Technology in Music Education: History and Current Perspectives

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Abstract

The field of education is subject to trends and viewpoints of the society in which it develops. Subsequently, music as a discipline and music educators are constantly adapting to shifts in thinking while taking advantage of the many benefits afforded by the advancement of technological resources. From the creation of basic harmonic functional tools such as solmization to more modern electromechanical devices like the iPad and its wealth of downloadable applications, technological resources when used thoughtfully and effectively create opportunities for authentic student-centered learning tasks. The text provides an overview of the history of technology integration in the music classroom of tools such as these in addition to others. Later, an array of learning opportunities made possible through the utilization of these tools are presented with specific music learning applications. This is followed by a discussion of current tech trends based in constructivism such as coding and makerspaces Finally, the text concludes with a consideration of challenges and suggestions for getting started with purposeful and successful integration of technology in the music classroom through technology integration models such as TPACK and SAMR.

Keywords: music education, technology, educational technology, trends, music teachers

Technology in Music Education: History and Current Perspectives

> "To realize success, the instructor must integrate the technology into the learning sequence in such a way that the technology fades into the background and the musical learning experience takes precedence."
> -Courtney Crappel (2013)

Educators are often inundated with countless educational trends, which are frequently greeted by feelings of apprehension. This unease can further cause the educator to become completely disinclined to risk trying something new and unfamiliar in the classroom regardless of the claims of improved student outcomes. Sometimes, however, the benefits can outweigh the costs. Technology is not a passing fad but an incredibly influential reality, especially for students who have never known a world without the prevalence of personal devices and endless internet resources. Before exploring technology and its application in the music classroom today, it is important to consider the history of technology in the classroom in a more general sense. With this lens, it is easier to see technology as another tool for facilitating student learning rather than another educational movement to be intimidated by or ignore. By prioritizing students and keeping them at the center of the learning process, educators can do no wrong.

Historical Context

Typically, people consider "technology" to include only those tools which are electromechanical in nature. However, this paper will examine the term using a broader definition. George Heller deems technology as "the application of knowledge-- most frequently scientific, engineering, and industrial knowledge-- to practical matters" (2011). This description lends itself well to the discussion of technology in conjunction with music education. Advancements in visual, audio, and other resources influenced music educators, their pedagogy,

and content throughout the subject's long history and continues to affect the way teachers approach it today.

At the outset of music education in a general historic sense, the chief objective of many educators was to teach students how to sing properly. The most common method utilized at this time was teaching students by rote— the teacher would model, often through many repetitions, and the students would imitate. In the late 10th century, there came a yearning for a way to teach students to be more independent as well as efficient in their musical acquisition. One of the first educators to create a tool for his students to wean them away from rote singing was Guido d'Arezzo, ca. 990-1050. Guido longed for his students to be able to sing a tune by reading music notation (which was fairly primitive by today's standards). Using syllables from the text of a familiar hymn, he developed an ascending sequence of reference pitches to which he and the students could refer while reading notation. Additionally, these syllables served as useful tools and guideposts when applied to learning other songs. This system, used and known today as solmization, was one of the first steps in helping students to apply acquired musical knowledge to learn new musical material more efficiently. In the late 13th century, this set of tones was displayed in textbooks accompanied by a diagram of a hand in which each joint of the fingers represented the ascending pitches in a spiral manner. Using this system while reading standard musical notation, choirmasters could simply point to various parts of their hands to train their students' ears and to further solidify the connection of sight and sound (Mark & Gary, 2007).

In the very beginnings of American music education, teachers began to develop their own visual tools to assist student learning. In 1840, Elizabeth Glover of England conceptualized a tool that had a great impact. Glover built upon Guido's tonal sequence and combined it with

harmonic functions. Using movable do, Glover was able to apply a set of pitch syllables and their harmonic function to various pieces of music. She created a visual "tone ladder" which helped students "modulate", or use the same syllable functions for any tune, regardless of the key or tonal center. This system, known as the "Tonic Sol-fa" method, was soon adopted by American authors Daniel Batchellor and Thomas Charmbury to be used in their instructional text *The Tonic Sol-Fa Music Course* in 1884. Two years later, Luther Whiting Mason developed supplemental charts to display this method. Benjamin Jepson crafted a "mammoth music chart" out of canvas and wood and transported this helpful visual reference from school to school (Mark & Gary, 2007, pp. 190-201). Eventually, Jepson abandoned his 1,200 square foot visual for the more practical blackboard, which many other educators of his time were thankful to employ.

