Music Teachers’ Experiences in One-to-One Computing Environments

by Jay Dorfman, PhD

Boston University

Abstract

Ubiquitous computing scenarios such as the one-to-one model, in which every student is issued a device that is to be used across all subjects, have increased in popularity, and have shown both positive and negative influences on education. Music teachers in schools that adopt one-to-one models may be inadequately equipped to integrate this kind of technology into their classrooms. The purposes of this study were to observe the behaviors, and explore the dominant perceptions and concerns of music teachers in schools with one-to-one technology programs. This four-case study was based on the Concerns-Based Adoption Model, which has previously been used to analyze stakeholders’ concerns about adoption of an innovation such as a new technology. Participant teachers expressed their concerns about adoption of one-to-one technology in their schools and classrooms as they related to musical goals, extent of integration, changes that could improve the programs, and other pedagogical factors. Results showed that while the participants used the technologies in distinct ways and to varying extents, they shared concerns about technical support, pedagogical support, and authenticity of integration.
For the past two decades, several models of ubiquitous computing\(^1\) have been implemented in American schools. This type of technology integration involves teachers and students having access to portable technology whenever and wherever they want it, and suggests that the technologies “disappear into the background” of the normal course of education (Weiser, 1991, p. 98). States including California, New York, Maine, Michigan, and Texas have devoted vast budgetary allocations to creating and sustaining ubiquitous computing programs in their schools, and devotion to these programs has proved extremely important. O’Hanlon (2007) found that school divisions value ubiquitous computing models so much that they will devote local funding to sustain the programs, even if funding from larger governing bodies is removed. A recent news-making implementation took place when the New York City Schools, a district of more than 1,000,000 students, adopted Google’s Chromebook devices for all students; the district’s Chief Information Officer called the devices “an affordable, manageable option for learning” (Friedlander, 2014, para. 6).

Among the models of ubiquitous computing, one-to-one\(^2\) initiatives, in which every student is issued a device that is to be used across all subjects, are the most common, and have been shown to lead to substantive changes in pedagogical approaches (Larkin, 2011-2012). Penuel (2006) offered three key features that help to define such programs: (a) students are provided with a computing device that contains software necessary for them to be productive; (b) these devices can access networks through wireless connections; (c) there exists “a focus on

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\(^1\) The term “ubiquitous computing” is attributed to Mark Weiser, a researcher at the Xerox Palo Alto Research Center, who envisioned computers as fading into the background of everyday life (Ronzani, 2009).

\(^2\) Descriptors of these types of programs, in which each student is expected to make consistent use of a single device on their own, are variously seen in the literature as “one-to-one,” “1-to-1,” “1:1,” “one-on-one,” and in several other configurations. “One-to-one” will be used throughout this manuscript, but this should not be taken as exclusive of literature that refers to programs with other nomenclature.
using laptops to help complete academic tasks such as homework assignments, tests, and presentations” (p. 331). One-to-one computing programs are typically designed to cut across all academic areas, including the arts, so that students and teachers use digital technologies as a foundation of their teaching and learning experiences.

Researchers have documented the positive influences that one-to-one computing can have on educational outcomes. Grant (2011) concluded that one-to-one computing models in which students take devices home with them serve to break barriers of communication between schools and families. When teachers make extensive use of ubiquitous technologies, time-on-task may increase (Donovan, Green, & Hartley, 2010), as may students’ general productivity, achievement, engagement, and research skills (Bebell & Kay, 2010; Chang, Liu, & Shen, 2012; Williams, 2014). Suhr, Hernandez, Grimes and Warschauer (2010) determined that one-to-one technology programs might positively influence certain aspects of language and reading achievement. One-to-one computing initiatives may also result in greater teacher confidence with technology and more positive attitudes toward its implementation (Lowther, Inan, Ross, & Strahl, 2012). Oliver and Corn (2008) found gains in student satisfaction with technology, technology-supported classroom activities, technology use across subject areas, and student technology skills that they attributed to a one-to-one implementation. In general, one-to-one computing programs have been shown to “bridge the digital and didactic divide that currently exists in schools” (Larkin & Finger, 2011, p. 523).

Despite the positive findings related to one-to-one initiatives, researchers have shown that some aspects of education with ubiquitous computing can be detrimental to students, teachers, and other stakeholders. Cuban (2006, 2010) is particularly critical of approaches to ubiquitous technology that are less thoughtfully planned than they might be in terms of their educational
objectives, content considerations, and shortcomings in teacher training. Recent failures of the implementation of a one-to-one iPad program in the Los Angeles Unified School District (Blume, 2013; Walling, 2014) might deter other large-scale implementations due to problems of security and improper usage. It is possible that managers of initiatives in the United States are not learning lessons from large-scale implementations that have occurred successfully in other countries (Trucano, 2010). Critics generally do not question the educational outcomes of successful programs, but problematic implementations have cast a shadow over some positive results.

