STUDY IN MOBILE MUSIC TECHNOLOGY: HIGH SCHOOL STUDENTS COMPOSING WITH GARAGEBAND FOR iPAD

By

STEVEN E. SABET

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Dr. Stephanie Cronenberg

And approved by

_____
Dr. Stephanie Cronenberg, Assistant Professor of Music

_____
Dr. William Berz, Professor of Music

_____
Dr. Steven Kemper, Assistant Professor of Music

_____
Dr. Catherine A. Lugg, Professor of Education

_____
Dr. Brandon Williams, Assistant Professor of Music

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Abstract

Given that a new era of music education technology has emerged in the 21st century and that technology presents increased opportunities for creativity, I investigated one application of integrating technology in the classroom using GarageBand for iPad. Music technology was shown to be an effective tool for reaching students outside of traditional music ensemble courses. Music technology can also fuse various music roles together, such as performer, composer, engineer, and producer. The purpose of this case study was to examine the experiences of high school students using GarageBand for iPad in a music technology class to compose original music. Students then shared and presented their works in class during peer-review critique sessions for growth and reflection. This study was carried out in my own classroom, and I served as both teacher and researcher. Three themes emerged from my research: Music and Production Features, Thinking Creatively, and Instructional Roadblocks. Recommendations for music teachers and for future research using music technology are also included in this dissertation.

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Chapter 1: Introduction to the Study

In 1985, I saw the blockbuster classic film *Back to the Future* and was amazed. I was eight years old when I saw Marty McFly plug his electric guitar into Doc Brown's CRM-114 amplifier and strike that famous power chord that was exhilarating to so many viewers. A few years later, I began to play the electric guitar, regularly studying and taking lessons outside the school day. I remember telling my fifth-grade music teacher that I was learning to play the electric guitar. Instead of commending me, she discouragingly told me the electric guitar was not an instrument.

Nevertheless, I persevered. Over time, I became interested in many different styles of playing and studied classical guitar in college. I am still surprised I was such a devoted student without having the benefit of public-school music-ensemble experiences. Although I did have a helpful high school music theory teacher, the only opportunity I had to play guitar at my public school was for student talent shows. However, there was one exception, found, in all places, in my junior English class. We were reading *A Streetcar Named Desire,* and the class had been instructed to write an essay about the story. However, when I asked my teacher if I could write a song instead that captured Stanley's sorrow, the English teacher, Mr. Soriano, enthusiastically agreed!

It was 1994. Surprisingly, my school had an analog 4-track tape recorder and a microphone that I was allowed to borrow. I set it up in my bedroom with my Gibson Les Paul guitar and Fender Super 112 tube amp and composed a chord progression and melody. I recorded the clean rhythm guitar part featuring jazz-voiced chords on one track and then recorded the distorted lead guitar melody on another track. It was raining that day, so I placed the microphone on my open window to capture the sound of rain, cars

driving by, and even a little thunder to create a moody atmosphere. Then, I mixed all three tracks together to create a cohesive mix for my assignment.

Mr. Soriano loved my music and shared it with all his classes. Other students gave me encouraging feedback as well. This experience meant a great deal because my peers provided a reassuring environment for my craft. I walked the hallways on air that week, appreciating the feedback from fellow students. Using technology to produce music made me feel like I had something different and special to offer musically and academically. I have never forgotten that feeling: It resurfaces daily in my practice as a music teacher as I strive to create similar experiences for my students.

Computer Technology Is Everywhere

Now, more than 20 years later, we live in an age in which computer technology has become almost ubiquitous. Information has become a commodity shared through computers and other digital devices. Gilbert (2016) spoke directly about our present environment, saying,

> [Technology] is present all around us and pervades our lives in almost everything we do socially, leisurely, and professionally. There is no longer a question of if we should use technology, but how we should use technology in the most effective ways possible. (p. 162)

Almost 5 years ago, U.S. Census data for 2013 (File & Ryan, 2014) reported that 78.9% of households had a computer at home, and 74.8% of families used the Internet. Internet usage was even higher (82%) among households with school-age children. Not surprisingly, households with higher incomes showed even greater Internet usage (97%), indicating the economic ability to purchase technological conveniences. Even households with an income of $25,000 or less reported noteworthy Internet usage at 54.7%. These reports suggest that most children have access to a computer at home regardless of

household income. Access to technology can help students complete homework and reinforce content at home.

Access to computer technology is also pervasive in schools. The National Center for Educational Statistics (2008) reported nearly 100% of schools in the United States have Internet, with 87% using digital media to support instruction. Additionally, the ratio of students to instructional computers with Internet access in public schools is 3.8 to 1. Even more encouraging, most schools with Internet access have provided professional development to assist teachers in integrating technology into the curriculum.

The Speak Up Research Project (2013) provides yearly data on computer technology usage in and out of school among K–12 students. According to their data, one-third of all students in grades 3–12 had access to a school-issued device and, in most cases, were permitted to take this device home. Researchers from the project surveyed teachers, parents, and principals on the benefits of mobile learning. They found mobile learning provided many benefits, such as learning beyond the school day, learning at any time, personalized learning, and increased student engagement.

During President Barack Obama's administration, the Computer Science for All program (Smith, 2016) invested $4 billion to expand the availability of computer science in grades K–12. Delaware, Hawaii, Washington, Arkansas, and more than 30 school districts in other states participated in the program. Smith wrote (2016),

> Computer Science for All is the President's bold new initiative to empower all American students from kindergarten through high school to learn computer science and be equipped with the computational thinking skills they need to be creators in the digital economy, not just consumers, and to be active citizens in our technology-driven world. Our economy is rapidly shifting, and both educators and business leaders are increasingly recognizing that computer science (CS) is a "new basic" skill necessary for economic opportunity and social mobility. (para, 1)

Through initiatives such as this, access to technology and the opportunity to develop computer skills have expanded across all grade levels. Consequently, students can more confidently look forward to their futures possessing computer skills to foster college and career readiness.

Society's Demand for Technology in Education

Using technology and integrating it into our schools are now priorities due to the nationwide implementation of the Common Core State Standards (Heick, 2013). Previously, teachers had greater freedom to adopt and integrate technology into their curricula based on their own teaching style. However, following adoption of the Common Core, the following standards highlight many expectations of technology in elementary, middle school, and high school grades (Heick, 2013).

> In Elementary Writing: W.4.6. With some guidance and support from adults, use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of one page in a single sitting (para. 4).

> In Middle School Reading: RI.8.7. Evaluate the advantages and disadvantages of using different mediums (e.g., print or digital text, video, multimedia) to present a particular topic or idea (para. 5).

> In High School: SL.11-12.2. Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data (para. 6).

> In High School Speaking and Listening SL.11-12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest (para. 7).

Furthermore, the momentum to embrace the 21st century and its digital aspects has gathered support from organizations outside of the government. The Partnership for

21st Century Learning (P21, 2015) recommended information, media, and technology skills to enable students to be competitive in a global economy. A diverse group of industry and business professionals, educators, and researchers helped create the P21 with the goal of helping students to succeed at work, in life, and as citizens. Recommended skills included (a) learning and innovation skills encompassed by the 4Cs: critical thinking, communication, collaboration, and creativity; as well as (b) life skills including information, media, and technology skills. The Partnership wrote about the priority of technology use in the 21st century (Partnership for 21st Century Learning, 2014) stating:

> Today we live in a technology and media-suffused environment with: 1) access to an abundance of information, 2) rapid changes in technology tools, and 3) the ability to collaborate and make individual contributions on an unprecedented scale. To be effective in the 21st century, citizens and workers must be able to create, evaluate, and effectively utilize information, media, and technology. (para. 5)

The Partnership recognized the use of technology has become an embedded part of ordinary life, far beyond the simple use of tools. As such, students must learn the requisite personal, professional, and citizenship responsibilities associated with effective, efficient, and economical use of technology.

Defining Creativity

Plucker, Kaufman, and Beghetto wrote (2014), "Creativity is widely acknowledged to be a key 21st century skill, and it is included in many countries' lists of desired college and career-ready outcomes for students" (p. 1). Creativity is a primary skill recognized and recommended by the Partnership (2014). Music educators are at a crossroads that requires them to fuse creativity and technology in a comprehensive environment to meet 21st century demands.

