Literature Review: Music Technology in Education ETEC 5203-Foundations of Educational Technology

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ETEC 5203 - Foundations of Educational Technology

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There have been many efforts to explore the possibilities that music technology offers in education, in spite of the synchronous nature of music performance (Dammers, 2009). This limited review includes thirty-four peer-reviewed research articles that investigate different ways music technology can be integrated into music education. From "traditional" uses such as online research (Barry, 2003), streaming audio/video (Cox, 2005) and traditional music notation software (Schroth, Helfer, & Dammers, 2009) to *Skype* lessons (Dammers, 2009) and *Dance eJay* (Gall & Breeze, 2005 and Mellor, 2008), the results are categorized and discussed. From the results, it is clear that while technology does offer many possibilities for the music educator, the paradigm of music research must be shifted to clearly state study objectives and to include audio/video material, as well as relevant sheet music in order for educators to truly absorb the information and gauge the efficacy of the use of the technology.

Literature Review: Music Technology in Education

In 2009, Dammers summed up the conundrum of using Information and Communications Technology (ICT) in the field of music education, stating that because music performance is, by its very nature, synchronous, the use of ICT is problematic at best (Dammers, 2009, p. 22). Many collegiate programs are embracing the possibilities of asynchronous online education (research rather than performance), but music programs are not generally moving in that direction (Dammers, 2009, p. 22). This does not mean that technology is not being used in music education, but it does shape *how* it is being explored and implemented from the primary level through higher education.

Before examining how technology is being used in music education, it is necessary to lay out parameters for the term. Rees (2001) defined music technology as "the systematic study of tools and techniques for music production, performance, education, and research" (Rees, 2011, p. 154). This article will deal primarily with education and research, showing how music technology – and more specifically ICT within the field of music – is being used to shape opportunities for music students of varying ages, skills and backgrounds. It will then turn to a discussion on the importance of clearly stated objectives within the research framework and consider an inherent problem in the manner in which the findings are presented.

Methods

The search for peer-review research articles began with the Quick Search Engine at the University of Arkansas online library website (library.uark.edu). The search parameters of the words "music," "technology," and "education" were used, with the options of online, peer-reviewed publications chosen. An additional search was made specifically searching the publication Journal of Technology in Music Learning without parameters on the title or subject matter. From these combined searches, forty-five research articles were selected for initial review. An additional Quick Search was made to search relevant doctoral dissertations, with one being chosen for inclusion based

upon its relevance to the use of technology in music education. Upon review certain trends concerning the use of music technology in music education emerged, and thirty-eight total references were chosen for inclusion in this review based on relevance to this pattern – including one dissertation, one non-research article, two TED talks and thirty-four peer-reviewed research articles.

Results

The study and implementation of music technology in music education can be placed into certain categories, depending on how the technology is used. Starting with asynchronous delivery of content, one can explore distance learning, which is mainly being explored and implemented at the collegiate level.

Distance Learning

Although it is practically impossible to deliver synchronous music education (Dammers, 2009), that does not mean that there is no possibility for online music programs in higher education. In 2003, Barry (2003) developed and evaluated web-based components for a graduate music education research course, with Phase I delivering web-based instruction in blocks and Phase II alternating web and traditional instruction (after receiving student feedback) (Barry, 2003). In 2001, Bauer (2001) integrated web-components into a traditional music education methods course to investigate student attitudes towards asynchronous instruction with generally positive responses (Bauer, 2001). At the high school level, an internet-based study unit was created with the purpose of teaching high school choral students vocal anatomy, with results showing that students' knowledge was successfully increased and that they were comfortable learning this way (Ryder, 2004, p. iv).

Of course, the time frame of these studies is more than a decade ago. They are representative of some of the first explorations of using what we would think of as "modern" ICT in music education. They are primarily concerned with asynchronous online instruction, either as a

fully web-based course of instruction or a hybrid. Other studies move away from the idea of online instruction and begin to look at how ICT can be used within the traditional classroom.

Audio and Video

In 2003, DeVries studied the use of ICTs in primary classrooms in Australia and found that most teachers were using CDs for song repertoire as well as modeling the singing for their students (DeVries, 2013, p. 5). Teachers also used other kinds of multimedia, including DVDs, video, the television and websites. However, more recent kinds of ICT (i.e. tablets or musical digital toys) were rarely used, with lack of knowledge and cost as the major constraints (DeVries, 2013, p. 5).