According to several critical sources, there is little extant research in which authors have examined the experiences of teachers and students involved in one-to-one programs (Bebell & O'Dwyer, 2010; Drayton, Falk, Stroud, Hobbs, & Hammerman, 2010; Grimes & Warschauer, 2008). The rapid expansion of these programs has caused difficulty for researchers to try to keep pace with the related phenomena to be investigated (Li, 2010) and has shown mixed results in terms of predicting student achievement based on factors of implementation (Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010). For those research findings that are available, external validity is challenging because programs are often small and embedded within the culture of a particular school. Much of the documentation of successes of, or challenges to one-to-one computing programs come from researchers who are part of the organization and maintenance of those same programs, and must therefore be interpreted as less than objective, and possibly self-serving. Some researchers (Dunleavy, Dexter, & Heinecke, 2007; Inserra & Short, 2012) have suggested that more research is needed on individual classrooms and ecosystems to understand students’ and teachers’ practices, and to examine the contributions that one-to-one computing can make to learning experiences.
Inserra and Short (2012) showed that implementations of one-to-one computing vary across academic subject areas in terms of elements such as individualized instruction and project-based learning. Those researchers determined that teachers in the social studies tend to emphasize these types of pedagogical techniques in one-to-one environments more than teachers in other subjects. Yet, while one-to-one computing is intended to cut across all subjects within a school, experiences related to implementation in arts and music classrooms have not been investigated. In addition to a lack of general understanding of the nature of teaching and learning practices that occur within one-to-one computing models, no studies have been identified in which researchers have examined such models in arts or music environments. The purposes of this study were to observe the behaviors, and explore the dominant perceptions and concerns of music teachers who are embedded in schools with one-to-one technology programs.

**Interpretive Framework**

The Concerns-Based Adoption Model, or CBAM, (Hall, George, & Rutherford, 1977; Hall & Hord, 2001) is a theoretical framework that has frequently been referenced for investigations of technological implementations in schools and other types of organizations. In their writing about the CBAM, Hall and colleagues described several studies that led to its development. Those studies focused on concepts such as anxiety, fear, strain, and criticism that teachers and other workers experience during their professional activities. They wrote that instruments related to the model “could be used as diagnostic tools for assessing where the individual members of an organization are in relation to the adoption of an innovation” (Hall et al., 1977, p. 4).

The model, based on principles of organizational change, suggests that individuals within an institution generally pass through “stages” of feelings or perceptions about newly
implemented innovations, which the researchers refer to as concerns. A concern is a “composite representation of the feelings, preoccupation, thought, and consideration given to a particular issue or task” (Hall et al., 1977, p. 5). The researchers suggest that there are four common types of concerns: (1) An unrelated concern is one in which the individual is disinterested in the innovation; (2) a self concern reflects the individual’s lack of confidence in their ability to use the innovation, and could perhaps be considered a concern of efficacy; (3) a task concern relates to the amount of time, effort, and energy needed to implement the change in the face of many other challenges; (4) an impact concern is about the influence of the innovation on students’ or participants’ engagement.

In addition to its theoretical grounding in organizational change, the CBAM framework has been reliably tested using diagnostic instruments for technology adoption scenarios (Hall et al., 1977; Newlove & Hall, 1976). Donovan, Hartley, and Strudler (2007), for example, drew on the CBAM to examine a school-wide technology implementation at a middle school. The CBAM is recommended when researchers seek to “understand the effects of the change on the individual, as well as to identify and examine components of the innovation itself” (Donovan et al., 2010, pp. 425-426). Several researchers have used the Stages of Concern Questionnaire—one of the instruments designed to measure the concerns construct—in doctoral dissertations about widely varying educational circumstances, including Hinch (2000), Hinds (2004), and Pavey (2005). Bauer (2013) conducted a study with music teachers in which the author used a version of the CBAM, focusing on the Levels of Use component of the model. Participants in the Bauer study reported their own levels of technology integration, and those results were correlated with measurements of teacher knowledge. The results of Bauer’s study were not necessarily influential in the context of this study because the CBAM was used only as a correlational
variable—the variable of primary interest was teacher knowledge; however, Bauer’s is the only study located for this review in which the CBAM was used with music teachers.

Research Questions

The Stages of Concern Questionnaire is a validated instrument for use in studies conducted under the CBAM umbrella. The main ideas of each section of the Questionnaire aided in the development of research questions, as did the *Manual for Assessing Open-ended Statements of Concern about an Innovation* (Newlove & Hall, 1976). The following research questions guided this study:

1. What music education goals can be most effectively supported through the use of one-to-one technology programs?
2. What are music teachers’ primary concerns about the implementation of one-to-one technology programs as they affect both their classrooms and their schools?
3. To what extent do music teachers integrate one-to-one technology programs into their teaching, and what factors influence them to do so?
4. What do music teachers cite as changes to one-to-one technology programs that could be beneficial to their students and to their teaching?