Clearly, a unified definition of creativity is needed. Plucker, Beghetto, and Dow (2004) conducted a literature review of 90 articles using the word *creativity* and found that only 38% included a concrete definition of creativity, demonstrating a lack of consensus on its definition. Nonetheless, they did identify areas of common ground addressing two specific qualities: uniqueness and usefulness. Based on their study, the researchers settled on their own definition of creativity: "Creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context" (p. 90). The findings of Plucker et al. (2004) are consistent with previous research. Amabile (1982) proposed the following two essential elements two decades earlier:

> A product or response will be judged as creative to the extent that (a) it is both a novel and appropriate, useful, correct, or valuable response to the task at hand and (b) the task is heuristic rather that algorithmic. (p. 360)

Csikszentmihalyi (1999) wrote about creativity with Big-C and small-c distinctions. The Big-C version of creativity discussed works that are considered valuable by a society. Big-C creative products receive high acclaim for contributing to their respective domains and are influential. Beethoven's 9th Symphony would likely qualify as a Big-C work. Small-c creativities are also important because they contain creativity that occurs in ordinary daily life. Small-c creativity is experienced when people are trying something for the first time, such as learning to ride a bicycle. Specifically, curiosity is a leading quality consistent in both Big-C and small-c creativity and a necessary trait in both instances (Csikszentmihalyi, 1999).

Furthermore, creativity is a process readily available to anyone. It is not an obscure, esoteric medium reserved solely for the Big-C creators such as Stravinsky,

Bach, or Beethoven. The Four-C Model of Creativity by Kaufman and Beghetto (2009) supported a theory exploring creativity across four different but equally important stages; mini-c, little-c, Pro-c and Big-C. The lowest level mini-c category is for tasks new to the learner. Kaufman and Beghetto recommended,

> Including the category of mini-c in our model of creativity helps protect against the neglect and loss of students' creative potential by highlighting the importance of recognizing the creativity inherent in students' unique and personally meaningful insights and interpretations as they learn new subject matter. (p. 4)

The mini-c level is a critical step for a student to explore new frontiers and to foster creativity early on. This beginning step is critical to music education because it is where creativity begins and is fostered. A creative person cannot move from mini-c through Kaufman and Beghetto's other stages of creativity to the Big-C level without first having creativity cultivated by his/her teachers.

Musical Creativity

Within music education, Elliott and Silverman (2014) suggested students experience creativity through performing, composing, improvising, arranging, and conducting. Elliott and Silverman wrote, "… to be deemed creative, we must recognize that we should pay attention to a child's music product in relation to, 'What is it good for or what can it do for the child?' instead of 'What is it?'" (p. 343). Understanding differences among people, Elliott and Silverman argued that creativity should be based on the individual's own unique process of creating a product. Asking *what is it?* focuses only on the product and fails to acknowledge the distinctive qualities and experiences that define each student. In music education, the process of creating the product is just as important as the product itself.

Additionally, the creative product must be relevant to its context. For example, Elliott (1995) referenced Beethoven's Eroica Symphony for its monumental achievement as a way of illustrating that Beethoven did not follow a strict set of rules, but invented new ones to enhance the stylistic beauty of the work. Consistent with Amabile's (1982) research on originality and usefulness, Beethoven's innovative style influenced the ways in which many composers wrote symphonic music thereafter, which made his music creative in its context. Webster (2002a) supported a similar idea, namely, that musical creativity is "the engagement of the mind in the active, structured process of thinking in sound for the purpose of producing some product that is new for the creator" (p. 11). Like Elliott and Silverman (2014), Webster focused on the process as an important creative step in music education.

Hickey (2003) viewed creativity from four perspectives: person, process, product, and environment. A key difference in her writing on creativity goes beyond the view of creating a tangible product and focuses on the creative person. The creative person often possesses certain qualities or personality traits like a sense of humor, ability to take risks, desire for adventure, or curiosity. Because of these common characteristics, creative people often acquire a reputation as the class clown. Teaching them to strategically redirect their creative energy can greatly benefit them. However, Hickey suggested everyone has the potential for creative development, regardless of his or her predominant personal traits.

The creative process has been well researched and is the method or process someone uses to achieve a creative outcome or product. It encompasses models of thinking such as convergent and divergent thinking. A long-standing model of convergent

thinking is found in the book *The Art of Thought* by Graham Wallas (1926). His thought process covered four stages, including preparation, incubation, illumination, and verification. Considering the Wallas model, Hickey wrote,

> If we apply Wallas's stages to music, the creative thinker, in preparation, begins by asking "What do I want to Compose? What instruments should I use? What style shall I incorporate into my composition?" These questions provide an important stimulus for students to explore and experiment with different musical parameters. (2003, p. 33)

Creativity can also be achieved or enhanced through divergent thinking, "The creative process has also been said to contain characteristics of fluency, flexibility, originality, and elaboration" (Hickey, 2003, p. 33). Divergent thinking is more flexible than convergent thinking; it measured by the Torrance Tests of Creative Thinking (TTCT). Hickey suggested that a balance of both convergent and divergent thinking approaches be implemented in the music classroom to exercise creativity,

> Naturally, because of the different personalities and temperaments of children, students will have varying degrees of tolerance for the open creative process. However, too often it us assumed that students are only able to work within the strictest parameters and that giving fewer parameters means a loss of teacher control. Neither extreme is educational or conducive to creativity. Children need structure and discipline as well as the chance for freedom, spontaneity, and the exploration of musical sounds. (2003, pp. 34–35)

The process of creativity culminates in an original product, "…the result of the creative thinking process must always be represented by some form of product. This separates real creative thinking from day dreaming or fantasy" (Webster, 2002a, p. 13). Creating a product evidences creative thinking or processes. As previously noted (Amabile, 1982), the product needs to be original and appropriate within its context to be creative. Hickey (2003) wrote,

> The context of the domain is relative to the social context and group from which a product emerges. In other words, a musical composition is creative relative to

> what other composers have done in that social context and time, be it the opera composers of the twentieth century or children in a third-grade classroom. Each context contains a different set of standards, yet each is a place in which more or less creative products can be made. (p. 35)

Hickey, like Elliott and Silverman (2014), suggested that the context of creativity is an important characteristic of musical creativity. Additionally, the product as it relates to other creative works of the same domain is also consistent (Hickey, 2003; Elliott & Silverman, 2014). Collectively, Hickey (2003) and Elliott and Silverman (2014) proposed the invention needs to be original, appropriate within its context, and relevant to their creative domain of interest to be measured as creative.

Hickey's last perspective, the environment, is a special place like a concert hall or an art studio were creativity exists. "The environment presents a rich and complex array of factors that are all integral to the creative process" (p. 36). The environment is the space where the creative person, the process, and the product are realized in a culmination of creativity.

History of Music Educational Technology

Beginning with the phonograph, or perhaps before, technology has shaped the teaching of music, particularly in the K–12 environment. Berz and Bowman (1995) provided a historical framework of technology development in music education, dividing the history into four periods: (1) Development Period (to 1965), (2) Mainframe Period (1965–1978), (3) Microcomputer / Traditional Computer-Assisted Instruction (CAI) Period (1978–1989), (4) Post-Microcomputer Period (1989–2000). As Berz and Bowman's work was published in 1995, I have proposed a fifth additional period called the Ubiquitous Computing Period (2001–present). In this section, I use variations of Berz and Bowman's (1995) four time periods, along with my new period, to discuss the history

of music education technology. For each era, connections to philosophical ideals or supportive frameworks are offered to reflect innovations of that period. At the end of this section, I suggest a new period, beginning in 2001.

Developmental Period (prior to 1965)

The Developmental Period embodied early technologies that shaped later generations. This is the era of the first electronic instruments and playback systems that helped pave the way for modern technologies. Mechanical devices such the player-piano and phonograph were credited for stirring up dance revival and music appreciation (Taylor, Kratz, & Grajeda, 2012). The player-piano became quite popular in the early 1900's. In fact, player-piano sales outpaced conventional piano sales between 1909-1919 and were marketed towards middle-class families as a piano for all (Taylor, 2007). The Pianola was a leading model manufactured by the Aeolian Piano and Organ Company of New York. In addition to providing entertainment value, player-pianos were often used to provide accompaniments while musicians learned to play an instrument such as the violin or flute (Taylor, 2007).