The chalkboard soon found its way into American classrooms. In the mid-19th century, Lowell Mason, an incredibly influential music educator, endorsed the use of the chalkboard as a teaching device. Moreover, Mason recommended a black board with three or four staves (five organized lines to be used for the placement of music notation). Classroom instruction and student attention now moved to the front of the classroom— both on the chalkboard and the teacher. Classroom management conducive to productivity was more attainable with students now active learners, developing the skill to multitask between the visuals on the board and paper at their desks (Karpf, 2012).

In the early 20th century, developments in audio technology made music more readily available to students across the nation. First came the phonograph: a relatively affordable, portable machine that could play recorded music off of vinyl records. This gadget coincided well with a shift to include a more aesthetic approach to music education, causing many educators to

incorporate music appreciation listening activities in addition to practical application of music knowledge. The phonograph allowed teachers to introduce students to musical examples other than what the teacher was able to produce with his or her own voice or piano skills. The extent to which students were able to explore and study music was now not limited to the location of the school or the proximity of professional performing groups. In addition, students could experience music from various cultures and listen to the examples repeatedly. Music textbooks began to include supplemental recordings to be used with the phonograph. Soon, however, the Great Depression began to affect the amount of expendable income people had to purchase records and a free source of music listening came to the forefront: the radio (Katz, 1998).

Radio as a technological tool appeared in the early 20th century and developed rapidly. Again, many schools used radio to supplement their instruction, but rural schools benefited the most from the rich resource. Marguerite V. Hood, a music education pioneer in Montana saw the advantages of incorporating this piece of technology into the classroom in isolated areas of the United States. Many educators were struggling to provide for their students at the time of the Great Depression, which sparked Hood to create her own local program entitled *Montana School of the Air* in 1937. These programs—along with others at the time—provided narrated musical examples of various time periods and locations of origin. The narration gave cultural, historical, and biographical information, providing context and opportunities for deeper connections (Cooper, 2005).

Not long after the radio became a mainstay in American homes and schools, television brought a visual resource to the nation. Growing out of the success of radio programs, many television offerings rooted in music appreciation sprouted up in the 1940s, bringing varied

examples of musical performances into the classroom. One particularly influential television program was written and hosted by celebrated conductor and music educator Leonard Bernstein. In 1954, Bernstein first appeared in his weekly program entitled *Omnibus*. Exploring a variety of music-related topics such jazz, conducting and a dissection of Beethoven's Fifth Symphony, *Omnibus* eventually aired during network television primetime and has been syndicated globally. According to The Leonard Bernstein Office, Inc., this program, as well as others, served as an additional educational outlet both in the home and in the classroom, exposing generations to the complexities as well as the joys of "classical music" (n.d.). These teaching tools were mostly used as supplemental enrichment lessons, as music educators could now draw upon a wealth of technological resources to add to their instruction (Carpenter, 1969).

The latter-half of the 20th century saw an incredible amount of technological advancements that swiftly made a shift from societal use to educational application. Computers emerged in the 1950s, although at this time they were slow and fairly complex in nature. As these devices continued to develop, they became more user-friendly and allowed for new possibilities in electronic music-making (using MIDI, or Music Instrumental Digital Interface), compositional software (such as *Finale* and *Sibelius*), interactive educational software (*Making Music* and *Making More Music* included these with their textbooks), CD-ROM capabilities (which could transmit audio recordings and eventually transfer to digital devices), and much more (Webster, 2002). With the addition of the Internet in 1991, the learning process was forever changed as information became more readily-available than ever before. As Clements puts it, "We have moved from a world where information was relatively contained to a world in which it is absolutely abundant" (2016). It became possible to connect globally and develop entirely new

products and skills. For music educators specifically, more resources became readily available through Google search engine, open source music editing software (like *Audacity*), and the seemingly infinite videos of YouTube.