Method

One-to-one computing implementations have been investigated using a number of methodological techniques, none of which seem to have emerged as particularly advantageous over the others. Observations of small-group collaborative activities, such as those conducted by Chang and colleagues (2012) are relatively common. Large survey studies have been used to examine the effectiveness of implementations within particular regions; examples include a
study about the one-to-one program in Michigan (Lowther et al., 2012), and another about a national program in Chile (Claro, Nussbaum, Lopez, & Diaz, 2013).

Several researchers from general education have used case study or multiple case study methods to examine, and sometimes to compare implementations. For example, Li (2010) documented a single implementation in terms of the diffusion of technology into the ecosystem of the school, and the ways in which the diffusion of the technology were socially influenced. Drayton and colleagues (2010) examined three high school science departments in schools where implementations of one-to-one technology had already reached a level of maturity. Donovan, Hartley and Strudler (2007) conducted a study in which they examined a middle school one-to-one computing implementation based on the CBAM framework. In each of these cited studies, research frames were limited to the individual school level, rather than examining district-wide implementations. Each of the studies was also based on qualitative methodology that included data collection techniques such as individual stakeholder interviews and classroom observations. The frequency of use of the case study supports the choice of method for this study.

**Participants and Criteria for Inclusion**

Four music teachers who taught in the northeastern United States were the participants for this study. All were music specialists with substantial experience. In order to understand the issues surrounding one-to-one technology implementations in various types of school settings, I chose to work with teachers in varying grade levels. The teaching situations of each of the four participants allowed me to view implementations of one-to-one computing in use with a different age group of students. The four schools were all in their second year of one-to-one technology programs. I located the teachers through Internet searching of my region to find schools and
districts where one-to-one models had been adopted, and then I contacted departmental supervisors for recommendations regarding which teachers might be interested in participating.

The participants have been assigned pseudonyms to protect their anonymity and confidentiality. I observed Alan teaching 6th grade general music classes. Alan, had ten years of experience as an English teacher and has six years as a music teacher, is a choral specialist with a strong background in Music Learning Theory techniques. I observed Jessica, who had 16 years of experience, teaching 1st grade general music. She is an elementary general music teacher who is also starting a strings program in her district. Katherine, who had 20 years of experience, is also an elementary general music specialist, but I observed her teaching a 5th grade class. Finally, Todd is a high school instrumental music teacher with 11 years experience who teaches “Music Exploratory” classes as well as band classes with atypical instrumentation; I observed him teaching the latter type of class.

**Data Collection and Analysis**

This inquiry used a multiple case study model as described by Yin (2013), and by Bresler and Stake (2006). Data were collected over the course of a six-month period during which time the researcher communicated with the participants via email, conferencing software (such as Skype or FaceTime), and in person. Each teacher was observed 3-4 times, with about two weeks between each visit, teaching music classes in which they were asked to make use of one-to-one computing as they normally would. I took detailed notes during each observation and video recorded the classes for reference. Immediately after or shortly following each observation, I conducted interviews with the teachers during which they responded to a series of pre-determined questions based on ideas from the CBAM (see Appendix A), and additional questions that emerged from conversation. These conversations followed semi-structured
interview protocol guidelines, allowing me flexibility to ask follow-up questions as they emerged (Creswell, 2013; Roulston, 2014).

The Concerns-Based Adoption Model, and its embedded issues of stages of concern and extent or “levels” of use, guided the development of this study. Most of the studies based on CBAM use the validated instruments to measure concerns while others collect several kinds of data regarding teachers’ concerns. Due to the relatively small number of participants for this study, the available instruments guided the interview protocol, and lent a priori codes to the analysis of observation and interview data.

Interview questions were constructed to allow the participants a conversational space in which to express their thoughts about their involvement in the one-to-one program, and their concerns about school-wide implementation, their classroom specifically, and their pedagogical approaches. These aspects of the interview questions were rooted in the elements suggested by the CBAM. In order to limit the conversations about pedagogy to the influences of one-to-one structures, I tried to focus my questions on the differences the participants noticed between preparing and teaching with and without the technology. The interviews were audio-recorded using a handheld digital recording device or a laptop computer; the recordings were transcribed shortly after each interview or group of interviews.