One of the earliest innovations, the phonograph, captivated people from various backgrounds. The phonograph likely was the single most innovative piece of technology from this period. Thomas Edison invented it in 1877, and it was the most stable device of its kind up to that point. Naturally, Edison believed the phonograph could be used for a variety of purposes, such as business tasks or to capture sentimental recordings. However, in 1878, Edison predicted (as cited in Taylor, Katz, & Grajeda, 2012):

> The phonograph will undoubtedly be liberally devoted to music. A song sung on the phonograph is reproduced with marvelous accuracy and power. Thus a friend in a morning-call [can] sing us a song which shall delight an evening company, etc. As a musical teacher it will be used to enable one to master a new air, the

> child to form its first songs, or to sing him to sleep. (p. 35)

The phonograph's effect on culture was important because people began to develop a new intimate relationship with music unlike anything ever before. Katz (2004) cited a 1931 *Disques* journal piece in which phonograph fans praised its benefits, saying,

> Alone with the phonograph, all the unpleasant externals are removed: the interpreter has been disposed of; the audience has been disposed of; the uncomfortable concert hall has been disposed of. You are alone with the composer and his music. Surely no more ideal circumstances could be imagined. (2004, p. 17)

Music educator Frances Elliot Clark embraced these powers of the phonograph in 1903. She realized the phonograph would be useful in teaching her students, and she convinced her principal to buy one. Mark and Gary (2007) noted how Clark believed her students would benefit from using the phonograph,

> She heard the voice of Welsh singer Evan Williams coming from a phonograph in a music store. He was singing "All Through the Night"—the same song she had taught her elementary students that week. She recognized the difference it could make to her students if they could hear Williams sing it. (p. 293)

Clark became a staunch proponent of the phonograph in music education and shared her enthusiasm through speaking engagements such as the that with the Wisconsin Teachers Association on "Victrolas in the Schools in 1910 (Mark & Gary, 2007)." After many presentations in various states, she accepted a position with the Victor Talking Machine Company in Camden, New Jersey and established its Education Department. She supervised recordings for classroom use and taught music teachers how to use them effectively. Frances Clark immediately realized the playback qualities of the phonograph and likely was the first user of educational technology in music education. Others later began to discover the possibilities of the phonograph. In the first two decades of the its release, the number of music teacher and performer users/owners increased dramatically,

indicating that listening to recordings inspired a new generation of musicians (Thompson, 2016).

Bennett Reimer (1989) recognized the phonograph's effect on music education and wrote "Once it was refined, the phonograph allowed all people full access to music without having to produce it themselves or be within earshot of those producing it" (p. 27). Recordings provided people with enriching musical experiences whether they knew how to play an instrument or were simply music aficionados. Thompson (2016) suggested the phonograph allowed listeners to focus on music with greater attention to detail and understanding. Before recordings, the experience of detailed listening to music was unlikely, especially if the listener was not an adept musician. The phonograph allowed listeners to develop a personal connection to music because they could listen to songs repeatedly, enhancing their ability to enjoy music.

Another innovative device was the Telharmonium created by Thaddeus Cahill in 1897. The Telharmonium was a massive organ-like instrument and the first synthesized instrument to produce electronic sine waves. The Telharmonium produced sounds similar to the cello, flute, bassoon, and clarinet. The Telharmonium bridged a technological gap by joining telecommunications and music. Cahill's vision was to sell music to clients over telephone lines, foreshadowing the way we share music on the Internet today (Webster, 2002b). As a result, Cahill was credited with creating Muzak (Williston, 2000).

Vacuum-tube technology combined with electromagnetic relay switches played a critical role in technology development during the 20th century. The vacuum tube played a role in computers like the Atanasoff–Berry Computer or ABC and musical instruments such as the theremin, the Ondes Martenot, and the Hammond organ. In addition, future

inventions, including amplifiers, jukeboxes, tape recorders, and radio technology would not have been possible without the initial development of vacuum tubes. This technology unlocked greater opportunities in music listening, composition, and, of course, education (Webster, 2002b). Advancements in technology helped to develop the most notable music technology laboratory of the day possible. The Computer Music Center (CMC), founded in the early 1950s in New York City by Princeton and Columbia universities, launched new experimentation and creation. CMC acquired an RCA Electronic Music Synthesizer or RCA Mark I in 1957. Access to this technology was nearly unattainable without the help of major institutions due to its high cost and size. Machlis and Forney wrote, "The synthesizer is capable of generating completely new sounds or combinations of sounds, with an infinite variety of pitches, durations, timbres, dynamics, and rhythmic patterns" (1995, p. 586). Princeton University professor and composer Milton Babbitt used this synthesizer to write "Composition for Synthesizer" in 1961 and "Phonemena" in 1969. Composer Edgard Varèse spoke highly of the music technology possibilities and said (as cited in Machlis & Forney, 1995), "I have been waiting a long time for electronics to free music from the tempered scale and the limitations of musical instruments. Electronic instruments are the portentous first step toward the liberation of music" (p. 585). Naturally, that same liberation of sound can be heard today with modern hardware and software instruments.

Mainframe Period (1965–1978)

Mainframe systems served large organizations such as universities, businesses, and government institutions. Designed to handle critical functions such as storing data, the mainframe computer served as an organization's technology headquarters or central

processing unit. Berz and Bowman (1995) described the Mainframe era as one devoted to research and support for universities across the country, such as the University of Illinois, Florida State University, and the University of Texas. In fact, universities were the only institutions able to afford these technologies (Peters, 1992). At the universities, tasks centered around Computer-Assisted Instruction (CAI) to teach programmed material through computer usage (Jonassen, 1993). Donald Blitzer founded the innovative PLATO computer system (Programmed Logic for Automatic Teaching Operations) in 1960 at the University of Illinois, which helped make CAI possible. The PLATO system became popular in college music instruction as did the successful GUIDO ear-training program developed by Fred Hofstetter at the University of Delaware. Another notable achievement took place at Stanford University, where Kuhn and Allvin used a system to evaluate pitch of melodic patterns (Eddins, 1981; Webster, 2002b).

CAI was an effective way to teach and review instruction (Moore, 1992). Berz and Bowman wrote (1994), "Use drill-and-practice software for reinforcing basic skills such as note naming and ear training. Do not expect drill-and-practice software to teach concepts" (p. 9). Musicians were, on one hand, excited about new musical possibilities, but, on the other hand, skeptical about the possibility of replacing musicians/instruments. In music education, computer-based music instruction or CBMI used CAI. Other programs included the CLEF Music Fundamentals Project of 1967, the Fundamentals of Rhythm of 1973, and the Elements of Music of 1975. These programs targeted teaching small groups of music educators and theorists. The CAI mainframe helped programmers to create applications from 1969 to 1980 but eventually ceased to exist because ordinary school districts and private teachers could not afford the technology (Peters, 1992).

Philosophical changes occurred during the Mainframe Period and revealed some of the earliest music technology focuses. Music educators began to think critically about the future of music education in the context of theses technological advancements. Music educators at the Tanglewood Symposium wrote their historic declaration in response to the changes in society of the 1960s. According to Mark (2000),

> There were three momentous catalysts of the 1960s that changed the way that Americans viewed their society—school reform, civil rights, and technology. Together, these three characteristics of the 1960s profoundly influenced the United States, and in doing so, they also influenced MENC [Music Educators National Conference]. (p. 2)

In the same article, Mark wrote specifically on technology:

> Americans were very familiar with technology by 1967, but had not yet learned to use it to their greatest advantage. Its applications for individuals were years in the future, but most people were aware that their lives would be more and more affected by technology. They just did not know in what ways. (p. 5)

Notable educators at the symposium declared, "Developments in educational technology, educational television, programmed instruction, and computer-assisted instruction should be applied to music study and research" (Mark & Gary, 2007, p. 365). Authors of the declaration recognized the need to integrate music technology with educational objectives and advocated for educators to adapt to its innovation (Mark, 2000).

A few years later, the Manhattanville Music Curriculum Project (MMCP) of 1970 extended the concept of how far technology might reach in the music teaching world (Thomas, 1970). The MMCP advocated the use of technology to create and control musical concepts like rhythm, form, timbre, dynamics, time, and pitch. Authors of the curriculum recommended using technology for creative possibilities in music education, particularly composition and performance, using an electronic music lab in elementary

the school setting, for example. The music technology lab afforded the opportunity to create sounds with sound generators, filters, amplifiers, oscilloscopes, and other types of electronic equipment that could lead to educational discovery. The MMCP marked an innovative paradigm shift that moved beyond traditional music education curricula. Unfortunately, conventional public schools again did not have the technological resources and staffing to implement this vision.

