9
ICT IN MUSIC EDUCATION

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Introduction

In this chapter the authors describe the current status, potential, and challenges of information and communication technologies for music learning in the United States and Japan. Conceptual frameworks for the integration of technology in music education are introduced and examples of practical applications of technology for music teaching and learning are discussed. The authors describe a variety of ways that technology is being used to facilitate music learning and musical participation in general, examining the information and communication technologies (ICT) knowledge and skills needed by music teachers to effectively integrate technology into diverse student learning experiences. Using technology for lifelong musicking and professional learning is examined and recommendations for future research and practice are provided.

ICT in music education can be defined as digital tools used by students and teachers to perform, create, reflect on, respond to, analyse, listen to, and communicate about music. ICT may include various types of media, software, hardware, online technologies, desktop and laptop computers, digital instruments, smartphones, tablet computers, and other technologies that allow people to facilitate musical experiences and learning. The study of ICT involves not only investigation of the technologies themselves, but also the efficacious application of those technologies to varied learning environments. In this chapter we describe the current status, potential, and challenges of information and communication technologies for music learning in the United States and Japan.

ICT in the United States

Historically, researchers have found that music teachers in the United States have used technology for administrative purposes, but they have not extensively integrated technology into curriculum and instruction (Dorfman, 2013; Jassmann, 2004; Ohlenbusch, 2001; Reese and Rimington, 2000; Taylor and Deal, 2000). In contemporary schools, however, there appears to be an increasing number of music educators who are utilising new approaches to music-making and learning facilitated through technology. Technology is being used for creating,

performing, and responding to music (Bauer, 2014a). It is helping educators to effectively assess student learning. It is also being used in ways that enable lifelong engagement in and learning about music. The space limitations of this chapter will not allow comprehensive coverage of these current practices. Therefore, the discussion will focus on four areas: (1) the influence of two new theories of technology integration with application to music learning, (2) the increasing emphasis on musical creativity facilitated through technology, (3) the growing impact of mobile computing devices, and (4) the opportunities for lifelong musical engagement and learning empowered through technology.

Using Theory to Inform Practice

Traditionally, ICT in the United States has been technocentric. The focus of educational technology practices has often been on the technology itself—its features and operation—without the purposes for and approaches to using that technology given the same degree of consideration. Recently, two theories of technology integration—TPACK (Technological Pedagogical Content Knowledge)[2] and SAMR (Substitution, Augmentation, Modification, and Redefinition)[3]—have begun to impact the way teachers think about using technology with students (e.g. see Cavanaugh, Hargis, Kamali, and Soto, 2013; Chou, Block, and Jesness, 2012; Harris and Hofer, 2011; Hofer and Grandgenett, 2012; Puentedura, 2008; Shin et al., 2009). Music educators, too, have begun to apply these ideas to the development and implementation of student learning experiences (Bauer, 2014a; Bauer, 2014b; Bauer, Harris, and Hofer, 2012; Dorfman, 2013).

TPACK is a model for technology planning and integration that developed out of Shulman's (1986) conception of teacher knowledge known as *pedagogical content knowledge* (PCK). Shulman believed that in order to be effective, a teacher needed to have a strong understanding of the subject matter content to be taught. He also recognised that there are certain pedagogical principles—how to teach and how students learn, things like sequencing and scaffolding instruction, principles of child development, motivational strategies, and so on—that all teachers need to know. However, Shulman realised that when specific content and pedagogical knowledge overlapped, a specialised type of knowledge, pedagogical content knowledge, resulted. For example, the approaches to assessment (a component of pedagogical knowledge) will vary for science, history, physical education, and music teachers due to the unique attributes of each discipline's content.