A few more resources of note that are prevalent in many schools today boast advantages of interactive capabilities and user-friendly interfaces. One interesting amalgamation of two aforementioned technological resources, the blackboard and the computer, culminated in the teacher-friendly interactive whiteboard (such as the Smartboard and Promethean Board). This tool acts as an interface for the teacher's computer, bringing hardware, software, the Internet, and more to the front of the classroom by the means of a projector. The ability to connect with vast amounts of quality resources through the computer and to display for students to interact with provides for more student engagement and ownership of the learning process (Mercer, 2010).

More recently, in 2010 Apple released its first version of the iPad, which spurred the release of many versions of touchscreen tablets from competitors. More than just an upgraded laptop, Steve Jobs of Apple described the iPad as a "third category device" alongside the laptop and the smartphone (Aiyegbayo, 2015). Now a mainstay in educational settings, the iPad offers educators and students many beneficial features in addition to the ease of use of the touch screen such as portability, increased battery life for prolonged use, and billions of affordable applications to enhance the learning experience in an incredible array of subject matters. These individual devices created a shift in the classroom dynamic as students could now take control of their own learning experience, from gathering information to receiving teacher feedback to collaborating with other students (Geer, White, Zeegers, Wing, & Barnes, 2017).

As Crawford stated, “the importance of technology in music has meant its necessary inclusion in teaching and learning” (Dunbar-Hall, Rowley, Brooks, Cotton, & Lill, 2015). The remainder of this paper considers the more recent developments in electromechanical technology tools, discussing the ability to provide new or more effective learning opportunities through technology, specific examples of current trends and resources in educational music technology, and challenges to successfully incorporating technology in a meaningful way.

Educational Opportunities

Just like any tool or resource, technology offers the ability to meet the increasingly diverse needs of student population. The potential to differentiate instruction to students of various interests, strengths, and learning styles allow for personalized learning. Educator Amy Burns takes advantage of these possibilities, using virtual instruments for students working on fine motor skills. The inclusion of these tools create an inclusive classroom environment with multiple means for success (Raths, 2014). Tobias suggests the teacher facilitate individual and small group projects, leading the students in questioning and exploring through the use of technology. This can generate a classroom built upon a community of learners, with peers assisting each other in the learning process. Although this approach may take substantial more scaffolding and demonstration for the younger learner, the potential for engagement and musical growth are great (2016). Through this student-centered approach, national news organization Education Week notes that there is “higher engagement among students, enhanced ability to keep content updated and current, and greater interactivity and adaptivity (or responsiveness to individual learners)” (Herold, 2016). With this pedagogical shift, the ownership of learning is put

upon the students while the teacher becomes more of a facilitator in the classroom, guiding student learning and providing feedback (Kuzmich, 2015).

In addition, the incorporation of technology enables for more complex learning tasks and the development of deeper thinking skills than in the more traditional manner of "sit and get" instruction. This is especially seen in the myriad of compositional opportunities afforded through software and digital applications. Even students without a substantial background in music theory or reading music notation are able to create sophisticated original compositions through the assistance of technology (Demski, 2010). Certain tech resources can also provide a platform for cooperative learning. For example, students can collaborate through various web-based word processing or presentation programs such as Google Docs and Google Slides. Applications such as Soundtrap and Noteflight also allow for the possibility of joint-composition projects with impressive efficiency. Borrowing from a constructivist approach to educational philosophy, student groups can demonstrate comprehension through creating presentations, blog posts, podcasts, videos, and much more to demonstrate understanding and deeper connections. Incorporating student choice can provide opportunities for students to explore their passions and become experts, able to mentor other students in their chosen area. This interaction turns students from passive users into purposeful creators of meaningful content.

With technology, communication among teachers, students, and parents becomes almost instantaneous in nature and provides for a greater understanding of expectations while fostering a collaborative learning community. Gow supposes that "technology's greatest gift has been our enhanced ability to generate, process, and disseminate ideas swiftly and efficiently." Word processing programs speed up the process of communication while fostering collaboration and

feedback (Gow, 2004). Digital portfolios such as Seesaw combined with online learning platforms such as Blackboard and Google Classroom provide not only transparency in expectations and instructional goals but a hub for resources, assignments, and feedback for students and their families (Schneider, 2016).