Another 2015 study looked at a small group of students using video in a much more creative manner. After the teacher showed her class a twenty minute segment of the Metropolitan Broadcast (originally recorded live in high definition) of Mozart's opera, *The Magic Flute*, students clamored for more and ended up watching the entire opera over the course of eight weeks (Acker, Nyland, & Niland, 2015, p. 68). The class began incorporating the storyline of the opera into their dramatic playtime and even had discussions about the symbolism in the opera (Acker et al., 2015, p. 68). The MET Broadcasts are filmed and broadcast live, with an incredibly high quality in video and sound, which makes it possible to engage students in the closest thing to a live performance as possible. This study clearly shows that these young students were engaged by the use of ICT in the classroom and took it far beyond simply "watching a video." While the students were not able to watch the broadcast live, they were able to get a similar experience in their classroom – as long as there is equipment set up with a teacher who knows how to use it.

Another area that can be hindered by cost and training – as well as equipment and infrastructure – is the setup of streaming audio in academic libraries (audio offered in house – not subscription based like Naxos) (Cox, 2005). Streaming audio is often the solution to tricky copyright issues, since the audio is never completely stored on the end-user's computer. This web-based

survey looked at academic libraries in Iowa, finding that 57% did not offer streaming audio or video, citing equipment, cost, training and infrastructure as the main hindrances (Cox, 2005, p. 29-31).

Distance Lessons

Although Dammers spent time covering the constraints of delivering music education in a synchronous setup, he did explore the possibilities in delivering private instrumental instruction via Skype (Dammers, 2009). Working with a colleague, he set up trumpet lessons for a young student in another state. Although the format was basically functional, the issues of lag and limited control of the camera view resulted in a recommendation that this be used a supplement to face to face lessons (Dammers, 2009, p. 17). One can only assume that advances in technology will overcome this lag sooner rather than later. One composer who took advantage of this inherent lag is Eric Whitacre, presenting a mixed live/Skype performance of his extremely difficult work "Cloudburst" in 2013 (Whitacre, 2013). This followed several completely *asynchronous* concerts in previous years, with singers sending in their YouTube performances of his work – recording that they made while watching a video of him conducting the piece. The works were then pieced together and presented in an amazing video production that included thousands of individual videos (Whitacre, 2011). Clearly, there is more to be explored in this area.

Another use of online video content was explored by Herrera and Hayes (2014), measuring the impact of pre-recorded "vodcasts" or video podcasts in delivering educational content to secondary instrumental students in Spain (Herrera & Hayes, 2014). Findings showed progress over the course of three academic years with students who used the tool, in this pioneering study (Herrera & Hayes, 2014, p. 177). It is important to note that all students showed improvement, whether or not they used the podcasts (Herrera & Hayes, 2014, p. 177), but this does not take away from the significance of the study.

Learning Without a Teacher

Other studies went even farther than pre-recorded vodcasts to deliver lessons to students who already had a foundation of knowledge by looking at how beginning level piano students learn without the aid of a teacher (Cremata & Powell, 2016). In this study, it was discovered that at this level, students actually learned more effectively with a program called *Synthesia* that did not teach them how to read music, but rather worked in an "iconic animated vertical piano roll interface" (Cremata & Powell, 2016, p. 147) much like *Guitar Hero*. This was compared to a YouTube video teaching the same piece, software called *eMedia* which is based on traditional music notation and to a control group which used printed instructions and sheet music. The study presents the idea of learning modalities as a positive in a multimedia piano lesson (Cremata & Powell, 2016, p. 148), but does not adequately address the key constraint – mainly that *Synthesia* does not teach a child to read music, but only to follow an animated piano roll in a manner reminiscent of a computer game. No attention is given to proper fingering, posture or any other skills that would normally be stressed in a piano lesson (especially a beginning lesson). This makes one wonder about the objective of the lesson. Was it to learn to play one song, or was it to learn to play the instrument? Another issue is that the authors of the study did not share the sheet music the students were expected to learn, nor did they share recordings of the results, leaving the reader without this key information in assessing the stated results.

This does not mean that electronic instruments (such as the one hooked up to the *Synthesia* software) are not useful in music practice. In 2013, Benson (2013) compared students using electronic keyboards for practice to those using traditional instruments (Benson, 2013) and found that there was no significant difference in the results (Benson, 2013, p. 46). While this may seem like a strike against electronic instruments, it does show that they are useful in situations where students may not have access to "the real thing."