Mishra and Koehler (2006) built on the work of Shulman by adding a technology component to the PCK model, resulting in TPACK (see Figure 9.1). To effectively integrate technology into student learning experiences, teachers need to have well-developed technology, content, and pedagogical knowledge. While all three knowledge areas are important, it is how they interact, influencing and constraining each other within a particular teaching and learning context, that impacts how teachers design and maximise effective learning experiences for students. Importantly, in the TPACK model, everything starts with subject matter content learning outcomes. The teacher must determine the appropriate fit between pedagogy and technology, aligning them with the content to be learned. For further discussion and examples of TPACK in music education, see Bauer (2013, 2014a, 2014b).

SAMR, which stands for *substitution*, *augmentation*, *modification*, and *redefinition* (Puentedura, 2008), can work in conjunction with TPACK. It is a way of thinking about using technology in increasingly sophisticated ways that range from enhancing instruction to transforming learning experiences. At the *substitution* level, technology is used as a direct

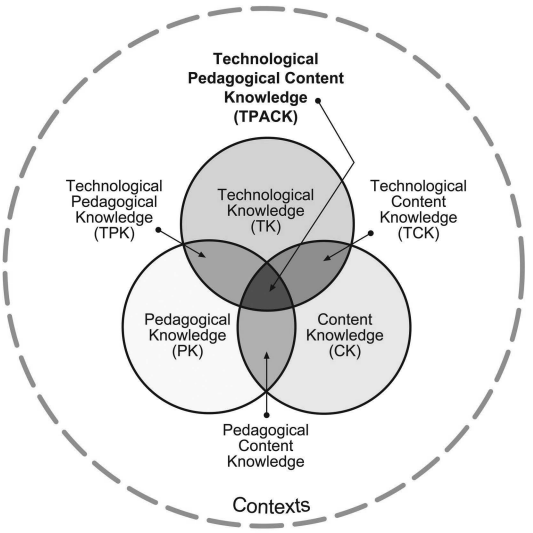

Figure 9.1 Technological Pedagogical Content Knowledge (TPACK).
Source: http://tpack.org/.

replacement for an older, possibly analog way of doing something. For example, in a music classroom, students might utilise a notation program to notate a melody instead of writing it out by hand on manuscript paper. When conceived as an *augmentation*, technology not only replaces an older way of doing things but also adds new functionality. To continue with the music notation software example: if students notate a melody using one of these programs, the teacher could also ask them to play the melody through the computer, allowing them to use their ears to 'proof listen' and find any notation errors they may have made.

The *modification* level occurs when technology is used to completely redesign a learning task. Here, the music student working with their melody might be asked to also create two variations of it, and to utilise different timbres facilitated by the software and computer in the process. Then the students could play the variations for each other, discussing the techniques used with each variation. Finally, *redefinition* indicates that the technology is being used to facilitate an approach that wouldn't have been previously possible. In our music notation scenario, a student might use a notation program such as Noteflight[4] to work jointly with another student located at a distance to create a musical composition. See Bauer (in press) for further discussion of the SAMR model.

Creative Thinking in Music Through Technology

The development of creativity has often been cited as a key outcome of music education. However, in the United States, school music has had a primary focus on musical performance, with a secondary emphasis on outcomes related to creating and responding to music. This has resulted in a high standard of excellence for bands, orchestras, and choirs, but fewer opportunities for students to fully develop their creative potential. However, a shift may have begun, with classes and experiences that emphasise creative musical thinking facilitated by technology becoming increasingly available to students (Williams and Dammers, 2015), including students who haven't traditionally been involved in school music classes. In addition, the

new National Core Music Standards, released in the summer of 2014, include creativity as a primary component (State Education Agency Directors of Arts Education, 2014). Skilled educators are utilising a variety of hardware and software to facilitate creative musical activities through innovative teaching and learning approaches. Often these technologies have served to support teachers' content knowledge and pedagogical understanding in ways that help them design learning experiences that enable students to engage with music creatively.