Observation videos and interview transcriptions were analyzed using NVivo qualitative analysis software. A priori analytical codes were derived from key terms in the research questions, and as suggested from sections of the available CBAM measurement instruments including the common levels of concern. A priori codes determined from the CBAM included classroom concerns, school-wide implementation concerns, and management of time. Additional codes were determined through iterative analysis of the data. Codes were extracted from the
transcriptions as themes emerged that were either common among the participants, or which distinguished them from one another. I read through the data repeatedly and developed codes regarding the participants’ perspectives and their ways of thinking (Bogdan & Biklen, 2003). Derived codes were used mainly to distinguish between the participants while a priori codes, derived from the interpretive framework (CBAM), were used to construct analyses of their commonalities.

**Researcher Bias**

As a music technology specialist, I approached this study with particular understandings of how technology is often used in music classes, having seen widely varying examples of these practices. My biases about the best ways to incorporate technology into music classes were not necessarily applicable in the context of this study because I typically teach, and observe other teachers, who work in technology labs, or whose teaching is intentionally based on technological integration. This study drew me out of that comfort zone by placing me in music classrooms that, if not for their placement in a one-to-one school, may not have been technologically oriented. Also, the teachers I observed and interviewed did not claim to be particularly technologically savvy, unlike teachers with whom I most frequently work.

In order to account for my biases, I took detailed field notes, reviewed video recordings to confirm observations, and discussed my interpretations of interviews with the participants and other researchers (Bogdan & Biklen, 2003). I also regularly reviewed the procedures used to apply the CBAM to observation and interview situations in order to adhere to the constructs contained in that theory. In order to establish credibility and dependability of my findings, I discussed many of my observations with the participants during interviews to make sure that I understood the intentions of their actions during the observed classes. I also followed up with the
participants via email to clarify some of the comments made during interviews. I reviewed video recordings of observations to confirm in-the-moment interpretations, thus making use of multiple data sources.

**Findings**

Similar to the structures used by Hickey (2015) and Bond (2015), who both drew on Yin (2013) and Bresler and Stake (2006), analysis of the data will be structured according to the research questions and by the analytical codes, both the suggested through the CBAM interpretive framework and those determined through iterative reading of the data. This section will be followed by an examination of the unique characteristics of each of the cases.

**Supporting Musical and Educational Goals**

The participant teachers discussed and demonstrated a wide array of uses for one-to-one devices in their classrooms. Some of these uses were aimed directly at supporting musical goals and objectives while other uses served administrative purposes. The most prominent uses of the devices that I observed fit the latter category. For example, Jessica told me that her initial instinct for using the iPads in her teaching was to replace paper sheet music that she would distribute to her chorus students, and instead scan music to distribute it electronically. Similarly, Alan uses iPads as a replacement for a textbook because, as he told me, “There’s no textbook specifically for what I do, so I make all the documents.” While Alan accepted the technology as a viable substitute for traditional materials, the other participants were less comfortable doing so, which shows the type of disinterest that is often associated with unrelated concerns in the CBAM model.

Another common use for the devices was as tools for documenting students’ work. All of the teacher participants used the devices’ cameras and recording capabilities to capture evidence
of students’ accomplishments. Katherine and Todd used captured images and sounds to help students develop electronic portfolios, which would later be used for evaluative purposes. Jessica regularly has students take videos of their performances. She cited a self concern relating to her confidence in evaluations of her teaching, referring to the classroom teacher:

…with the new teacher evaluation system that has come through now, they want us to document everything…So I’ve already talked to the teacher about sending me some of those videos so I can hold on to them for my evaluation stuff that I need because I need my evidence.

Katherine expressed that, due to the secure nature of some devices, as well as individual user accounts, transferring documents from students’ devices to public forums for portfolio development was often difficult. She suggested a task concern—one relating to time and effort—that as students and teachers gain more experience with management tasks such as this, portfolio development would become easier.

Making music with devices. Because the one-to-one programs were relatively new to each of the schools, the participants admitted that integrating the devices into their musical performance programs remained challenging, and they were still exploring ways to do so authentically. I observed Katherine, for example, instruct her students to use the Smart Guitar function in GarageBand for iPad to provide chordal accompaniment patterns for a rhythm activity. Katherine also suggested that she sees potential for devices as support for music analysis, but had not explored that with her students yet. Similarly, Todd recognized potential for composition and arranging, but his ideas for lesson plans were still in development. Alan regularly does composition activities with his students using GarageBand, and he has tried, with limited success, to incorporate collaborative music making using Bluetooth-connected devices.
Concerns about Implementation in the School

Despite reports of successful uses of one-to-one devices for supporting musical and educational goals, concerns dominated the interview conversations. The participants agreed on an impact concern—one related to the teachers’ and students’ self-motivated engagement—that one-to-one initiatives were largely “top-down”; that is, decisions to implement the programs came from superintendents and administrators. As a result, not all teachers would accept the potential of the program enthusiastically, which impacted the extent to which the devices were actually used in classrooms. In addition, where implementation occurred at the district level, extent of use varied from one school to another. About his school, Alan reported:

Our principal is over 80, and he’s doing a great job, but he just really doesn’t have the wherewithal to just go around and make sure everybody is using iPads to the best of their ability. It’s just not really his style to be . . . pushing technology on teachers. He finds [out] if they are doing good work without an iPad, then he doesn't force them to use it. So when not everybody buys in, then things just start to crumble.