Aural Skills

Another area of student study that can be aided by ICTs is in the area of aural skills. Practicing ear-training can be problematic because of the lack of immediate feedback from a knowledgeable musician. A 2014 study (Manzo, 2014) showed that software instruments are effective in supporting aural training for students in identifying chord progressions (Manzo, 2014). Another 2014 study (Hopkins, 2014) looked at the question of ICT in aural skills from the other side, using ICT to test orchestral string players' instrument tuning skills. The software, called Tuning Perception Test was used as an assessment tool, not as a tool to help increase their skills (Hopkins, 2014).

ICT Use in the Classroom

In 2001, Beckstead lamented over the fact that music educators were examining music technology as tools to make traditional composition methods, without exploring the new possibilities offered by ICT in the music classroom (Beckstead, 2001, p. 47). In the sixteen years that have followed his speculations on the future of technology in music education, many have taken up the challenge of finding ways to bring ICT and music together in a way that stretches past what is thought of as "traditional" – either traditional music education or traditional students. The next section looks at the use of varied composition software in the United States, the United Kingdom and a few other European countries.

United States

In the United States, Dammers has led a concerted effort to explore the use of ICT in a dedicated music classroom (Dammers, 2009, 2010 and 2012). He first looked at the use of ICT in music classes in the New Jersey (Dammers, 2009) and then throughout United States (Dammers, 2012). In one intriguing case study, he followed the work of a particular music teacher who wanted to reach out to an entirely different group of students – not the students enrolled in band and choir, but the students who were considered "non-traditional" music students (Dammers, 2010, p. 60). Students used *GarageBand* as compositional software, which is based on sound loops and graphic animation of sound, rather than traditional instruments and sheet music notation. The class was conceived as the first part of a three-course music sequence which would go onto music theory and then AP music theory (Dammers, 2010, p. 62). The course saw fifty-three students in its first three sections with minimal advertising (Dammers, 2010, p. 61), and Dammers concluded that individual teachers are creating music technology courses with the intent of pulling in a "new population of secondary students" (Dammers, 2010, p. 55). One flaw in this study comes from the lack of follow-up data. There is no information concerning what grades the students received, or whether or not they continued in the sequence. There was also no audio recordings to aid in assessing the results of the course. While he proved his point that individual teachers are creating music technology composition courses, the information he provided is not enough to convince teachers that might be considering this kind of course that the outcome will be truly beneficial in anything other than initial enrollment.

Regardless of that flaw, his work in surveying the formation of music technology classes in first New Jersey (Dammers, 2009) and then the United States (Dammers, 2012) has returned important findings. The results seemed to indicate that these courses are generally teacher-driven and normally taken by non-traditional students (Dammers, 2009, p. 25 and Dammers, 2012, p. 73).

Only fourteen percent of high schools in the United States offer technology-based music classes, with constraints being lack of training (Dammers, 2009, p. 34) and funds (Dammers, 2009, p. 25). In a similar study, Dorfman (2008) looked at the use of music technology and integration of it into music programs in Ohio, K-12 music programs (Dorfman, 2008). His suggestion supported the notion that teachers need professional development in music-related technologies, with an emphasis on "authentic ways to integrate technology into the classroom, and to have students actively engaged in the use of technology for music learning (Dorfman, 2008, p. 34)

Looking at the use of composition software in a different way, Nevels (2012) reported on a case study of a fifteen year old guitar student who used software to compose in a non-conventional setting. Instead of focusing on whether or not tech was being used, he looked at one individual case where a student used Band in a Box software to compose a song (in which he played lead guitar) that he then recorded (Nevels, 2012). The experiment was deemed a success, but again, the lack of audio evidence leaves the reader wanting. While the author considered the smile of the student sign of success (an important accomplishment, to be sure), the reader is left wanting to hear the finished work. The same can be said in another study that examines the use of composition software to challenge the gifted student with new opportunities in music (Schroth, Helfer, & Dammers, 2009, p. 56). This study gave students the option of using notation software (*Finale* or *Sibelius*), but again did not provide any notated examples of the students' completed compositions. Still another case study that followed the compositional efforts of a single student discussed how she used the software to compose in dots and squiggles (Stauffer, 2001). This study looked more at the creative process, rather than the use of the technology, but the lack of a recording makes it very difficult for the reader to truly assess the results.

United Kingdom/Europe

In collecting research references concerning the use of compositional software in the music classroom, there was a much larger collection of studies from Europe, primarily the United Kingdom. This was likely an outcome of the UK government encouraging teachers to utilize ICT in their music classrooms (Savage & Challis, 2001, p. 140).