Improvisation, which Azzara and Grunow (2006) describe as "the spontaneous expression of meaningful musical ideas" (p. iv), has often been relegated to students enrolled in school jazz bands. Some teachers have not felt comfortable teaching improvisation because they themselves didn't improvise, having learned music almost exclusively through written notation. Today, a variety of inexpensive and easily accessible technologies make it possible for students to develop their improvisational abilities individually and in groups. There exist a number of software applications and websites that are valuable for the development of aural skills and theoretical understanding essential to fluent improvisation.[5] YouTube, Spotify, iTunes, and similar sources of online audio can be easily accessed to listen to music and develop an aural understanding of various musical styles and genres. Software such as SmartMusic, Band-in-a-Box, and iReal Pro,[6] as well as commercial audio recordings, make it possible for students to individually practice improvising with accompaniment.

Likewise, music educators have utilised the affordances of technology to engage students in music composition facilitated by music production and notation software (e.g. see Bauer, 2012; Freedman, 2013). Non-traditional and younger music students who don't read music notation are using both specialised applications[7] and music production software such as GarageBand[8] to create original works and learn about compositional processes (e.g. Williams and Dammers, 2015). Remixing music—taking a pre-existing composition and altering it in a variety of ways, sometimes combining it with one or more other songs or sounds to where the final product becomes what is essentially a new work—is another creative musical activity facilitated through music production software that is being embraced by some teachers and students.[9]

For students who read music, notation software provides a number of affordances to the process of composing music (see Bauer, 2014a). Music-COMP (formerly known as the Vermont MIDI Project)[10] is a curricular approach that has been at the forefront of helping students become composers, using technology as a primary tool. Music-COMP students use notation software to create compositions, exchanging the resulting notation files or otherwise electronically sharing (e.g. using NoteFlight) their compositions with other students and professional composers via online forums. Following critique and reflection with peers and the professional composers, students revise their compositions accordingly.

Mobile Devices

The proliferation of mobile devices—smartphones and tablet computers—has had a major impact on the daily lives of many people throughout the world. These technologies are also finding their way into everyday use by music teachers and students in the United States (Riley, 2013). While the full potential of mobile devices has yet to be discovered, their portability and versatility are major attributes. Since they are relatively small, it is convenient to always have them available for use. Through a plethora of free and inexpensive apps (applications), smartphones and tablets can be instantly transformed into metronomes, tuners, notation programs, digital instruments, video viewers, music players, audio/video recorders

and editors, digital audio workstations, and communication devices, among others. They are also capable of connecting to online resources, furthering their usefulness. For instance, through music services such as Spotify,[11] teachers and students have access to millions of recordings of music of all styles and genres that are available at any time, from anywhere they can connect to the Internet. This type of access would have been unthinkable only a short time ago and can potentially transform many aspects of music teaching and learning.

Music teachers are finding numerous innovative applications for mobile devices. As one example, New York public school music teacher Adam Goldberg has utilised iPads to provide students with mental and physical disabilities a way to be musically creative and expressive (Westervelt, 2014). Goldberg combines both traditional instruments and iPads in a Technology Band. The iPad apps used allow students to perform musical arrangements that would otherwise not be possible. Because these apps enable pleasing musical sounds to be produced without the need for finely developed technique, these students are able to participate in a musical ensemble in a meaningful way. Their engagement with music also provides therapeutic benefits that help to mediate their physical and cognitive challenges.

Lifelong Musicking

Small (1998) coined the word '*musicking*' (from the verb '*to music*'), indicating that music is an active process to experience, not merely a thing to be observed. Technology has increased the opportunity for all people to actively engage with music, from infancy to older adulthood. Developmentally appropriate software, online resources, and technological devices are available for young and older children to create, perform, listen to, and otherwise learn about music in both formal (in school) and informal (outside of school) educational settings. Musicians of all ages distribute, listen to, and discuss their music online through sites such as YouTube and SoundCloud.[12] Older youth and adults engage in conversations about music and musical artists via social networks and email listservs, exchanging ideas about performance practices, repertoire, philosophical approaches, and more. Performers of all ages use accompaniment software such as SmartMusic to facilitate their practice. Devices such as iPads are affording numerous new modes of musicking.