The music teacher participants, especially Jessica and Katherine, who taught elementary general music classes, also expressed several concerns about collaboration with classroom teachers. One concern was that classroom teachers were not available to collaborate because the time that they have allotted to plan is when their students are in special classes such as music. While this situation may not be unique to collaboration with technology, this time conflict leads to a lack of collaboration among the faculty in general, making collaborative use of technology challenging and suggesting self concerns about the participants’ abilities to engage fully with the technology. Collaboration was particularly important in these elementary settings because classroom teachers are charged with maintaining devices and installing apps. If specialists and classrooms teachers do not communicate regularly, then device maintenance needs are not met.
Concerns about Implementation in the Participants’ Teaching

**Classroom management.** The participants recognized immediate benefits of integrating one-to-one devices into some of their classes, and were eager to express those ideas. They mentioned digitizing sheet music for choral ensembles, using video apps to capture performance, and many other uses of the technologies. Concerns, however, far outweighed expressed benefits. Preparation of lessons that use devices, the teachers reported, was a process that required a great deal of time, perhaps more than for lessons without technology. This is a *task* concern because it reflects issues of time usage. Classroom management, while not problematic *per se*, seemed to present different issues than would be found in a class without one-to-one devices. In talking about a lesson in which technical issues had arisen, Katherine said:

> My plan when I run into those is to try and get as many kids as I can where I need them to be and then troubleshoot. Like, separate out the kids who have it and the kids who don’t and then try to do some troubleshooting. But if I don’t have another adult in the room, I don’t see how I could possibly do that.

Katherine recognized, however, that her fluidity in managing her classroom would improve along with her abilities to use the technology. She said that she and her students were “coming to a mutual understanding,” and that she is getting better with the technological tools.

**Technological limits.** The participants discussed their frustration with the one-to-one devices being limited, and the impacts of those limits in their classrooms. A consistent theme was a concern about installation and management of apps on iPads. In most cases, classroom teachers controlled this process, and specialist teachers had to communicate their needs to the classroom teachers. Such an arrangement was burdensome for the classroom teachers, and complex for the music teachers who may not have time in the day to seek out their colleagues or follow through on approval processes for installing new apps on devices. While these concerns do not fall clearly into one of the types of concerns suggested by the CBAM interpretive
framework, they were relevant to the teachers’ daily work and influenced their interactions with students.

Alan also noted that, when using iPads, he wished the devices had the ability to multi-task rather than using only one application at a time. If the device had this capability, he would, for example, have his students listen to an example and simultaneously play a virtual keyboard. On a practical level, Alan also noted that the district purchased iPad cases that did not allow adequate space for headphones to be connected, which presented a logistical problem for his music students.

**Concerns about preparing and teaching.** The participants suggested that because they were all in the early stages of one-to-one device integration, planning for teaching took much more time than they wanted it to, but they realized that the investment of their time would pay off. Alan said, “It’s a lot of front loading, but once you get it to where you want it, you only have to do it for one class and then hopefully it’s spot on for the rest of them.”

The participants suggested that, as they tried to integrate devices into their teaching, they determined that it was more difficult to do in some settings than in others. When approaching a lesson she has taught many times without the technology, Jessica asks herself, “Is it worth the time and effort?” Katherine has explored ways to use iPads in her 5th grade chorus, but “the downfalls of having 60 kids in the room and trying to monitor that [are] just too overwhelming.”

**Concerns about Extent of Integration and Time Use**

The participants expressed concerns relating to the extent of integration in the sense that using one-to-one technology for entire classes could disrupt their typical workflows, particularly when technical issues arose. Jessica referred to an example in which she used iPads for sheet

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3 This research was conducted prior to the release of the iOS 9 operating system which facilitates multi-tasking functionality on iPads.
music for her elementary chorus. When wireless speeds in her school choked the students’ ability
to download music efficiently, the process used more time than distributing paper copies might
have. I observed Todd conduct a lesson in which his students wrote rhythmic counts into a score
using an iPad app. He confessed that it probably would have gone faster on paper, but he is
compelled to use the technology as much as possible by the climate of his school. These show
elements of both task and impact concerns as described in the CBAM framework. In general, the
participants recognized that when their planning is effective and the technology works well, the
time spent using it is valuable; however, they also recognized the downfalls and time wasted as
an artifact of extensive integration, especially when technology fails.