Current Trends in Utilizing Instructional Technology

As mentioned earlier, one philosophy of learning is centered on the idea that people create their own knowledge through experiences and reflection (known as "constructivism"). This concept, developed by educational philosopher John Dewey, first gained popularity in the early 20th century and is now considered best practice by many (Holoboff, 2015). Technology can provide various opportunities for students to synthesize their understanding into a comprehensive product. For example, instead of assigning students to individually complete a report to demonstrate knowledge about a particular composer, the teacher could present options for student choice (a student-led approach) to show understanding in a way that interests the student. This could be accomplished through creating a multimedia presentation with pictures of the composer and significant locations, audio examples, Youtube clips of performances or scores, links to relevant resources, and much more. Alternatively, a student could disseminate information through a short movie or podcast with a biographical outline (Frankel, 2010). Through this and similar projects, students are actively engaged constructing their own learning while student interest and individual strengths enhance the learning experience (Holoboff, 2015).

Two more recent trends driving the field of education at the moment involve incorporating coding experiences as well as a focus on STEAM (Science, Technology, Engineering, Arts, Mathematics) activities, sometimes in the form of makerspaces, into the

curriculum. Computer code is the systematic language of computers, while coding is the act of creating and effectuating instructions in a programming language to direct a computer to complete a sequence of tasks (Freeman, Adams Becker, Cummins, Davis, & Hall Giesinger, 2017). As Kosturko states, "In many ways, western musical notation mirrors computer code quite well. Musicians read sheet music. Sheet music contains a series of instructions written in a well-defined language establishing things like instrumentation, duration, and pitch" (2015).

Combining these two areas of coding and music can be a gateway for further exploration into either subject by students of all levels. High school computer programming classes use platforms such as EarSketch (http://earsketch.gatech.edu/) to draw upon students' interest in music by using the creation of electronic-based music through pre-recorded audio loops to teach about coding techniques and principles. Students of a younger age can find a similarly engaging musical coding experience through websites like Scratch (https://scratch.mit.edu/) and Pencil Code Gym (https://gym.pencilcode.net/) to create music and basic music tools such as interactive digital instruments or recorder finger position charts. All of these platforms are free and welcome an open community of collaboration in their coders. Combining coding and music creation in a more tactile and elementary-friendly manner, Osmo learning platform for iPad and iPhone (https://playosmo.com/) released the "Osmo Coding Jam" game. Complete with various coding block manipulatives and a reflector placed over the camera, the application "reads" students' block sequence and translates it into a sequence of combined musical sounds and patterns. Music educators and their students can draw parallels between coding and musical form, developing their sense of logic and critical thinking while gaining relevant experience in one of the fastest growing occupations in the United States (Freeman et al., 2017).

More hands-on, exploratory learning experiences in the form of makerspaces are also growing in popularity. A makerspace is a physical environment, sometimes housed in a library or resource room, that provides students with the space and tools to explore, experiment, learn, collaborate, create, and problem-solve while cultivating 21st century skills. This setting developed out of the want and need for public spaces with community tools and resources for creating and sharing knowledge. In the education world, these locations are adaptable to any content area and provide engaging student-centered, inquiry-based learning opportunities. Often, makerspaces house a variety of technological resources in addition to other more traditional tools. This may include computers and tablets with various software and applications, 3D printers, green screens, and more. In Denmark, one school instituted a "Creator Space" and asked students to explore the science of sound in combination with music by designing and creating musical instruments (Freeman et al., 2017). One popular product used in educational settings for these types of spaces is a kit called Makey Makey (https://makeymakey.com/). This piece of technology connects an electronic circuit board to a computer via a USB cable, rendering it a secondary mouse or keyboard for the computer. Using alligator clips and conductive material, students can interact with programs and websites and even clip onto bananas and "play" (touch) them like a piano and hear their musical creations. "Learning through making," according to Halverson and Sheridan, "reaches across the divide between formal and informal learning, pushing us to think more expansively about where and how learning happens" (2014). Frequently, schools and libraries will present or display completed work in the makerspace as a representation and reminder of the focus on the creation of knowledge versus strictly the consuming of knowledge (Smay & Walker, 2015).