ICT is also providing new ways for music teachers to continue to engage in professional learning that exists along a continuum from informal to formal. Informal personal learning networks, where teachers connect with valued resources and individuals through social networks and other online resources, are a means of professional development that can take place on a daily basis (Bauer, 2010). Webinars, seminars broadcast over the Internet, are increasingly offered to music teachers to provide them with current information on topics of interest.[13] MOOCs (massive open online courses), short courses that take place online over a period of time—often several weeks—are another technology some teachers are using to review existing approaches to music, teaching, and learning, and to learn about new ones.[14] Finally, complete college courses and even entire graduate degree programs in music are being offered online, providing flexibility for busy music teachers who are interested in formally continuing their education (see Bauer, 2014a, for further discussion).

Current Situation of the ICT Environment in Japanese Schools

In Japan, awareness of the need for utilising ICT at school was promoted in the 2000s. In 1998, the Curriculum Council issued a report requesting measures to tackle the issue of

information education in schools. Based on this report, the national curriculum, revised in 2003, required high schools to provide information education. As a result, information education became a compulsory subject for the first time.

Along with the development of a system for improving students' ICT skills, the effective use of ICT in school teaching has become one of the most important challenges. Beginning in the 2000s, a series of government-led projects was launched, including the Innovation of Learning project (Ministry of Education, Culture, Sports, Science and Technology, 2014) and the Future School Implementation project (Ministry of Internal Affairs and Communications, 2010), the principal aims of which were the development and effective use of ICT in an environment where the Internet, e-blackboards, and tablet PCs were available for every student.

As a result of these efforts, the ICT environment gradually improved from the 2000s. A large-scale survey conducted in 2012 showed that the availability of ICT hardware and Internet connectivity at school was relatively good; 96.6% of elementary school classrooms had large-sized display equipment such as a digital TV or e-blackboard (Horita, 2014), which were mostly connected to projection instruments. Furthermore, more than 70% of schools had ultra-high-speed Internet service (Ministry of Education, Culture, Sports, Science and Technology, 2013).

ICT in Music Education Practice and Its Problems

Compared to general classrooms, it seems that music rooms do not have adequate ICT devices (Horita, 2014). Given that music education began using records, CDs, and DVDs soon after they were developed, one might assume that music would be among the first subjects to utilise ICT. Currently, however, music is one of the subject areas that struggles most with the integration of ICT. The ICT devices usually found in general classrooms are not available in music rooms, and furthermore, music educators' motivation to use ICT seems very low (Fukami, 2014).

Although there has been no nationwide survey that investigated ICT use in music classes, Hatsuyama (2014) showed the learning area in which it has been most utilised. In the early 2000s, ICT use in music education consisted mainly of students using notation software for music composition. During this period, since ICT use was not popular in other subjects, it can be said that ICT was relatively familiar in music education. After 2005, the utilisation of ICT shifted from notation software to digital learning content (Hatsuyama, 2014). At the same time, however, ICT use in music education diminished, in contrast to other subjects, where it became actively utilised.

Possibility of a Singing Test Using ICT Technology

Unfortunately, it is hard to say that the application of ICT in music education has developed satisfactorily. However, a visionary project has been implemented. In 2008, the National Institute for Educational Policy Research conducted nationwide surveys on academic music ability, in which students were tested for singing ability, music appreciation, and music theory. The epoch-making aspect of this survey is that ICT technology was used for evaluating the singing ability of a large number of students, and about 1,000 junior high school students participated. In the survey, notebook PCs were distributed to each participant and the singing test was conducted in a group. About 30 to 40 students

went through the test simultaneously with their headphones and microphone connected to their individual PCs.

The test was designed for learning a new song in a general classroom setting. The students were asked to memorise and sing an upper voice of two-part chorus. They listened to the model performance played from the PC, and they were then asked to make their own recording according to the instructions given on the PC. Before recording the final performance, they could listen to their practice recordings in order to brush up.