Benefits of the Programs

The focus of this study was on concerns about one-to-one implementation, but the
participants did express many of the benefits of technology integration as well. Several of the
teachers suggested that using devices to replace distribution of paper sheet music in ensembles
was beneficial. Alan said of his middle school chorus:

We buy the music…then I scan it and send it to the kids. It’s just amazing. It’s fantastic
for the kids to not have to deal with a folder system. They can just swipe through, make
notes on it…It’s just amazing.

The other teachers using this technique were aware of the copyright violation
implications of scanning music and distributing it electronically, but the convenience apparently
outweighed the risk associated with doing so.

Though it might be attributable to the novelty of the devices, Jessica suggested that,
“there are some things in the curriculum…that seemed a lot more mundane before we did them
on the iPad.” She confessed that in most cases her lessons have not changed, but that there is
added excitement and engagement for the students because of the digital devices. Todd
recognized the potential for collaboration, and for communication with parents and students outside of his classroom. Despite her overall concerns about integration, Katherine thought that her students were excited about the possibilities for using one-to-one devices in her classroom. She said, “I think it’s put a positive spin on music for them because maybe they feel like they have a little bit of extra knowledge that they can share—it empowers them.”

**Changes that would Benefit One-to-One Programs**

The most common concern that the participants expressed about needed changes to their one-to-one programs related to management of apps on iPad devices. Lack of uniformity between schools—even those in the same district—was a notable finding in this area. Jessica suggested that professional development time dedicated to establishing and implementing policies around this would be a beneficial idea. Katherine agreed that assigning dedicated staff to maintain the physical devices, and to aid teachers with their implementation ideas would help the program flourish. While a less controllable factor, Alan suggested that staff turnover would be a welcome change so that younger teachers and administrators, who would perhaps be more enthusiastic about one-to-one technology integration, would help to move the program forward.

**Findings Unique to the Cases**

**Alan**

Of the participants, Alan was, by far, making the most sophisticated uses of the one-to-one technologies. He made facile use of the students’ iPads as well as his own iPad and desktop computer/projection system. He regularly produced good-quality demonstration videos that his students accessed through the YouTube app, and used Google Classroom for most of his administrative work.
More than the other participants, Alan had an overall positive outlook toward the one-to-one program. He welcomed new and different technologies into his classroom, and saw reliance on technologies as a benefit. Regarding the iPad, he said:

It just makes things so much easier just to have everything in one place… I see [the students] one time a week… They come in, they watch the video from last week, and then they can just have a minute of practice. I think that it’s amazing.

In addition to the general music/piano class that I observed Alan teaching, his 7th grade classes do a lot of work making music with iPads. They do a unit using GarageBand for composing; both the use of that particular software and the engagement in extended composition activities were unique among the teachers in this study.

**Todd**

Todd mentioned his plans to use one-to-one devices to improve his students’ performance in traditional instrumental classes. He proposed that, as the year progressed, he would like to use the technology to lead collaborative listening activities to have students come to conclusions about musical elements that their ensembles can address and improve.

The distinguishing characteristic of Todd’s one-to-one implementation was that the district had first chosen to issue students iPads, then switched their implementation to Chromebooks. This led regularly to situations in which students were using two different kinds of devices in a single class. Todd anticipated the switch and stated, “I knew that the writing was on the wall, so I just sort of held out last year and I did not do too much with the iPads.” As a result, he expressed that his work with one-to-one technology was just beginning, although the program was actually in its second year. The mixed-device classes led to many management problems because Todd could not rely on iPad apps; rather, he could only use web-based services that all of the devices could access. At times, Todd would simply give up and send
students with iPads to the school’s library to check out Chromebooks on a temporary basis. He said of this situation that, “As a teacher, it’s very frustrating.”

Despite Todd’s interest in eventually integrating technology more deeply into student performance, his classes were the most clearly delineated of those I observed between “technology time” and “performance time.” On all occasions on which I visited, Todd and his students did a technology-based activity for a short while, then put their devices away and rehearsed music on their wind and percussion instruments. Todd was still developing his ideas about how one-to-one devices can be authentically integrated into learning music performance.

Jessica

In a school district that emphasizes documentation of student work for assessment, Jessica excelled at using technological devices to do so. The lessons she conducted with her first-grade students consistently called upon them to take pictures and video, capture drawings, and input other kinds of data to record their work. Jessica also dealt exceptionally well with management of devices, especially with such young students. She used easily recognizable “commands” so that the students would treat the devices with care. For example, she would instruct the students to “hug their iPads” so that they would carry them carefully around the room, and to “place them screen down” on their laps so that she could call the students’ attention elsewhere.