Modular synthesizers created by Robert Moog and Donald Buchla during this time, heard on the innovative recordings found on the album *Switched-On Bach* by Wendy Carlos in 1968, fueled this spirit of experimentation. Carlos and Moog met at the Columbia-Princeton Electronic Music Center in 1967 and launched a long-standing collaboration (Lendino, 2012). Carlos created the soundtrack to Stanley Kubrick's film adaptation of *A Clockwork Orange* with Moog's help. The Moog synthesizer was an innovative, analog, keyboard-styled instrument that used transistor-based technology rather than vacuum tubes. Transistors allowed synthesizers to be built smaller and become more compact. The Moog synthesizer maintained a loyal following and impacted various styles and genres of music.

The Mainframe Period marked opportunities for computer-assisted instruction at colleges and institutions. Strong efforts to connect college students to technology inspired research and enhanced prospects for ordinary people to use technology. Advancements in transistor technology made synthesizers, sound generators, and other equipment smaller and more portable, fostering greater individual use. Views of music education began shifting, prompting thoughtful responses to advancing technologies.

Microcomputer Period (1978–1989)

The Microcomputer/Traditional CAI period marked a breakthrough in K–12 education resulting from the release of the Apple II microcomputer, the IBM Personal Computer (PC), and the Macintosh computer. This period laid the foundation for mainstream access to technology and marked the beginning of integration and use of computers in schools. In 1995, Berz and Bowman wrote:

> The introduction of these relatively inexpensive machines allowed practical implantation of computer technology in the K–12 classroom and altered previous instructional models—this due in large part to the increasing availability and portability of personal computers. (p. 18)

The Apple II microcomputer provided a sophisticated audio computing environment with the help of the digital-to-analog conversion (DAC) board created by MicroMusic. DAC hardware could produce four-voice digital sound, and software developers began to unveil programs like Harmonic Dictator, Apple Music Theory, and Aural Skills Trainer. Companies like Mountain Hardware Corporation and ALF Corporation created upgraded hardware with up to16 channels of digital sound. These innovations helped to bring on the second generation of CBMI (Peters, 1992). Additionally, the National Consortium for Computer-Based Music Instruction was formed during this period to advocate for a supportive environment for these new technologies and programs.

The Microcomputer Period also marked several other key innovations. MIDI (musical instrument digital interface) protocol was created by Roland Music founder Ikutaro Kakehashi and Sequential Circuits founder Dave Smith in 1983. This became the music industry's standard communication protocol to connect equipment such as synthesizers with computers. Companies like Yamaha and Roland implemented MIDI

technology into their synthesizers, allowing any musician access to MIDI upon purchase (Muro, 1993).

Another key innovation was IBM's 16-bit PC, which was able to handle digital audio like the Apple II computer. Standardized protocols for MIDI, which enabled compatibility with both Apple and PC-style computers, resulted in an exciting time for digital audio technologies. Peters (1992) wrote, "MIDI software was developed for the Apple and the IBM home computers—software that allowed children to both look at music on the computer screen and play music on an instrument" (p. 23).

Innovations combined with increased computer speed, improved MIDI technology, and lower computer cost inspired hundreds of new music education software programs such as Mark of the Unicorn's Professional Composer, Performer, and the later Digital Performer programs. New hardware also came into being at this time. The Microcomputer Period was a time when ordinary users consumed and interacted with music technology unlike Mainframe Period technology, which only existed in large institutions or in the possession of wealthy connoisseurs of music technology.

Post-Microcomputer Period (1989–2000)

With the assistance of PC-style computers, musicians and music educators had access to world of new possibilities. Berz and Bowman identify the beginning of the Emerging Technologies Period as 1989, stating further that it continues to the present (1995). Bennett Reimer reflected on technological advancements of this era and highlighted music composition and technology as prominent areas for inquiry. Reimer wrote,

> Just as the phonograph allowed all people direct access to all music through the essential mode by which music is experienced—listening—the developing

> computer technologies are providing all people with the capacity to do something that only the tiniest fraction of people in Western cultures could do previously—to compose. (1989, p. 28)

Reimer suggested while early music technologies, such as the phonograph, enabled anyone to *play* music, modern technologies empowered anyone to *compose* music. He wrote, "Electronic technologies now allow students to accomplish all the essentials of genuine composition: to produce and retain a musical idea by recording it and make whatever refinements they choose…" (Reimer, 1989, p. 28). The Finale notation software program, released in 1988, supported technologies used for composition. Finale provided a platform for composition in a PC environment with a host of features supporting the ability to create, edit, save, and play back compositions. Sibelius introduced their version of notation software in 1993, resulting in a competitive market for notation programs that fueled the work of composers, arrangers, publishers, performers, music teachers, and students.

The Digital Audio Workstation (DAW) revolutionized sequencing and digital audio capabilities. DAW software provided users with tools to sequence, record, mix, and master audio, placing powerful tools, previously available only in professional studios, in the hands of ordinary users. Notation programs were known to input music notation, playback scores, print, and share sheet music. However, DAWs afforded users additional, advanced features like recording live musicians in combination with sequenced synthesized instruments not possible with notation programs. DAWs were invented with the first generation of the Pro Tools software by Digidesign in 1991. However, Pro Tools could not accommodate MIDI; it was only compatible with digital audio. DAW programs advanced music composition beyond sheet music, effectively creating a personal music

studio (Cook, 2013). Pro Tools was capable of four audio tracks and with additional sound cards and interfaces, could expand up to 16 tracks of simultaneous recording and playback. Steinberg created Cubase in 1989, but it only supported MIDI sequencing. Intuitively, it established the industry standard of using horizontal timelines and stacking the tracks vertically; virtually all software developers followed suit.

In 1992, Cubase delivered the first DAW to combine simultaneous audio and MIDI tracks. This was first available for Power McIntosh computers and later, for Windows users. Naturally, other DAW programs emerged like Emagic's Logic and Sony's ACID. These technologies paved the way for the *tapeless recording studio*. DAW environments were capable of audio-recording, MIDI sequencing, mixing, and mastering—all on PC-style computers at the same moment in time when those devices became increasingly more affordable.

Notation and DAW programs were very innovative technology-based education (TBE) tools. Moore wrote, "… the environment created through TBE is one rich in possibilities for the learner. Technology enables the individual to do things only possible through the technology" (1992, p. 30). Moore suggested music curriculum objectives such as synthesis, higher-level thinking processes, and application of concepts and skills for composition and improvisation could be realized with TBE tools (Moore, 1992). These programs provided convenient sound management, and students could edit their compositions with conscious refinements just as a professional composer would do.

New technologies prompted organizations to think creatively and respond as technology made composition more possible in the classroom. NA*f*ME (National Association for Music Education, formerly MENC) supported composition through its

National Standards of 1994 for composing and arranging music within specified guidelines. Menard wrote, “In 1994, National Standards for Arts Education in Dance, Music, Theatre, and the Visual Arts were published, identifying performing, creating, and responding to music as the fundamental processes of music in which humans take part” (2015, p. 115). Music composition was a priority of the National Standards for Arts, but composition failed to achieve widespread integration in curricula in U.S. public schools (Menard, 2015).

Additionally, in 1995 TI:ME, or the Technology in for Music Education, was formed with the assistance of the National Association of Music Merchants (NAMM) to help music teachers integrate technology into the classroom. TI:ME continues to help teachers by providing professional development, offering music composition contests and awards for students, and offering teacher certifications.

Shortly after TI:ME was established in 1999, NA*f*ME (National Association for Music Education, then MENC) published its *Opportunity to Learn Standards in Music Technology*. The committee of college professors, music educators, technology experts, and creators of music technology equipment made specific recommendations across four main areas, including curriculum and scheduling, staffing and equipment, materials and software, and facilities. However, the committee anticipated numerous problems and warned:

> It is important to note that each one of these categories is important. It is, unfortunately, an all-too-common occurrence to find a school that has invested in computer hardware without the appropriate software to run on it, without appropriate facilities in which to store or use it, and without the all-important teacher training and technical staff support that enables the school’s faculty to bring the equipment’s potential value to bear on the students’ potential for learning (MENC, 1999, p. 1).

The Post-Microcomputer Period continued to provide technology users with a wide palette of professional tools. Users could use technology to compose, record, edit, and produce music with notation software, MIDI, digital audio workstations, and MIDI sequencing. While institutions were more likely to afford these technologies, home users and educators began to make use of the potential of music technology. While this potential was recognized by organizations like NA*f*ME (National Association for Music Education), NAMM (National Association for Music Merchants), and TI:ME (Technology in Music Education), end users such as music teachers and students still needed effective integration practices and budget dollars to make the use of these technologies a reality.