The schools that participated in the survey were chosen randomly, and a majority of the students went through the test without any problems. Their performances were evaluated highly: more than 80% of all the participants memorised the song and sang it with the correct rhythm, and more than 60% of them used correct pitch (National Institute for Educational Policy Research, 2010).

ICT in Informal Education

Leading-edge ICT technology has a large influence not only in the formal education system but also in informal learning contexts. As has been widely known in many countries, entertaining musical activities, such as karaoke, Wii, and Vocaloid are extremely popular in Japan. Contrary to the case in school settings, in informal settings young people seem to be actively engaged with modern technology. For example, karaoke has now become one of the most popular leisure activities in Japan (Mito, 2007), and its leading-edge technology has made a large contribution to the promotion of singing activities (Mitsui, 1998).

Karaoke attracts young people not only because it provides pre-recorded accompaniment, but also because the machines are equipped with several devices that attract singers (Ōshita, 2005). One of the most important features of karaoke is the large number of songs available, which has been dramatically increased by the development of telecommunication technology. A standard model is equipped with about 150,000 songs representing various musical genres, including J-pop (Japanese pop songs), Western pop, traditional songs, and so on. Furthermore, what attracts young people the most is the rapidity of the song selection and the availability of newly released songs. The singers can instantly search and choose songs from a vast selection, and newly released songs are available immediately.

The recent development of karaoke accessories such as an auto-scoring system have also made a great contribution to the popularity of karaoke. The auto-scoring system rates a singer's performance in terms of the accuracy of pitch and timing. Almost all the karaoke machines in Japanese karaoke facilities have this function. The machine can evaluate various singing techniques such as vibrato, portamento, and even the quality of voice. The system provides visual feedback to singers in real time as they perform. Although the reliability of the auto-scoring system leaves much to be improved, the system has become a necessary item for karaoke (Mito and Boal-Palheiros, 2012, 2013). The automatic recording system is popular as well. Singers can record their performances and listen to them immediately afterward, or burn an audio CD instantly.

Integration of ICT in Formal and Informal Music Education

To summarise the discussion so far, music education at school still faces several problems in exploiting ICT effectively, although promising practices are emerging. On the other

hand, in informal music education, musical activities seem to be well integrated in learning situations. For example, karaoke singing can be seen as a promising learning style that applies ICT. The next section discusses how ICT music education in these two situations, formal and informal, can be integrated and offers recommendations for the future of ICT in education.

Enhancement of Teaching Content

One of the most important problems to be solved in ICT music education is the lack of learning content. For example, few e-textbooks on music are available, especially in comparison to the number created for other subjects. As of 2012, only one publisher has published e-textbooks for secondary school music.[15] Furthermore, only a small amount of digital learning content is posted on the Internet. Although there are various possibilities of ICT learning in music, such as choral learning and music listening, the lack of a sufficient amount interferes with the development of ICT practice in music education.

The abundant song repertoire of karaoke suggests the importance of the enhancement of digital learning content in ICT musical learning. One of the reasons karaoke gained popularity is that the large karaoke singing repertoire exactly matches young people's singing and listening style in which they listen to and sing a variety of songs one after another. Furthermore, they want to sing the latest songs as soon as they are released (Kishimoto and Azami, 2001). It is not an exaggeration to say that, in karaoke, customers can choose any song they want to sing; this is a strong advantage that the school ICT does not have.

For these reasons, it is indisputable that the lack of ICT learning content hinders the popularisation of ICT in music education. The enhancement of ICT learning content is an urgent need for schools. Of course, adding content alone does not guarantee a match with young people's musical behaviour. The teaching materials that are used at school have to be examined carefully. Simply increasing the number of songs available through school ICT does not solve the problem. However, varieties of songs that are not in the textbooks are often sung in music classes. Thus, the need for a larger repertoire of songs, including more recent selections, is an important challenge for music education.

