bases music classes and prepare guided reflections about their observations. In these ways and others, I encourage, my students to think deeply about the ways in which technology, content, and pedagogy interact; the elements of teaching and learning with technology that are particularly positive; and the elements of teaching and learning with technology that need improvement. Darling-Hammond and colleagues (2005) suggest that, “technology provides tools that aid in reflection and improvement” (p. 188); learning technology skills, and using technology to improve teaching, therefore, creates a cyclical experience of learning and reflecting that can be viewed repeatedly and at slower speeds than found in “the rapid pace of classroom life” (Rosaen & Florio-Ruane, 2008, p. 723).

Reflection may also help students to draw connections between the contents of technology studies and ideas they learn and practice in other portions of the pre-service curriculum. Particularly important is reflection on pre-service activities in the arts enables students to consider the focus of their practice on incorporating values of aesthetic education into their teaching, rather than designing courses that are merely technical (Holzer, 2013).
As teachers who set examples for pre-service students, faculty members must practice “reflection-in-action” (Schön, 1987), and be transparent about their own pedagogical experiences and decisions. Zeichner (1993) suggests that, “reflection is treated as a social practice rather than merely as a private activity” (p. 11). Clarity around the process of reflection would certainly benefit pre-service teachers. Reflective learning and reflective teaching will help pre-service teachers to develop their own pedagogical theories and decisions; faculty members should encourage critical examination of teaching and learning experiences so that pre-service teachers can develop their distinct pedagogical styles.

Finally, faculty members can seek opportunities to simulate real technology-based music classes, or actually immerse their students in technology-based music environments as much as possible. As mentioned earlier, a methods approach to technology preparation would suggest that pre-service teachers engage in activities such as peer teaching, field observation, or if possible, teaching in the field. Only through these types of experiences can pre-service teachers gain valuable familiarity with situations they may encounter in their careers.

**Maintenance**

A mythology has developed that students enter undergraduate programs with technology skills that far surpass those of faculty members, or so-called Digital Immigrants (Prensky, 2001). More accurately, while the undergraduate students I encounter are savvy with particular consumer technologies such as particular functions of their cell phones, they generally lack depth of experience with applications for music teaching and learning. Put another way, they know what they need to know to make particular technologies function for their personal habits, but they do not always consider the educational applications of those technologies. Certainly these
are generalities, but I have seen them consistently throughout my college teaching career, and some research literature supports the notion (e.g., Margaryan, Littlejohn, & Vojt, 2011).

Because of this phenomenon, in my teaching I draw a distinction between pre-service teachers and in-service teachers in terms of their needs. Pre-service music teacher education, I believe, needs to include introductions to technology skills that are specific to music teaching, and varied opportunities to practice those skills. At the pre-service stage, technology skills should be taught and practiced with an eye toward their application in the music classroom, or for uses that are connected to classroom needs. Even the most pedestrian of applications—for example, office-type software or music player software—can be approached from an educational perspective and framed in ways that will be beneficial for the music teacher.

At the graduate level, I propose that emphases should be different than at the pre-service level. Graduate music education curricula typically include coursework in which students engage in reading theoretical perspectives of critical issues in music education, and in which they learn to consume and critique research in the field. Technology-focused coursework at the graduate level should adopt this same stance. Students at the graduate level should be exposed to theoretical constructs that may influence how they think about technology-based music teaching. This approach can certainly include the aforementioned TPACK framework, and might also include theories of creativity, constructivist learning, social learning, and others. As students are exposed to theories, they should be encouraged to recognize items of technology that appeal to theoretical constructs inherently, and to seek out opportunities to approach technology-based learning from a theoretically informed perspective.
While exposure to, and practice informed by theoretical perspectives is important, maintenance of skills remains necessary, and is complicated by the ever-changing nature of technology. Koehler and Mishra (2008) wrote of this volatility:

the knowledge required to learn to use digital technologies is never fixed. Technology changes quickly, causing hardware and software applications to become outdated every few years. One has to continually keep up with the changing demands of new technologies...Moreover, the rapid changes often happen in piecemeal fashion, which leads to users having to work with a variety of versions of software and hardware, some of which may be incompatible with each other...The instability of digital technologies requires that teachers become life-long learners who are willing to contend with ambiguity, frustration, and change. (p. 8)

Technology does not stand still, so teachers must continually renew their technological knowledge through formal professional development and informal exposures to software and hardware. Recent research has shown that music teachers are more likely to pursue formal technology professional development when the motivation to do so is their own (Dorfman & Dammers, 2015, in press). Given these findings, professional development providers should continue to offer learning opportunities that are accessible to teachers, and should include a variety of topics in those opportunities. Perhaps the most significant contributor to this effort in the United States has been the Technology Institute for Music Educators (TI:ME) which, since 1995, has been offering professional development workshops through various universities. The week-long workshop model that is typical of TI:ME courses has been shown to significantly increase several indicators of technology comfort and use for teachers (Bauer, Reese, &
Regardless of the source of professional development, I encourage school administrators to support teachers in their quest for skill development in technology.