Ubiquitous Computing Period (2001–Present)

Berz and Bowman published their article, identifying the four periods of music education technology, in 1995 thus highlighting many technological advancements of the 20th century. The year 2001 marked a new millennium with ever-increasing access to technology. Mobile music technology became important with the release of Apple's iPod in 2001 and iPhone in 2007, which pioneered almost unlimited mobile technology potential. The year, 2001 was chosen as the start of the Ubiquitous Computing Period because the iPod's release brought forth mobile music technologies. Furthermore, the U.S. Census Bureau (2001) reported that 51% of American households owned a computer and 42% had Internet access. Additionally, the Pew Research Center (2009) reported that 65% of adults and 45% of teenagers owned a cellphone in 2004. Early 21st century statistics showed a growing population of users with household and mobile technologies.

Previous eras featured technology as stand-alone tools to complete tasks, enhance efficiencies, or to substitute for human functions. Access to music technologies was limited to select groups of people at colleges, universities, or the elite few with skills to operate or afford the technology. Additionally, most music educators did not receive proper music technology training, and student use of music technology was ignored. Rees (2011) wrote:

> Until the past two decades, music technology from primary through tertiary music education was largely ignored or dismissed in the education of students or implementation by faculty. Left to computer music aesthetes, informatics departments, and music technology degree programs, music technology played a peripheral role, if that, in schools. (p. 150)

The Ubiquitous Computing Period is an era that can improve music education through technology. Personal access to technology has become widespread and effective integration, it is hoped, will make Rees's statement obsolete.

Delivery of instructional content is an important component of the Ubiquitous Period. In 2001, the iPod was released by Apple Inc. It drastically changed the way people consumed and interacted with music. While it was not the first MP3 player invented, it became the industry standard for portable music listening devices and garnered 90% of the market (Evans 2004; Burton 2009).

Burton (2009) wrote, "The ushering-in of the new in music technology is to be expected, then, from those who find themselves on the margins, whether of a society or a musical movement" (p. 78). This musical movement continued with Apple's release of the DAW GarageBand in 2004, installed on every new Apple computer. GarageBand provided purchasers with access to professional-quality music technologies by simply opening the box and plugging in their computers. Martin and Slater (2012) wrote,

> Since 2004, Apple has bundled GarageBand software as part of the iLife suite. GarageBand is effectively a scaled-down version of Apple's flagship Logic Studio audio software providing a highly intuitive interface allowing users of various skill levels to work with sound easily and quickly. By doing so, Apple grants all of their customers access to potentially good quality multitrack recording and sequencing at no extra cost, whether or not it is wanted. This signals a significant shift towards the democratization of technology and is a potent symbol of the ubiquity of music technology within contemporary society. In essence, every room with a modern Apple computer has the potential to host musico-technological activities far more sophisticated than leading studios possessed in previous eras. (p. 64)

Theoretically speaking, any Mac user could create his or her own music using GarageBand, send the song to iTunes, and then listen to the song while on the go using an iPod. GarageBand gave ordinary people the ability to produce their own music outside of a recording studio. Additionally, low-cost, portable versions of GarageBand for both iPad and iPhone, released in 2011, were expected to sell over 50 million units (Sarno, 2011). Webster (2011) wrote, "Laptops continue to be large sellers, but the tablet is expected to overtake the sales of laptops in coming years. The late Steve Jobs, Apple's visionary leader, famously claimed that this is the era of "post-PC" (p. 115). GarageBand for iPad/iPhone was innovative because it allowed users to play instruments by tapping the screen to simulate instruments such as piano, drums, guitar, and bass with excellent sound quality. GarageBand even featured user-friendly Smart Instruments that gave anyone the ability to make their own music without the experience of learning to play a traditional instrument.

Music technology is becoming increasingly powerful and flexible. GarageBand runs on Apple computers however, other similar free programs exist for PC users, such as Studio One Prime by PreSonus (PreSonus, 2015). Studio One Version 3 Prime gives users a 1.5 GB sampler library and provides a recording, mixing, and sequencing

environment with virtual instruments and effects. The software targets beginning composers, producers, and music students with entry-level yet powerful tools. Additionally, other programs like Soundtrap and Soundation became available with no-cost options for users to get started working with music technology. Teachers can incorporate many programs into their classrooms without the extra cost of purchasing software, thus providing access to music technology once reserved for the professionals.

Today, music technologies serve three main purposes: tools, media, and instruments (Brown, 2015). Tools are used to control devices or communicate with technologies such as MIDI protocols. Viewed as a resource, technology becomes a channel for creativity; for example, using a DAW to create a song. Finally, technologies functioning as instruments amplify a person's creativity, for instance, when the user plays with GarageBand's virtual instruments on the iPad. Technology has moved beyond a simple tool used to perform tasks. In the modern era, music technology has become its own discipline.

Accessibility is another area in which music technology plays a pivotal role in music education. Limited access to technology in previous eras suggested technology was only available to privileged individuals; but in a democratic society, technology should be available to all people. Bell (2016) wrote, "In a democratic society people are the starting point" (p. 140). In music education, the student is are the starting point, and access to technology will empower student participation in a democratic society of the 21st century. As recommended by the Partnership for 21st Century Learning, technology can assist our students in fulfilling their citizenship responsibilities.

However, an obstacle exists. Recently, Ableton's co-founder Gerhard Behales spoke about music development and technology at the 2017 Moogfest. Behales (as cited in Mertens, 2017) said, "We need a revolution in music education—20 percent of kids that go to high school [in the U.S.] have music lessons and everybody else nothing, this is really a broken system" (The Children Are the Future, para. 1). Behales's statement implies that American music educators are failing to serve the majority of students and suggests that drastic changes are needed to close the gap. Using instructional technology within democratic ideals can help teachers reach more students, especially through activities such as composition (Ward, 2009).

Gilbert (2016) stated that widespread adoption of technology is needed for students to be successful in class and beyond and called for reforms in music teacher training that included democratic ideas. Gilbert selected three e*ssential conditions* from the International Society for Technology in Education (ISTE) for emphasis. These essential conditions require a paradigm shift to integrate technology in the classroom. The essential conditions are (a) student-centered learning, (b) equitable access, and (c) engaged communities.

Lancaster (2017) suggested that student-centered instruction fosters democracy and motivates collaboration and ongoing learning between students and teachers. Music educators in the United States operate in a teacher-centered role as a result of traditional, classical, and marching-band programs. Teachers dominate (active role) in teacher-centered learning, while students (passive role) lack a voice in their learning (Mascolo, 2009). Gilbert (2016) recommended, "Using technology to enable students to select appropriate material, compose, arrange, listen and evaluate are ways in which music

educators can create a student-centered learning environment" (p. 163). Gilbert's suggestion implies that students should have a voice in their education and that technology can facilitate the process of empowering them. Using GarageBand or Finale, students can compose, listen, and share music with peers or teachers. Other creative activities, such as composing with Finale, or using tools to listen critically, or assessing their own development, are all examples of student-centered uses. Gilbert advocates including student-centered activities and democratic ideas, such as choice, in student outcomes.

Equitable access is another condition to incorporate technology and foster democratic ideas. Gilbert wrote, "Assistive technology and instructional materials that are becoming more accessible in the digital age contribute to more students receiving the benefits of music education than ever before" (2016, p. 167). Computer-assisted programs like GarageBand's Smart Guitar for iPad or iPhone allow users to play chords, notes, and strumming patterns instantly. High-quality, user-friendly features are available for many virtual instruments. Assistive technology fosters an inclusive environment by allowing students to make music regardless of cognitive and physical ability. Equitable access can be facilitated through assistive technologies, allowing more students to actively participate in music classes.

The last essential condition is engaged communities that connect student-centered learning and encourage equitable access. Gilbert wrote, "If music educators can support student-centered learning and equitable access of [to] resources, then we may be in a better position to include, connect and cooperate with a broader population of people" (2016, p. 169). Engaged communities use social media and networking to share student

work. Examples of engaged communities included podcasts, creating and using blogs and wiki sites, and using Skype to share musical works and ideas. Engaged communities can also provide a model for reflection in achieving these skills. Engaged communities offer opportunities for students to experience equal representation in music class. Gilbert's recommendations of using technology to promote student-centered learning, assistive technology, and engaged communities mean that music teachers can reach more students while fostering democracy in music education.