Jessica’s greatest concern was how she could most fluidly and authentically integrate the devices into her curriculum. She explained her thought process:

When I’m doing a certain lesson or I’m teaching a specific thing, I try to think, ‘Well, what could I possibly do with the technology to enhance it? What could I do?’ Then you have to figure out whether, ‘Well, is that really worthwhile doing or not?’ You kind of have to vet it in a way. Is that worth the time and the effort? Are the kids really going to learn more because I’m using the technology or is it just so I can say that I’ve used the technology?
Jessica expressed clear struggles with the relative novelty of the one-to-one program. While she makes good uses of the technology, she still has questions about its general value.

**Katherine**

Katherine was the most skeptical of the participants about the implementation of, and perhaps reliance on, the one-to-one program in her district. The technical support available to her was particularly lacking—there was one person from the IT department who had been designated to handle all issues related to iPads, and that person traveled from one school to another, making her inaccessible to teachers. Katherine expressed concerns about the time it took her to prepare lessons in which she would integrate iPads, and wondered how it was benefiting her students. She said:

> It’s time consuming to walk them through everything and I’m not really sure what the benefit is of using the iPad versus using a piece of paper. Those are some of my own thoughts about, ‘Why would I use this instead of a worksheet I’ve photocopied on the printer?’ It just seems everything is a project, in general. It’s, like, ‘Permission, permission, permission, permission.’ You need everyone’s permission to do this, that, or the other thing, which almost seems like it’s too much trouble to really work.

She confessed that there had been several times during the year when she got frustrated with the technology and simply gave up.

Katherine recognized the potential of iPads as tools for creating digital portfolios, and the uses I saw her make of the technology with her students were designed for that purpose. She did not find the tools provided to her, such as Google Classroom, to be very useful for the ways she teaches, but she expected that as she got to know the tools better she might find them more helpful. Overall, however, she was not convinced that the one-to-one program was worth the investment of her time and energy.
Discussion

Though customary for case study research, the small number of participants is a limitation of this study. The four teachers who participated were all interested in becoming better at integrating technology into their teaching, but they may not be representative of the larger population of music teachers. The four teachers all worked in middle- or upper class school districts where investment in technology was prioritized, and were therefore a somewhat homogeneous group of participants. The findings of this study are intended to be exploratory, and should not necessarily be generalized to the larger music teacher population.

A further limitation stems from the interpretive framework, the CBAM, itself, which is designed to probe participants about their concerns, and does not leave room for examining positive outcomes of a technological implementation. The participants in this study had many concerns about their schools’ one-to-one programs, and the framework, therefore, was a useful one for capturing their concerns. It should be noted, however, that there were positive results of the program implementations, as described previously. Research from the general education field has provided examples of successful one-to-one implementations which have resulted in engaged teachers, open lines of communication, and gains in several measures of student achievement (Bebell & Kay, 2010; Bebell & O'Dwyer, 2010; Drayton et al., 2010; Wilson & Peterson, 2006). Future research about one-to-one technology programs, and music teacher and student participation in those programs, might be conducted using frameworks that are not as negatively skewed as the CBAM. Findings from such studies might better enable music educators to build on the successes of these programs rather than dwelling on concerns.

There were both unique and common characteristics between the one-to-one implementations observed for this study. In terms of musical goals and objectives, the
participants expressed, and showed through their lessons, that they believe composition and
listening to be most appropriately addressed using individualized technologies. While some of
the participants were using the technologies to enhance performance of both instrumental and
vocal music, they often struggled to find ways to do so which were both authentic and
advantageously efficient.

The primary concerns about implementation of one-to-one technologies that the
participants expressed were related to the systems of support and management that their schools
had adopted. Variously, the participants spoke of concerns with centralized control and
administration of the devices, policies that made the devices inaccessible, or lack of time to
collaborate with their colleagues to improve one-to-one initiatives. In all cases, the participants
said that there were problems with the implementations that influenced both their own time
usage and their students’ learning. These problems would thus be considered either task concerns
or impact concerns according to the CBAM descriptors.

Breadth and depth of integration varied from one participant to the next, but it is difficult
to draw conclusions about this because observations only occurred during lessons in which
technology was used extensively. This occurred despite the fact that, in my initial contacts with
the participants, I explained that they should only use technology in the classes I would visit in
the ways that they normally would. From the data, it can be concluded that the teachers tended to
dedicate only portions of each class meeting to technology-focused activities. Foundational
literature on the CBAM model suggests that, over the course of time, adoption will increase for
these teachers as both their technical proficiency and willingness to disrupt their comfortable
habits change.
The participants expressed that desired changes to the one-to-one programs were related directly to the major problems they demonstrated. They needed more time to plan activities that make extensive use of technology; they needed better policies for administering the devices; and they needed more time to collaborate and plan with their colleagues. Further, they needed more and better professional development to become more fluent with the devices and software. These findings from the interview data corroborate findings from observational data that superficial integration is probably the result of the novelty of the one-to-one programs in each of the schools, and that sophistication of integration may improve over time and with more and better teacher training.