**RESEARCH NEEDS FOR MOVING FORWARD**

Similar to Zeichner’s (1999) call for research about teacher education in general, I propose that music teacher education has several research needs that might propel the technology component of our field. In accord with Berry’s (2007) suggestions regarding the purposes of self-study of teacher preparation referenced earlier, it is critical that we examine and modify the ways technology is approached in pre-service music programs. Doing so would help us align practices with beliefs, and develop reflective critiques that are valuable. I suggest the following as possible ways forward for researchers.

Technological competency must be a cornerstone of program development as programs are evaluated. Researchers should consider evaluating programs from the perspective of their inclusion of technology. The long-held (and previously mentioned) question of the effectiveness of the stand-alone technology class, as it compares to other models, may be addressed through program evaluation. Further distinguishing between the techniques and methods course models might be accomplished through program evaluation, though it is possible that researchers could propose effective alternatives. This type of research may also shed light on the types of technology integration that are most appropriate in particular branches of the music teacher education curriculum, and offer models for replication.

Policy studies might provide insight into effective ways to include technology in pre-service music curricula. With the recent focus of the teaching profession on measurable performance indicators (Shuler, 2013), teacher education faculty must be certain that their curricula prepare teachers for increasingly data-driven schools in which they will be held.
accountable for their students’ progress. With more specific standards that reference detailed outcomes of learning, the types of skills that pre-service music teachers are required to develop may be further nuanced. While the relevance of skill development maybe be promoted, this might impact the creativity and freedom with which faculty design courses. The research community should examine the impact of state and federal policies on music teacher education curricula, and the mandates that will influence their students’ future integrations of technology into P-12 classrooms.

I have previously drawn distinctions regarding technology content that might be addressed at the pre-service versus in-service levels. No researchers have yet examined this distinction, or the usefulness of content that might reside in courses at one level or the other. Music teacher education faculty design courses based on suspicion of what might be useful, or—perhaps worse—based on the newest gadget or software to hit the market. Systematic examination is needed to determine what types of in-service technology learning experiences are most relevant or desired, and in what ways those experiences relate to classroom implementation. This type of information may help to clarify the pre-service/in-service distinction, if indeed a clear line exists. Also at the in-service level, a decade has passed since the most substantial investigation (Bauer et al., 2003) into the effectiveness of technology professional development for music teachers. With new, informal, and personalized professional development models now appearing—including online synchronous and asynchronous learning—it is important to examine the effectiveness and desirability of these new models. Doing so could shape the ways in which skills are learned for the next decade.

Finally, with the rise of the TPACK model, we are in a position to observe, and perhaps accurately measure, students’ preparation for technology-based music instruction. While some
have questioned the validity and usefulness of the model (Brantley-Dias & Ertmer, 2013), it remains the most sophisticated and all-encompassing theoretical perspective from which to paint an accurate picture of pre-service teachers’ preparedness for teaching in a technology-based environment. Similar to researchers in other fields, music education researchers should conduct studies in which we examine the usefulness of TPACK for conveying the complexity of technology-based music teaching to pre-service students, and in which they use the notion of TPACK to assess development in the practices of technology-based teaching. Since TPACK is a model that is intended to cut across disciplines, researchers could examine the validity of its constructs specific to music education (Cavanagh & Koehler, 2013; Shinas, Yılmaz-Ozden, Mouza, Karchmer-Klein, & Glutting, 2013). Studies in music education that draw on the TPACK framework might also examine the extent to which technology can be an effective means for teaching music, and the types of pre-service technology experiences that translate particularly well into in-service classroom applications.

REFERENCES


Brantley-Dias, L., & Ertmer, P. A. (2013). Goldilocks and TPACK: Is the construct "just right?". 

cailier, S. L., & Riordan, R. C. (2009). Teacher education for the schools we need. Journal of 
Teacher Education, 60(5), 489-496. doi: 10.1177/0022487109348596

cavanagh, R. F., & Koehler, M. (2013). A turn toward specifying validity criteria in the 
measurement of technological pedagogical content knowledge (TPACK). Journal of 

darling-hammond, L., Banks, J., Zumwalt, K., Gomez, L., Sherin, M. G., Griesdorn, J., & Finn, 
teaching. In L. Darling-Hammond & J. Bransford (Eds.), Preparing teachers for a 
changing world: What teachers should learn and be able to do (pp. 169-200). San 

Association for Technology in Music Instruction, San Diego, CA.

Oxford University Press.

dorfman, J. (2015). Perceived importance of technology skills and conceptual understandings for 
pre-service, early-career, and late-career music teachers. Symposium of the College Music 

dorfman, J., & Dammers, R. J. (2015, in press). Predictors of successful integration of 
technology into music teaching. Journal of Technology and Music Learning, 5(2).


Webster, P. R., & Williams, D. B. (2011). Music technology skills and conceptual understanding for undergraduate music students: A national survey. Paper presented at the Association for Technology in Music Instruction, Richmond, VA.
Webster, P. R., & Williams, D. B. (2012). Refining a national survey on music technology competencies: Active ways to engage students. Paper presented at the Association for Technology in Music Instruction, San Diego, CA.