The bulk of these studies looked at the use of music software in composition projects. Software such as *Mixcraft* (Minott, 2015, p. 261) and *Dance eJay* (Gall & Breeze, 2005 and Mellor, 2008, p. 451) were used by secondary students in putting together music compositions, with focus on how students used the technology to create the compositions, the effects of formal instrumental music instruction on the strategies used by the students and also looking at the creative process from the viewpoint of defining exact what it means to be musically creative (Mellor, 2008, p. 451). While the bulk of the studies concerned secondary students, Mills and Murray looked at "good use" of ICT in ages eleven to fourteen, stating that this group is often neglected, (Mills & Murray, 2000, p. 29). In all of these studies, students did not use music notation, and generally worked with "pop" sound loops (Minott, 2015, p. 268 and Mellor, 2008, p. 457) or loops prepared in advance for the study (Gall & Breeze, 2005, p. 420). In higher education, a study concerning the student perceptions of MIDI (music instrument digital interface) was conducted in 2001 (Airy & Parr, 2001).

A key concept in many of these studies was the idea of "democratizing" the compositional process (Ward, 2009, p. 154), and a fascinating study in New Zealand showed how this democratization can lead to unlocking the potential of "troubled" student with positive results (Bolton, 2008).

There was evidence of studies in other European countries that followed these same lines. In Italy, a study looked at the interaction between children and musical machines in children aged three to five (Addessi & Pachet, 2005, p. 21), with attention paid to the use of an improvisatory set

up. Another study in Sweden followed eight year old children creating music with a synthesizer and music software (Nilsson & Folkestad, 2005).

Issues in Research Dealing with ICT in Music Education

One of the key issues that has been illustrated in these studies is the lack of training for teachers (DeVries, 2013). Waldron and Veblen (2008) examined the possibility of both teaching and learning in a virtual music community (Waldron & Veblen, 2008), while in a separate study, Waldron (2009) discussed how an online community of practice (COP) can be used to spread informal music learning on the internet (Waldron, 2009). Clearly there is a need for professional development for teachers (DeVries, 2013) if the end goal is the continued integration of ICT into music education.

However, there is no clear agreement on the objectives that are to be accomplished through the use of ICT in music education. What are the goals? Is it to reach non-traditional students (Dammers, 2010)? If so, is the goal meant to be giving them better self-esteem, which was mentioned in more than one study (Legette, 2002 and Savage & Challis, 2001)? Should the goal be to bring students into the world of classical music by any means necessary? The composer Eric Whitacre was enticed into his first choral experience with the promise of a free trip to Mexico with a "hot" soprano section and his first experience in rehearsal changed his life forever (Whitacre, 2011). Are we to deny children the right to that kind of experience because we do not want to overwhelm them with classical music? These questions need to be answered in advance of any research undertaken, and the resulting objectives stated clearly within each abstract and/or discussion.

Another issue that needs to be addressed is the fact that many of these studies are not statistical, because music (and musical skill) is not something that is easily quantified. Many of them are case studies (Addessi & Pachet, 2005; Airy & Parr, 2001; Bauer, 2001; Bolton, 2008; Dammers, 2009; Dammers, 2010) or learning stories (Acker et al., 2015)), involving hours of observation and interviews with students and teachers. The goals have to then be articulated as

something other than statistical data. However, this becomes problematic in judging the results of each study. The lack of audio or video recordings and the lack of sheet music makes it virtually impossible for the music educator to determine whether the conclusion is accurate or wishful thinking. The author of an article can enthusiastically describe the results of the study, but without audio or video evidence, the results have significantly less impact.

Conclusion

Clearly there are many possibilities for the use of ICTs/music technology in the world of music education. From streaming audio/video to the more traditional CDs and DVDs; from online research to software programs that deliver immediate feedback on aural skills training; from the use of notational software like *Finale* or *Sibelius* to the use of *GarageBand* or *Dance eJay*, there are many possibilities to integrate ICT into the music classroom – whether that classroom is face to face or online. However, there is a gaping hole in the body of research that needs to be addressed. A new paradigm needs to be created, whereupon the extensive audio and video records are shared via the internet – perhaps YouTube or set up on special website with private sharing sights (with parental and student consent). In cases where actual sheet music has been created, that needs to be shared as well. Music is aural by nature, and until there is a way to share the aural results – until these changes are made, we cannot have a full sharing of ideas. Perhaps the community of practice via social media will be the best way to informally share the results of these different experiments, with teachers enthusiastically showing off the work of their students and convincing other teachers in the process.

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