Digital portfolios or e-portfolios are other products frequently employed by teachers, especially those who see students over the course of several years as music educators often do. E-portfolios can be described as "artifacts through which students collate, archive, reflect on, and present outcomes of their studies" (Dunbar-Hall et al., 2015). E-portfolios have proved to be an effective method for tracing long-term development of skills and understanding as well as an opportunity for the students to practice summative reflection on learning. In addition, they are organized and sequential in nature, often including a space for teachers to give immediate feedback. They can even be shared in real-time with parents and administrators as a way to bring the community into the music classroom. More importantly, through practice of self-reflection and evaluation, students are afforded invaluable lifelong skills in self-awareness as well as independence and ownership of learning (Dunbar-Hall et al., 2015). The emphasis on process with continuous assessment, feedback and adjustment provide students with authentic opportunities for reflection and growth as musicians (Tobias, 2016). Common platforms for these e-portfolios include Seesaw, Google Classroom, Weebly, and WordPress.

Another current trend involves the use of technology as a means to enhance large group rehearsals, enabling deeper understanding and enriching performance experiences. Band director Tim Bréhaut points out that typically, ensemble courses "already have authentic outcomes (in the form of public concerts), a strong emphasis on both collaboration and differentiation, and a focus on higher-order thinking… promote critical thinking, require complex problem solving, and strengthen communication skills." With this thinking many educators question the purpose of bringing more technology into this type of classroom environment. Bréhaut suggests, however, that integrating technology appropriately can "expand the boundaries of the rehearsal room" and

provide efficient means for acquiring musical knowledge and skills (2015). Although some performance-based classes still tend to follow the teacher-centered model, there are ever-increasing instances of band, orchestra, and choir directors using technology to "flip" the classroom from the traditional setting to a more individualized, student-centered environment. Using audio recordings of performance pieces as well as related reference recordings, directors can provide students with multiple versions of a work for student reference. These examples may include audio tracks with isolated parts, accompaniment for students without keyboard skills, and diction practice for choral students. Additionally, posting a score for individual or group study allows students to easily see the harmonic relations between individual parts while facilitating meaningful discussion of musical concepts as students employ critical thinking and problem solving. These practices can save valuable time as well as promote individual practice and accountability (Daugherty, 2002). Lastly, the vast amount of video examples on Youtube can provide endless examples of professional musicians demonstrating proper posture, performance technique, practice habits, and countless other concepts for students to refer, discuss, evaluate, and reflect upon, assisting in the continual growth of each student (Schneider, 2016).

One skill that has recently seen great development through the use of technology is that of music composition, or creation of original musical thought. Many software programs and applications are making it possible for any student to develop and demonstrate their capability to compose music, even if they do not have substantial theoretical knowledge. Teachers can use an interactive whiteboard with staff lines and drag-and-drop notes and rests to introduce this concept for group practice. This can be further enhanced with the use of notation software such as Finale and Sibelius or web-based applications such as Noteflight, allowing students to hear

and evaluate their compositions in real time (Nolan, 2009). GarageBand is another application with which students can compose and arrange using pre-recorded loops or manually input with MIDI keyboards or controllers connected to the computer (Wise, Greenwood, & Davis, 2011). Other more kid-friendly applications such as Sketch-a-Song Kids and Monster Music Pro use iconic notation instead of the traditional staff, which can allow students without extensive background knowledge to easily create compositions (Frankel, 2010). Through these tools and others, students are able to quickly create, assess, edit, and record compositions, which can be a "game-changing" shift for teachers and students (Raths, 2014). It is worth pointing out that these programs and resources, while efficient and especially useful for students with limited knowledge of notation, are not able to replace or replicate the intricacies of "human performance" (Beckstead, 2001).

Professional development and collaboration opportunities for teachers have also shifted from more formal to less formal settings through web and social media resources. The Technology Institute for Music Educators website (www.ti-me.org) houses a collection of lesson plans, grant writing advice and discussion forums. The National Association for Music Education (www.nafme.org), a vast resource for all things music education, includes on their website guidelines for providing students with what is necessary for an effective learning environment (e.g. technology recommendations) titled "Opportunity to Learn Standards" (Demski, 2010). Additionally, social networks such as Twitter and Facebook allow for discussions with music educators from all over the world on any concept imaginable. These threads of conversation become searchable and trackable by the use of hashtags such as #mused

and #musictech and provide substantial more opportunities for music educators to connect and grow in their field than were ever available before.