In each of the defined time periods that have been discussed, organizations developed and published national standards and struggled with the demands of integrating music technology into established school environments. Now, for the first time, music technology has its own formal standard alongside other longtime standards for performing and listening. In 2014, the authors of the National Core Arts Standards along with the NAfME (National Association for Music Education) leadership wrote explicit standards to guide teachers and students in music technology. While music technology standards were not included in the National Arts Standards of 1994, these 2014 Music Standards indicate a desire in the field to treat music technology equally with other areas of music education. Some notable standards included in the publication are:

> MU:Cr1.1.T.IIIa: Generate melodic, rhythmic, and harmonic ideas for compositions and improvisations that incorporate digital tools, resources and systems.
>
> MU:Cr3.2.T.IIIa: Share a portfolio of musical creations representing varied styles and genres that demonstrates an advanced level of musical and technological craftsmanship as well as the use of digital and analog tools, resources, and systems in developing and organizing musical ideas. (National Coalition for Core Arts Standards, 2014, p. 1)

Berz and Bowman (1995) suggested that technology development was initiated by higher education, industry, government, or a collaboration of all three before real-world implementation took place. Upon public reception, technology eventually became part of the fabric of ordinary life. Inventions like the phonograph, synthesizers, digital recording, powerful computer systems, and software have influenced music and music education alike. Two monumental inventions, in my opinion, stand out: Edison's phonograph and Apple's iPod. Edison predicted that the phonograph would mostly be used for music, and the iPod attained this as well. However, the iPod led the movement away from stationary technologies to mobile, personalized technologies.

Integration of technology into ordinary life is commonplace in the current Ubiquitous era. No longer is it necessary education, industry, or government to initiate technological change; technological change is in the hands of consumers and occurs daily. Mobile technology will likely be a major factor of all future K–12 music education, from planning of instruction to its delivery and outcomes.

My Instructional Philosophy

I started working as a general K–5 music teacher in 2002 near the beginning of the Ubiquitous Computing Period. In 2006, I began teaching music technology at the high school level and currently have had 10 successful years of teaching music technology. My students have entered competitions by Little Kids Rock, Inc., NJMEA (New Jersey Music Educators Association) Music Technology Expo, NJ Teen Arts Festival, and the TI:ME Music Technology Expo and have won several awards.

While participation in various competitions and festivals has been rewarding and gratifying for both my students and me, the greatest satisfaction we have mutually

enjoyed has come through creating, sharing, and reflecting on the original music the students have created. My students often begin with a riff on the guitar, a pattern on the keyboard, or an interesting rhythm as the germ of their musical creations. These initial composition kernels could be compared to motifs or themes heard in a classical composition. As their teacher, I coach my students in turning these simple ideas into full songs with defined, contrasting sections. I have found that students learn best from their hands-on learning practices rather than through lectures or didactic instruction. My students work in a heuristic manner through problem-solving, enjoy recording themselves in our project studio, and experiment with different programs and software such as Studio One, GarageBand, Logic, and Reason. Many of my students play instruments such as guitar or piano, but lack strong music reading skills. The majority of my students would probably not take a music class without a music technology component.

As a teacher, I have adopted Gilbert's (2016) essential conditions recommendations. I incorporate student-centered learning by encouraging students to create music they enjoy listening to. I use assistive technology such as GarageBand for iPad to encourage participation of students without performance or formal music experience. I also use engaged communities to promote students' sharing of their work to inspire growth and reflection. These essential conditions have guided me and have helped me ground my instructional practice in the ideas of educational democracy.

I believe everyone has musical ability and can create and compose music regardless of talent or training. All that is required is the ability to make sounds and to organize them in some manner. The origin of the sounds does not matter. The sounds can be created by an electronic or acoustic instrument; however, something tangible needs to

be produced. Technology is the best means to attain that objective. Many of my students' projects turn into multimedia collaborations, including music for choreography, film scores for short student films, backgrounds for poetry, or simply music to be enjoyed as songs or instrumental pieces. Students also enjoy opportunities to sit back and listen to their projects with their peers during in-class listening sessions as we engage in reflective and creative discussions.

Statement of the Problem

One of the problems faced by music educators today is integrating music technology into the curriculum. Technology is almost ubiquitous. Integrating music technology into the music curriculum was recommended to foster creativity and technology skills to prepare students for the 21st century (NA*f*ME, 2014; National Coalition for Core Arts Standards, 2014; Partnership for 21st Century Learning, 2007). High quality technology tools are available and have become affordable (Kaloterakis, 2013). However, even with access to affordable, available technologies, many music teachers are resistant to integrate music technology into their practice (Dorfman & Dammers, 2015; Scher, 2014).

Williams (2012) reported that 80% of U.S. students do not participate in traditional music ensembles. This means that most students are excluded from the traditional music learning schools tend to offer. However, Williams reported most students from the underserved population have a musical life outside of school and play an instrument, sing with other students, or want to pursue careers in music performance or the music industry. In a national study of music educators, Dammers (2012) found that most music technology courses were created in the last decade and often were initiated by

the music technology teacher. Dammers also discovered that music technology courses attracted different or nontraditional music students. Research suggests music technology courses are a constructive way to attract more students and foster democratic ideas such as student-centered learning (Gilbert, 2016).

There are four types of technology-based music classes, or TBMCs, typically taught in K–12 schools: (a) music production, (b) arts technology, (c) comprehensive musicianship, and (d) hybrid variation. However, there is a shortage of qualified music educators with technology specialization (Dorfman, 2017). Music technology requires a broad spectrum of skills by the music teacher, involving tools, media, and instruments (Brown, 2015). Music technology environments exist around notation, sequencing, digital audio, and the Internet, and others will likely emerge with advancements in technology (Moore, 2003). My course falls into the music production category.

Using music technology to teach music composition is considered an effective use of technology integration (Moore, 2003). Music technology in composition has shown numerous benefits including immediate feedback, editing features to correct performance issues, no prerequisite formal music training, creativity, assisted technologies, access to virtual instruments, and others (Airy & Parr, 2001; Chen, 2012; Cuadrado, 2015; Cuadrado, Lopez-Cobo, Valverde, & Varona, 2017; Nielson, 2013; Seddon & O'Neil, 2003; Tobias, 2012). My own teaching practice has been greatly affected by these technological advancements, and I am able to accomplish more with my students as a result.

Equitable access and student-centered learning are encouraged in my school district. Each student is provided with a school issued laptop to use in school and at

home. Additionally, mobile learning is supported because students use school-issued iPads to learn and interact with content in music technology classes. Professional-quality tools and software are available in my class, which makes my situation ideal for mobile technology research. The Ubiquitous Computing Period offers the perfect opportunity to realize music technology integration in my classroom and beyond.

Recent studies showed iPads and other mobile devices have a positive impact on student outcomes (Diemer, Fernandez, & Streepey, 2012; McBeth, Turley-Ames, Youngs, Ahola-Young, & Brumfield, 2015). However, research on the topic of music composition on iPads is scanty (Verrico & Reese, 2016). Focusing on one way that music educators have used technology for music composition, my research investigated how high school students compose music using GarageBand on the iPad. My study aimed to provide research on music composition using mobile devices and fill a gap in the research literature.

Research Purpose and Question

Given that a new era of music education technology has emerged in the 21st century and that technology is intertwined with creativity in the ways described, I investigated one application of technology to enhance musical creativity in the hope that the study would offer a model for use in other music classrooms in the United States: the GarageBand composition tool. The purpose of this study was to examine how using GarageBand for iPad affected the way high school students compose music in a music technology class. The following question guided my research.

1. How do high school students experience music composition when using the *GarageBand* app for iPad?

Chapter 2: Review of Literature

The Ubiquitous Computing period is upon us. In the 21st century, we live in an age where most students grow up with computer technology available and accessible from birth onward. Technological tools present wondrous opportunities for creativity and exploration for students and educators. Music technology can play an important role in providing students with meaningful and creative opportunities to make music combined with 21st century learning objectives.

This literature review will discuss music educators and their integration of music technology in schools. Music composition is an established area where music technology shows promising integration; however, the literature will show music composition needs more attention by music educators. This literature review will also address music educators' use of music technology tools for musical composition. These tools include notation, sequencing, digital audio workstation, digital audio, and Internet to achieve musical and educational benefits. Music technology tools offer ways for musicians to expand beyond the traditional role of musicians to become composers, performers, engineers, producers, and listeners providing exciting opportunities for music educators.