The Lack of PC Terminals and Interactive Learning

The lack of computer terminals is also a problem with ICT in music education that cannot be overlooked. Despite the popularisation of low-cost tablet PCs, not many schools are equipped with a sufficient number of PC terminals for the students. In 2013, the average number of students per PC was 6.5 (Ministry of Education, Culture, Sports, Science and Technology, 2013). This problem led to another problem: the lack of interactive learning. At present, ICT in music education is usually conducted only through one-way communication. It is used as a subsidiary tool for teaching, for example, in presentations on content such as the musical text or recordings. Students rarely have the opportunity to engage in interactive learning in music class using individual PCs.

The popularity of karaoke shows the possibility of interactive learning in singing using a PC terminal. As described in the previous section, karaoke involves singing not just with pre-recorded accompaniment but also with various kinds of interactive systems such as an auto-scoring system and recording system. These functions not only enhance the entertainment appeal to young people but also match their purpose in singing.

A series of studies revealed that young people have a strong sense of improving their singing skill even in informal learning contexts (Mito, 2004, 2007, 2010). The analysis of their singing behaviour clearly revealed that their singing style at karaoke was sometimes strongly oriented towards memorising particular songs and improving the quality of singing, while intentionally elaborating musical aspects such as pitch, rhythm, and expression.

Young people actively use auto-scoring systems and recording systems for practicing songs at karaoke, which is a form of interactive leaning. This trend is prominently visible in the recent popularisation of *hitokara* (meaning 'going to karaoke alone'). One reason young people go to karaoke alone is to secure as much time as possible for practicing songs. Within the last few years, the number of karaoke facilities specialising in *hitokara* has grown dramatically, and many young people use such places for singing practice, during which time they actively utilise the recording system or auto-scoring system.

The singing test described in the previous section strongly indicated that the karaoke-style method of interactive learning is feasible even in the school learning setting. The participants smoothly interacted with the PC when following the instructions, and the system for providing feedback on their performance worked effectively. Given that it is extremely unrealistic to give students individual lessons, interactive learning using PC terminals is a promising strategy.

In Japan, music education faces several problems such as a decline in the number of teaching hours and the number of skilled teachers. In this situation, it can be said that the development of ICT education is particularly needed. However, as discussed in this section, the advantages of ICT have not been fully exploited at school. On the other hand, technology has been well integrated in the characteristics of informal learning, based on which young people acquire extensive musical skills. The development of ICT education in schools and in informal settings needs to be pursued in an integrated fashion as two sides of the same coin.

Summary

ICT is impacting music teaching and learning in the United States and Japan in many ways. Its influence is not limited to specific types of musical activities, students, or learning contexts. ICT has helped to facilitate new approaches to creative musical activities, as well as to the acquisition of listening and performance skills. It is being used with traditional and non-traditional students in formal and informal educational settings. ICT makes it possible for some individuals, for example, those who have special needs, to engage with music in ways that would not otherwise be possible.

Effectively utilising ICT in music teaching and learning is not an easy task. As stated earlier, meaningful integration of technology into students' musical experiences requires teachers to not only have a well-developed understanding of music itself, but also of technology and corresponding pedagogical strategies. Teachers must also consider how these three components—music content, pedagogy, and technology—interact and influence one another. Adequate equipment and resources, along with support of administrators and instructional technology staff, are also important if ICT is to reach its potential for creating, performing, and responding to music. The promise of ICT in music education in both the United States and Japan is great. Continued efforts to innovate, develop, and study best practices for its use are essential if that promise is to be fulfilled.

Notes

1. TPACK (http://www.tpack.org).
2. SAMR (http://www.schrockguide.net/samr.html).
3. Noteflight (http://www.noteflight.com).
4. Two free websites are MusicTheory.net (http://www.musictheory.net) and Teoria (http://www.teoria.com).
5. SmartMusic (http://www.smartmusic.com), Band-in-a-Box (http://www.pgmusic.com), and iRealPro (http://irealpro.com).
6. For example, O-Music (http://www.musicfirst.com/o-music).
7. GarageBand (http://www.apple.com/mac/garageband/).
8. For more information about remixes, see http://www.ted.com/talks/kirby_ferguson_embrace_the_remix?
9. Music-COMP (http://music-comp.org).
10. Spotify (http://www.spotify.com/).
11. YouTube (http://www.youtube.com) and SoundCloud (http://soundcloud.com).
12. For example, the National Association for Music Educators has been presenting a series of webinars (http://www.nafme.org).
13. Coursera offers a number of MOOCs that may be applicable to music educators. Visit http://www.coursera.org and search for *music.*
14. E-textbook version of an approved school textbook. All the paper-based information in the textbook is digitised. In addition, sound sources of the teaching materials such as singing, instrumental performance, and appraising are included.