Challenges to Consider

Ann Clements states, “In a time when people can access information at the touch of a button, we must reconsider what schools should be teaching and assessing” (2016, p. 330). While the examples in the previous section provide insight to a select few opportunities made possible through the use of technology, with technology can come the challenge of implementation in an effective manner. One of the most prevalent barriers to this goal involves the lack of sufficient training and professional development for educators. This deficiency in coaching combined with the large amount of time necessary to understand, practice, and feel confident in utilizing technology scares some educators away from using technology all together. Without specific examples of application to a real learning environment, teachers encounter confusion and a hazy view of how to incorporate technology in their classrooms. In one study, it was determined that 94% of music educators expressed the want for additional technology training while only 13% of districts offered a yearly training in music technology (Bauer, Reese, & McAllister, 2003). Herold and Smith offer solutions in the form of “job-embedded” training with relevance to individual teaching situations. They also suggest the use of “early adopter teachers” acting as mentors to their teaching colleagues as opposed to non-educator vendors of software. (2015).

Similar to this issue of insufficient technology training, some school districts quickly jump on board with the newest available resources and programs with the goal of improved student outcomes, but often have not conducted sufficient research on the most effective implementation of technology initiatives. A relatively recent trend is the investment in

"one-to-one" programs where each student is given near-constant access to a personal device such as a Chromebook or an iPad. Hypothetically, this would allow for students to engage in educational activities "24-7" with time and location of learning dictated by the individual student (Herold, 2016). Time and time again, these districts do not sufficiently train the teachers (how to use these devices to enhance learning in the classroom), the students (how to care for the devices and use them for appropriate educational purposes), or the parents (to understand the true purpose of the devices and how to regulate use at home) (Borja, 2006). Distributing and managing these devices can also become a nightmare without proper preparation and communication of expectations (Herold, 2016). Again, a general recommendation of more thoughtful research and a clear dissemination as well as an accountability program would aid in these situations.

Additionally, music educators often have limited contact time with students to deliver content, especially in the current era of incessant standardized testing and accountability measures, which does not foster a student-centered learning approach. This emphasis on testing imposed by federal and state policies do not provide anything by way of motivation or encouragement of a teacher to dedicate time to experiment with meaningful infusion of technology in the learning environment (Herold & Smith, 2015). With these time constraints, teachers are often reluctant to change their ingrained routines and habitual teaching methods (Herold, 2016). Generally, teachers tend to utilize technology more as a means to assist with their administrative duties rather than transform their teaching strategies and environment (Herold & Smith, 2015).

There exist a few visual models geared toward helping educators approach integrating technology into the learning environment in the most seamless and effective way. Both are applicable to any content area and age level. First, the Technological Pedagogical Content Knowledge (TPACK) model looks at the interplay of the three areas of knowledge and how they work together to inform teaching practices. Pedagogical knowledge and content knowledge are more inherent to the traditional sense of the the role of the music educator in that they are expected to deeply understand musical concepts and techniques while also demonstrating expertise in best teaching practices in designing, communicating, and implementing learning tasks. Technological knowledge for music educators is an awareness of which tech tool would be best suited for a particular student task (Tobias, 2016). The model consists of three venn diagrams with areas of intersection between each of these fields of knowledge. For example, a teacher in the music classroom using the TPACK model as a part of planning the outline for a unit of study would consider what information and skills students need to understand and how to facilitate growth of the students based on their age, interests, skills and abilities utilizing a variety of effective technological tools in an accessible manner. Tobias suggests, “Music educators can employ TPACK when developing appropriate solutions to problems that arise when integrating technology into the classroom” (2016, p. 121).

The second framework for technology integration is the SAMR model. Developed by Dr. Ruben Puentedura in the mid-1980s, SAMR is a hierarchical ladder with progressively increased potential for student outcome and achievement. The four levels of SAMR include substitution, augmentation, modification, and redefinition. Substitution involves using a technological tool as a direct substitute for another. This occurs with a learning task identical to the task previously

accomplished without the use of this new resource. For example, in the music room this could look like students using a digital notation program such as Noteflight for a composition assignment in place of the typical paper, pencil, and staff paper. The task is virtually unchanged, similarly the learning outcome is virtually unchanged, although an increase in efficiency is often associated with substitution. Augmentation is like substitution in that the learning task is familiar, but the tech tool provides some functional improvements (like the ability to hear playback and instantly edit and save a composition). There is some marginal increase in student outcome at the augmentation level, but essentially in these first two levels, technology is *enhancing* the task.