Use of Technology in Schools

In the United States, teachers are embracing technology in ways that suggest technology has positive effects on education. Teachers report technology improved content delivery, motivated student learning, helped differentiate instruction, and provided greater possibilities for instruction (PBS, 2013). The Pew Research Center (2013) found positive uses of technology in the classroom involving Internet use and mobile devices. Teachers from middle and high schools reported the following outcomes:

(a) 92% of those surveyed stated that the Internet has a *major impact* on their ability to access content, resources, and materials for teaching, (b) 69% responded that the Internet had a *major impact* on their ability to share ideas with other teachers, (c) 67% say the Internet has a *major impact* on their ability to interact with parents, and (d) 57% say it *helped interactions* with students (The Pew Research Center, 2013). Most teachers in the Pew study reported using the Internet to access resources, share ideas with teachers, and interact with students and parents. However, teachers also reported that using technology in the classroom demanded new, more advanced technology skills requiring more training. Nonetheless, these are promising data because in 2000, at the advent of the Ubiquitous Computing Period, the U.S. Department of Education (2000) found only one-third of educators included technology in their teaching.

Technology Integration in Music Education

In music education, teachers' use of and integration with technology has traditionally differed from that of general education teachers. Dorfman and Dammers (2015) reported technology integration among music educators remained challenging because, "A general perception persists that prominent obstacles stand in the way of integrating technology into music instruction in the deep, effective, all-encompassing ways that other academic areas have been able to accomplish" (p. 46). Previous research (Reese & Rimington, 2000; Taylor & Deal, 2000) found that music teachers did not use technology in their classrooms. While research showed music teachers desired technology development, the overwhelming majority used technology primarily for administrative tasks such as lesson planning. Taylor (2003) surveyed music teachers from several test states, including New York (large state population), Kansas (medium state

population), and Utah (small state population) to explore differences in technology use. Taylor found 61% of the teachers reported they could not use it in their classrooms. Nonetheless, Taylor reported that most teachers saw the value of using technology to teach composition, encourage skills in learning to listen to music, perform rhythm patterns and read notation, and introduce musical terms. Even more teachers (93%) saw the value of using music technology to support learning outside the classroom. In that same year, Jinright (2003) surveyed music teachers from Alabama, Georgia, and Florida and reported that only 20% of music teachers were using technology in their teaching, suggesting a larger gap in these states compared with Taylor's (2003) "test state" findings.

Dorfman (2009) surveyed 552 music teachers from Ohio and examined their use and integration of technology in the classroom. Dorfman found that teachers' use of technology in the classroom was more common than students' classroom use of technology. Technology used most by teachers included writing and arranging music with notation software, creating electronic accompaniments, and burning CDs. However, teachers reported low levels of regular or weekly and daily usage. Most teachers used technology less than once a month in categories such as music sequencing. Teachers reported high levels of comfort in general technology use and lower comfort levels in music-related tasks like notation, sequencing, and editing. Dorfman recommended training in specific music technology tasks to increase comfort levels for classroom integration. On the students' side, technology use was much lower, and computer-assisted instruction was the leading use. Furthermore, most students reported using technology in class less than once a month in all reported categories. Dorfman (2009) also reported

large percentages of teachers improving their technology use and integration; however, many others reported technology was not a leading issue. Teachers described budget issues and lack of equipment or facilities as factors that impeded their technology use and integration.

Scher (2014) surveyed 53 (of about 200) music teachers serving K–12 grades in Delaware and found all music teachers had technological access that included the Internet, computers, or tablets. Also, most of them had access to recording equipment. Despite having access to this technology, only 13% of music teachers used a computer regularly. Scher's findings suggest access to technology does not necessarily lead to integration. However, Scher's research uncovered positive use of recording equipment,

> …access to recording equipment could be an indicator of overall technology use. This implies that those teachers with access to recording equipment, such as microphones, DAWs, and sound systems, are more likely to use these items, as well as additional technology in their classrooms. (p. 40)

Scher's research suggests that music teachers with access and proficiency in recording technologies are more likely to integrate technology in their practice. While more research is needed in this area, teachers should develop skills in recording technologies, as having these skills may lead to technology integration in the classroom.

Music Technology = Student Access to Music Learning

In 2006, Edwards researched students enrolled in traditional music ensembles such as choir, orchestra, and band. For the study, Edwards examined state-reported data from California, Florida, New York, and Ohio, representing four different regions of the United States. Edwards found that only 18% of the students were enrolled in traditional music classes.

In 2011, Williams expanded on Edwards's research. Williams identified nontraditional music (NTM) students as those not actively participating in traditional music classes. The following eight attributes describe the NTM student, according to Williams:

1. Are in the sixth through twelfth grades (middle and high school in the United States or Levels 2 and 3 using UNESCO standards)
2. Do not participate in traditional performing ensembles
3. Have music life independent of school music
4. May sing or play an instrument (if so, likely drums, guitar, or keyboard)
5. May not read music notation
6. May be unmotivated academically or have a history of discipline problems
7. May be a special-needs student
8. May aspire to a career in music recording or music industry (2012, p. 137)

Williams (2011) invited 19 music technology teachers to participate in a study to research the occurrence of NTM (non-traditional music) attributes of their students. Williams reported that 82% of the students enrolled in music technology courses were not part of a performing ensemble or traditional music course. Other findings included a that there was a low percentage of students who could read music, that the guitar was the leading instrument played, and that students typically had a musical life outside of school, such as playing in garage bands, electronic/computer music-making, and songwriting or composing. Many teachers reported that music technology courses were created to attract students not likely to participate in music classes or to increase the overall music department enrollment. A few teachers reported students who were unmotivated or behaved inappropriately in other classes did not exhibit these behaviors in the music technology class. Williams's (2011) research raises questions about the potential of music technology to reach more students who would not take a traditional

music class. Understanding the NTM attributes can guide teachers toward reaching more potential music students.

There is a demand to add more music technology programs in schools. Abril and Gault (2008) found that a number of principals reported that concert band was an expensive endeavor and that its cost had an impact on the number of student participants. However, some principals believed that a lower-cost program, like music technology or composition, would be more financially feasible.

Dammers (2012) researched music technology offerings by surveying high schools across the United States. The first phase surveyed principals, while the second phase involved music technology teachers. Only 14% of the principals reported that their schools offered technology-based music classes. The northeastern portion of the U.S. boasted the highest participation of music technology. Sixty-six percent of the principals believed technology-based music classes were a positive addition to the high school curriculum. And, encouragingly, most principals without technology-based music courses believed offering a class would be possible.

Dammers's (2012) research showed that 67% of music technology classes began in the last 10 years and were typically initiated by the music technology teacher. Also, 89% of teachers wanted to attract nontraditional music students and could do so by starting a music technology class. Dammers wrote,

> It is possible that technology may provide a focal point for new pedagogical practice that will be able to increase the percentage of students who study music in middle school and high school. TBMC [Technology-Based Music Class] teachers' efforts are clearly successful in attracting new students since, on average, 69% percent of the students in these TBMCs are nontraditional music students. (2012, p. 81)

Dammers' research concluded offerings of music technology attract students to enroll in music classes. Dammers' finding supports Williams's (2011) view that music technology could help reach a larger population of public school students.

Current research suggests traditional music offerings do not reach most students. Expanding music course offerings to include music technology presents an opportunity to attract nontraditional music students and increase overall music enrollments. Additionally, research showed that music technology classes produced positive outcomes for students. While further research is needed, offering music technology classes seems to provide robust learning opportunities for all students.

The Need for Preservice and Professional Development Training

The research discussed previously demonstrated a demand for music technology instruction; however, most schools do not have a music teacher qualified to teach the course. While many school districts are without proper music technologies, an effective teacher is most likely the biggest indicator of successful outcomes. The lack of training among music teachers is a leading factor of unsuccessful inadequate technology integration. Rees wrote, "…it is the lack of knowledge and skill using music technology in the hands of tertiary graduates that has been the greatest inhibitor to its proliferation" (2011, p. 150). Rees's view proposed college music graduates are unprepared to enter the profession as music technology teachers.