References

Azzara, C. D., & Grunow, R. F. (2006). *Developing musicianship through improvisation.* Chicago: GIA.

Bauer, W. I. (2010). Your personal learning network: professional development on demand. *Music Educators Journal*, *97*(2), 37–42.

Bauer, W. I. (2013). The acquisition of musical technological pedagogical and content knowledge. *Journal of Music Teacher Education*, *22*(2), 51–64. doi:10.1177/1057083712457881

Bauer, W. I. (2012, March). *Musical creativity, learning, and technology: a case study of the Vermont MIDI Project.* Paper presented at the 2012 Biennial Music Educators National Conference; St. Louis, MO.

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

Bauer, W. I. (2014b). Music learning and technology. *New Directions: A Journal of Scholarship, Creativity and Leadership in Music Education*, *1*(1). http://nd.music.msu.edu/music-learning-technology-william-bauer/

Bauer, W. I. (in press). Musicianship-focused curriculum and assessment. In C. Conway (Ed.), *Focusing on musicianship in designing curricula and assessments.* Chicago: GIA.

Bauer, W. I., Harris, J., & Hofer, M. (2012). Music learning activity types. http://activitytypes.wmwikis.net/Music

Cavanaugh, C., Hargis, J., Kamali, T., & Soto, M. (2013). Substitution to augmentation: faculty adoption of iPad mobile learning in higher education. *Interactive Technology and Smart Education*, *10*(4), 270–284.

Chou, C. C., Block, L., & Jesness, R. (2012). A case study of mobile learning pilot project in K-12 schools. *Journal of Educational Technology Development and Exchange*, *5*(2), 11–26.

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

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

Freedman, B. (2013). *Teaching music through composition: a curriculum using technology*. New York: Oxford University Press.

Fukami, Y. (2014). Nihon no dejitaru kyoukasho kairyou ni kansuru teian: Kankoku shisatsu, nikkan dejitaru kyoukasho no hikaku wo tousite [Proposals for improvement of Japanese e-textbook: visit to Korea, comparison between Korean and Japanese e-textbook]. *Japanese Journal of Music Education Practice, 11*(2), 22–26 (in Japanese).

Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology-related instructional planning. *Journal of Research on Technology in Education*, *43*(3), 211–229.

Hatsuyama, M. (2014). Syougakkou ongakuka-kyouiku ni okeru ICT no kakawari to katsuyouhou [Involvement and utilization of ICT in elementary school music education]. *Japanese Journal of Music Education Practice, 11*(2), 27–33 (in Japanese).

Hofer, M., & Grandgenett, N. (2012). TPACK development in teacher education: a longitudinal study of preservice teachers in a secondary MA Ed. program. *Journal of Research on Technology in Education*, *45*(1), 83–106.

Horita, T. (2014). Gakkou kyouiku ni okeru jouhouka no doukou to kadai [Trend and problems of informatization at school education]. *Japanese Journal of Music Education Practice*, 11(2), 6–13 (in Japanese).

Jassmann, Art E. (2004). *The status of music technology in the K-12 curriculum of South Dakota public schools*. EdD dissertation, University of South Dakota. ProQuest Digital Dissertations database (Publication No. AAT 3127829).

Kishimoto, Y., & Azami, T. (2001). *J-pop marketing: IT-jidai no ongaku-sangyou [J-pop marketing: music business in IT era]*. Tokyo: Chuokeizai-sha (in Japanese).