Moving to modification requires a redesign of a task, allowing for more opportunities for student growth and learning. Using the sharing and collaboration features on Noteflight could turn the individual composition assignment into a group project with each member contributing content, providing feedback, and taking part in the shared knowledge and creation of the group. Lastly, the redefinition level involves tasks that are completely new to the classroom, bringing goals and objectives never thought to have been previously possible within reach through the use of a tech tool. Instead of the traditional notational composition assignment, students could be asked to create an original composition with pre-recorded audio loops from GarageBand to provide thematically-appropriate background music to a silent video clip, finalizing the project for presentation in iMovie. The modification and redefinition levels are *transformative* to student learning outcomes and often involve a synthesis of knowledge and skills from multiple areas. Puentedura asserts that in these transformative levels, students not only make strides in comprehension but are provided with more opportunities for collaboration, mentorship, and

ownership of their learning (Common Sense Education, 2016). Similar to the TPACK model, SAMR involves a continuous cycle of evaluation, reflection, questioning, and modifying practice when approaching the task of integrating technology into teaching practice. The aim is not to start with a focus and emphasis on the technological tool, but the learning process and skills involved in the student learning objective. Puentedura reiterates this point while referencing the crucial relationship of pedagogy and content in the TPACK model: "[The tool makes] it possible for the teacher to rethink how the content can work for a student to better understand it. How will I as a teacher rethink the presentation to be more useful for the student?" (McQuade, 2015).

Conclusion

Despite the challenges posed by the rapid advancement of technology, it is important to keep in mind that technology, when used appropriately as an educational tool, works just like any other resource. Frankel points out that "technology in the music classroom, when facilitated with sufficient teacher training and appropriate curricular integration, has the potential for having a very positive impact on the music education the students receive" (2010, p. 237). To be clear, merely using technology in the classroom does not guarantee deeper, more meaningful learning connections than are possible in more "traditional" methods. As one article on the transformation—or lack thereof—of teaching through the utilization of technology states, "there's nothing transformative about every kid having an iPad unless you're able to reach higher-order teaching and learning" (Herold & Smith, 2015). The Horizon Report by the New Media Consortium (NMC) takes this point further to say that rampant technology use in education does not automatically provide increased student outcomes, nor does using technology

just for technology's sake assist in the closing of the achievement gap in race, gender, and other areas (Freeman et al., 2017). However, when technology is used in a purposeful and thoughtful manner with the help of research-based integration models such as TPACK and SAMR, the opportunities for engaging, effective student-centered learning are far-reaching and will allow students to reach levels of musicianship never thought possible.

References

Aiyegbayo, O. (2015). How and why academics do and do not use iPads for academic teaching?. *British Journal Of Educational Technology, 46(*6*),* 1324-1332. doi:10.1111/bjet.12202

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

Beckstead, D. (2001). Will technology transform music education? *Music Educators Journal*, *87(*6*)*, 44. doi:10.2307/3399692

Borja, R. R. (2006). Researchers weigh benefits of one computer per lap. *Education Week*, *25*(36), 10.

Bréhaut, T. (2015). Is there an app for that? Integrating technology in the band room. *Canadian Winds / Vents Canadiens, 13(*2*)*, 32-35.

Carpenter, T. H. (1969). The utilization of instructional television in music education. Retrieved from https://files.eric.ed.gov/fulltext/ED032788.pdf

Clements, A., (2016). Teaching general music in the digital age. In C. R. Abril, & B. M. Gault (Ed.), *Teaching general music: Approaches, issues, and viewpoints* (pp. 327-346). New York, NY: Oxford University Press.

Common Sense Education. (2016). *The Impact of the SAMR Model with Ruben Puentedura.* [Video file]. Retrieved from https://www.youtube.com/watch?v=SWU0Dzz6gs0

Cooper, S. (2005). Marguerite V. Hood and music education radio broadcasts in rural Montana (1937-39). *Journal Of Research In Music Education*, *53*(4), 295-307.

Crappell, C. (2013). Making it work: A case study of the installation and implementation of technologies in a group piano classroom. *MTNA e-Journal*, *5(*1*),* 2-15.

Daugherty, J. F. (2002). Technology report: Electronic learning for twenty-first century choirs: Rationale, strategies, and values. *Choral Journal*, *43(*5*)*, 71-79.

Demski, J. (2010). How music teachers got their groove back: Music instruction goes digital. *T.H.E. Journal*, *37*(9), 26.