**Conclusion and Implications for Music Education**

Previous studies of one-to-one technology implementations in schools have varied greatly in terms of the maturity of the programs. For example, the schools examined by Drayton and colleagues (2010) had all gone through at least one cycle of technological obsolescence and replacement. All of the implementations in the present study are relatively new, and, therefore, are difficult to compare to those in previous research. Still, both this study and previous research provides support for the notion that implementations can vary greatly, and all variations are likely to result in both successes and room for improvement. In their review of literature about one-to-one implementations, Bebell & O’Dwyer (2010) suggested that it is important to examine the overall strategies of implementation, but also to do so in individual educational contexts. As previous researchers have suggested (Rosen & Beck-Hill, 2012; Shapley et al., 2010; Suhr et al., 2010), it is possible that greater depth of integration will result in positive gains in student achievement and other measures of success, but integration must penetrate more of the activities in which music students and teachers engage before such gains might be seen. Further research
should be conducted on whether the extent of integration influences measures of student success in music classrooms.

Teacher development has been a consistent theme in research about one-to-one implementations, and, therefore, deserves continued examination. This study concurs with Bebell & O’Dwyer’s notion that implementations require “the need for school level leadership support” (2010, p. 9). McGrail (2006) suggested that teachers need “open communication and collaboration” (p. 1075) in one-to-one implementations in order to promote their senses of agency and enthusiasm. Support may also come from technology specialists at the school level (Stanhope & Corn, 2014), suggesting that administrators are not the only members of the school community that are essential for successful implementations. Further research is suggested regarding the influence that greater (or lesser) support can have on effectiveness of one-to-one implementations. Continuing to examine these programs from varied perspectives, including teachers, administrators, and IT specialists, may yield insight into how they can be successful.

In a discussion about in-service teachers’ development of Technological Pedagogical Content Knowledge (TPACK), Harris (2008) suggested that teachers’ professional development opportunities should be guided by the situatedness of technological integration. Harris compared the actions of a teacher in a technology-enhanced classroom to those of a jazz musician improvising because both roles are about decision-making both in advance and in the moment. Harris recognized the importance of the right types of in-service learning: “[Technology] professional development for experienced educators should promote both autonomous and collaborative instructional decision-making while simultaneously encouraging open-minded consideration of new instructional methods, tools, and resources” (2008, p. 267). McGrail (2006) and Penuel (2006) have both suggested that successful one-to-one technology implementations
must be accompanied by appropriate, sustained professional development opportunities for teachers. Bauer (2013, 2014) and Dorfman (2013, 2015) have both suggested that technological pedagogical content knowledge may be a usable framework for music teacher professional development; this may imply that teachers who are exposed to a model that recognizes the balance between technology and pedagogy may become more successful with technology integration.

While this study used a purposefully selected group of four teachers who may not represent all music teachers in one-to-one schools, the findings imply that music teachers may be in need of specialized training toward the goal of successfully implementing one-to-one technology into their classrooms. Training models should include ongoing support to aid music teachers as they implement the technology, and as their dependence on it grows. Time for collaboration among music teachers, and between music and classroom teachers is needed to allow the one-to-one model to successfully fulfill its mission of providing technological access whenever and wherever teachers and students are doing work (Weiser, 1991). For music teachers to develop comfort with the technology tools of one-to-one programs, and to address concerns of planning, collaboration, and support, schools and districts must promote a greater emphasis on in-service training and cooperative opportunities between teachers and staff. While each of the four cases in this study were distinct, they provided consistent evidence to support these needs.

Given recent large-scale implementations such as those in New York and Los Angeles, administrators should consider the importance of support and training as factors in successful ubiquitous technology programs.
References


Appendix A – Interview Protocol

1. What concerns do you have about the use of one-to-one technologies in your school in general?
2. What concerns do you have about the use of one-to-one technologies in your classroom?
3. How extensively do you use the one-to-one technology in your classes?
4. In what ways could the one-to-one program be changed so that it could be of greater benefit to you and your students?
5. What musical goals and objectives do you feel can be best supported through the use of one-to-one technology?
6. Do you have concerns about time as they relate to 1:1?
7. Tell me about the faculty support and collaboration that goes on around 1:1? Are there resources available for you?
8. How has 1:1 changed your approach?
9. What impacts do you think 1:1 has had on the students?
10. How does 1:1 come full circle in your school? Do you have a chance to evaluate the program, etc.?