Ministry of Education, Culture, Sports, Science and Technology. (2013). Survey results of the digitization of education at school. http://www.mext.go.jp/a_menu/shotou/zyouhou/1287351.htm

Ministry of Education, Culture, Sports, Science and Technology. (2014). Report for innovation of learning project. http://www.mext.go.jp/b_menu/shingi/chousa/shougai/030/toushin/1346504.htm

Ministry of Internal Affairs and Communications. (2010). Report for future school implementation project. http://www.soumu.go.jp/main_sosiki/joho_tsusin/kyouiku_joho-ka/future_school.html

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: a framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054.

Mito, H. (2004). Role of daily musical experience in acquisition of musical skill: comparison between young musicians and nonmusicians. *Bulletin of the Council for Research in Music Education*, *161/162*, 165–172.

Mito, H. (2007). *Learning musical skill through everyday musical activities*. Unpublished PhD thesis, Roehampton University.

Mito, H. (2010, August 1–6). *Singing behaviour in everyday lives: Investigation through diary method*. Paper presented at 29th ISME World Conference, Beijing.

Mito, H., & Boal-Palheiros, G. (2012). How do young people sing in everyday life and at school? In *Proceedings of the 24th Seminar on Research in Music Education* (pp. 42–46). Thessaloniki, Greece.

Mito, H., & Boal-Palheiros, G. (2013, July 7–10). *How do young people sing in everyday life and at school?* Paper presented at The Phenomenon of Singing International Symposium IX, St. Johns.

Mitsui, T. (1998). The genesis of karaoke: how the combination of technology and music evolved. In T. Mitsui & S. Hosokawa (Eds.), *Karaoke around the world: global technology, local singing* (pp. 31–44). London: Routledge.

National Institute for Educational Policy Research. (2010). Research on a particular problem: Junior high school and elementary school music. http://www.nier.go.jp/kaihatsu/tokutei_ongaku/houkoku_zentai_001.pdf

Ohlenbusch, G. (2001). *A study of the use of technology applications by Texas music educators and the relevance to undergraduate music education curriculum*. DMA dissertation, Shenandoah University, Virginia. ProQuest Digital Dissertations database (Publication No. AAT 3010524).

Ōshita, E. (2005). *Karaoke wo hatsumei shita otoko [The man who invented karaoke]*. Tokyo: Kawade Shobo Shinsha (in Japanese).

Puentedura, R. (2008). TPCK and SAMR: Models for enhancing technology integration. In *As we may teach: educational technology, from theory into practice*. Maine Department of Education. https://itunes.apple.com/itunes-u/as-we-may-teach-educational/id380294705?mt=10

Reese, S., & Rimington, J. (2000). Music technology in Illinois public schools. *Update: Applications of Research in Music Education*, *18*(2), 27–32.

Riley, P. (2013). Teaching, learning, and living with iPads. *Music Educators Journal*, *100*(1), 81–86.

Shin, T., Koehler, M., Mishra, P., Schmidt, D., Baran, E., & Thompson, A. (2009). Changing Technological Pedagogical Content Knowledge (TPACK) through course experiences. In I. Gibson et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2009* (pp. 4152–4159). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

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

Small, C. (1998). *Musicking: the meanings of performing and listening*. Middletown, CT: Wesleyan University Press.

State Education Agency Directors of Arts Education. (2014). National core arts standards. http://www.nationalartsstandards.org

Taylor, J., & Deal, J. (2000, November). *Integrating technology into the K-12 music curriculum: a national survey of music teachers*. Poster session presented at the annual meeting of the Association for Technology in Music Instruction. Toronto, Canada.

Westervelt, E. (2014). iPads allow kids with challenges to play in high school's band. http://www.npr.org/blogs/ed/2014/06/11/320882414/ipads-allow-kids-with-challenges-to-play-in-high-schools-band

Williams, D.B., & Dammers, R. J. (2015). Music creativity through technology. http://www.music-creativity.org