Dunbar-Hall, P., Rowley, J., Brooks, W., Cotton, H., & Lill, A. (2015). E-Portfolios in music and other performing arts education: History through a critique of literature. *Journal of Historical Research in Music Education, 36(*2*)*, 139-154.

Frankel, J. (2010). Music education technology. In H.F. Abeles, & L. A. Custodero (Ed.), *Critical issues in music education: Contemporary theory and practice* (pp. 236-258). New York, NY: Oxford University Press.

Freeman, A., Adams Becker, S., Cummins, M., Davis, A., & Hall Giesinger, C. (2017). *NMC/CoSN Horizon Report: 2017 K–12 Edition.* Austin, TX: The New Media Consortium. Retrieved from https://cdn.nmc.org/media/2017-nmc-cosn-horizon-report-k12-EN.pdf

Gow, P. (2004). Technology & the culture of learning. *Independent School, 63(*4*)*, 18.

Halverson, E. R., & Sheridan, K. M. (2014). The maker movement in education. *Harvard Educational Review, 84*(4*)*, 495-504, 563, 565.

Heller, G. N. (2011). From the melting pot to cultural pluralism: General music in a technological age, 1892-1992. *Journal Of Historical Research In Music Education, 33(*1*)*, 59-84.

Herold, B. (2016). Technology in education: An overview. *Education Week*. Retrieved from http://www.edweek.org/ew/issues/technology-in-education/index.html

Herold, B., & Smith, C. (2015). Why ed tech is not transforming teaching. *Education Week, 34*(35*),* 8.

Holoboff, J. (2015). Building ideas for student-centered musical learning. *Canadian Music Educator / Musicien Educateur Au Canada, 57*(1), 32-33.

Karpf, J. (2012). The last dramatic instructional innovation? The chalkboard and music education in a historical prospective. *Journal of Historical Research in Music Education, 34*(1), 62-80.

Katz, M. (1998). Making America more musical through the phonograph, 1900-1930. *American Music, 16(*4*),* 448.

Kosturko, L. (2015). CS is everywhere: Coding in your art/music/PE classroom. [Blog post] Retrieved from https://blogs.sas.com/content/sascp/2015/12/03/cs-is-everywhere-coding-in-your-artmusicpe-classroom/

Kuzmich, J. (2015). How relevant is your teaching: Mastering music can FLIP the switch! *School Band & Orchestra*, *18(*10*)*, 40-45.

Mark, M. L., & Gary, C. L. (2007). *A history of American music education: Contemporary theory and practice* (3rd ed.). Lanham, MD: Rowman & Littlefield Education.

McQuade, P. (2015). *Ruben Puentedura - SAMR.* [Video file]. Retrieved from https://www.youtube.com/watch?v=CgyNKsnuBB4

Mercer, A. (2010). Ten years of technology advances in education. *Canadian Music Educator / Musicien Educateur Au Canada*, *51(*3*)*, 56-57.

Nolan, K. K. (2009). SMARTer music teaching. *General Music Today, 22(*2*)*, 3. doi:10.1177/1048371308324104

Raths, D. (2014). 4 ways technology can make your music lessons sing. *T.H.E. Journal, 41*(11), 29.

Schneider, G. (2016). Technology enhances teaching and learning in the music classroom. *School Band & Orchestra, 19(*6*)*, 36-37.

Smay, D., & Walker, C. (2015). Makerspaces: A creative approach to education. *Teacher Librarian, 42(*4*),* 39-43.

The Leonard Bernstein Office, Inc. (n.d.). *Omnibus*. Retrieved from https://leonardbernstein.com/about/educator/omnibus

Tobias, E.S., (2016). Digital media and technology in hybrid music. In C. R. Abril, & B. M. Gault (Ed.), *Teaching general music: Approaches, issues, and viewpoints* (pp. 112-140). New York, NY: Oxford University Press.

Webster, P. (2002). Historical perspectives on technology and music. *Music Educators Journal*, *89*(1), 38. doi:10.2307/3399883

Wise, S., Greenwood, J., & Davis, N. (2011). Teachers' use of digital technology in secondary music education: Illustrations of changing classrooms. *British Journal Of Music Education, 28*(2), 117-134. doi:10.1017/S0265051711000039