In a recent study, Haning (2016) surveyed 46 senior music education undergraduates who had completed coursework and fully expected to graduate. Haning found that 63% of the participants had taken a required music technology course. Nonetheless, only 43% felt ready to use music technology effectively in their future

classrooms. The students reported this was because technology coursework contained mostly notation and sound-mixing programs. Unfortunately, they reported the courses lacked training on how they could implement technology effectively as future teachers. Integration skills need further review, since participants reported that they felt unprepared to transfer skills effectively into the classroom.

Dorfman (2016) conducted research from the collegiate faculty perspective on preservice training for future music teachers. A total of 169 faculty members participated in the study. The data revealed that most music education programs required a music technology class to graduate. However, Dorfman found only a third of the respondents agreed that the music technology course would help prepare students to use technology as music educators. Nonetheless, respondents reported technical knowledge and facility as critical factors leading to technology integration. Dorfman (2016) wrote, "…the respondents largely felt that students who enter the field with excellent technology skills will be more successful at reaching a broad audience of students than those without such skills" (p. 11). Dorfman suggested that gaining competent music technology skills was a leading predicator of success in the music education classroom.

Minott (2015) identified several tasks or strategies teachers used to integrate technology in the classroom including preparation, exposition, demonstration, technical, classroom management, monitoring computer usage, allocation, and learning support. Minott used these tasks to develop a template to organize strategies teachers used during a six-week unit of music composition using the popular DAW program, Mixcraft. Forty-one 9th-grade students from an all-girl high school in West London, England, participated in the study. Minott found the most common strategy teachers used was

learning support during instruction. Examples included listening/critiquing student work, probing students' choices during the compositional process, moving around from student to student, and providing feedback. Delivery of information, or exposition task, was the second-most-reported task used during instruction through lecture-styled PowerPoint slides. The exposition stage also included goals, guidelines, and resources for assignment completion. Demonstration of compositional or technological skills were the least used (9%) teaching tasks reported. Dorfman's research suggests competency with technology skills is leading indicator of successful integration of technology (Dorfman, 2016) and Minott's results support Dorfman's suggestion.

In a later study, Dorfman (2017) observed that music education curricula offer two types of preparation courses: method and technique classes. Techniques classes require students to learn specific performance skills and typically occur in early training. Methods classes focus on pedagogy and are usually positioned later in training. Dorfman suggested implementing technology in techniques and methods classes would prepare students with both standalone technology and pedagogical skills. Bresson (2006) emphasized the teacher's ability to model technology in the classroom as most effective when teaching music technology and stated that Dorfman's (2017) approach could help improve integration later in the classroom.

Teacher technology training was researched to improve preservice training and professional development (Dorfman, 2009; 2017). Findings suggest better training can lead to more effective use and integration in the classroom. Bauer (2014) offered three suggestions regarding in-service teacher training incorporating technology. The first suggestion was to train teachers to use technology related to job responsibilities which

can assist the teacher to fulfill ordinary professional duties. This approach can help the teacher develop skills while working more efficiently. The second suggestion was to target training on areas where the teacher's performance is weakest. Naturally, teachers will need training to improve problem areas or to meet benchmarks relevant to the stage in their career. The last suggestion was extended professional training programs that yield better outcomes than short-term training sessions.

Konstantinou (2016) suggested leveraging teachers' willingness to adopt technology into teaching practices as a strategy for increasing technology integration. Konstantinou conducted a case study of 10 primary music teachers in Cyprus, Greece focused on their use of technology in the classroom. The teachers were of different ages and expertise in music technology varied. Teachers were permitted to use any technology available at school, including free software programs. Students used technology in class to practice music concepts and compose music. Students reported an increase in excitement, engagement, and motivation using music technology. Additionally, teacher's views on using technology changed throughout the course of this study (2016),

> As teachers were using technology more and familiarizing themselves with more programs and devices, their thinking, practices and concerns about the introduction of technology in music lesson were changing as well. (p. 183)

Konstantinou's research also showed teachers' willingness to use technology in the classroom helped overcome obstacles of technology integration.

Music technology classes demand expertise of content and pedagogy like all other forms of music instruction. Much of the music education profession was resistant to developing instructional skills for successful integration. Research suggested that music educators are generally not prepared to integrate technology effectively. Research also

suggested that improvements in professional development and preservice training are needed for future and currently practicing music educators.

Music Technology Models of Instruction

Music technology consists of many skills, objectives, and concepts. Therefore, delivery of instruction varies. Williams (2012) researched and identified four different models of instruction for technology-based music classes or TBMCs:

1. Music Production: A TBMC that is designed to teach music styles, form and some theory, but listening skills are emphasized over music reading and notation. Music recording, looping and sequencing activities and live music performance are dominant activities in this model.
2. Arts Technology: A TBMC that is similar to the Music Production model but adds to the music elements graphics, animation, and video production as well as interaction with theater, dance and creative writing activities.
3. Comprehensive Musicianship: A TBMC is designed around a traditional general music class with technology integration. Music styles and forms are emphasized, but composing is more likely standard notation based. More traditional theory and music keyboard skills are stressed.
4. Hybrid Variations: Some schools offer a full-year, ongoing course of study that takes the Comprehensive Musicianship model and blends in elements of Music and Arts Production models. (p. 137)

Williams's work identified models of existing music technology instruction. His curricular models can direct music educators to identify what type of instruction may work best with their current student population or help improve an existing technology program.

An additional model is mobile learning since tablets have become more prevalent in K–12 and collegiate environments (Riley, 2013). Recent studies showed that iPads and other mobile devices have a positive impact on student outcomes (McBeth, Turley-Ames, Youngs, Ahola-Young, & Brumfield, 2015). Diemer, Fernandez, and Streepey (2012) found that students who were comfortable with e-learning and mobile devices reported significantly increased levels in perception of learning and engagement. Students already

use their mobile phones during band rehearsals and access music online that they are learning to perform (Wallerstadt & Hillman, 2015). However, research into using mobile technology to create and perform music is limited (Verrico & Reese, 2016).

Verrico and Reese investigated 11 college music majors while they used iPads in a music ensemble. Student activities included writing original music, improvisation, and performance of cover songs playing the iPad as their instrument. After a 7-week period, students performed their works in concert as an iPad ensemble. The researchers found several themes emerged from this experience: informal and judgement-free context, exploration, socially constructed knowledge, collaboration and democracy, shared leadership and autonomy, and process and enjoyment. Additionally, Verrico and Reese found students experienced music in different ways compared with traditional music ensembles. Verrico and Reese wrote, "By using the iPad as a new instrument (not a surrogate for their primary instrument), they experienced release from expectations of perfection and were at liberty to explore" (p. 326). Technology use was at the forefront of the researchers' study. Their findings indicated humanistic ideas of creativity, collaboration, and democracy that can be much more important than musicianship.

Music technology integration requires a specific skill set to be effective. Many teachers have been successful in using learning-support strategies to contribute to positive learning environments with technology. However, teachers need to develop technology expertise and pedagogical skills to serve as a model for students to follow. Teacher preparation needs to be addressed with effective professional development and pre-service training in college. There are several models of music technology that teachers can use. Teachers should consider two important factors when identifying which

one would best suit their situation: technology already in their schools and students' needs. Williams (2012) wrote most music technology programs currently exist around music production and music composition is at the forefront of music production programs.

Music Composition in Schools

Hickey (2012) wrote, "Computer technology is to music composition in the classroom what the phonograph was to music appreciation just after the turn of the twentieth century" (p. 24). Hickey's statement signals the critical importance of technology to the teaching of music composition in the 21st century. As music technology is recognized as an effective facilitator of music composition in the classroom (Moore, 2003), this section addresses the demand for music composition to exist, problems that are impeding widespread adoption, and research where educators have incorporated music composition successfully into the curriculum.

There is much debate about the status of music composition instruction occurring in schools. Abril and Gault (2006) researched music curricula from the view point of elementary principals, comparing current versus ideal music class offerings. Abril and Gault found that, under ideal conditions, developing creativity was the most important broad educational objective; however, music composition was the least reported learning outcome. Abril and Gault's (2006) findings indicate a disconnect between instilling creativity and using composition as means to educate creative outcomes. However, principals believed that students would compose their own music as result of in-class performing and music listening experiences. Unfortunately, music composition curricula need defined instructional protocols like other areas such as music performance. Abril

and Gault (2008) replicated this study again in 2008, from the perspective of secondary school principals, with similar results. They stated,

> The fact that principals labeled creating and composing as the musical learning being met least effectively was consistent with findings reported in a prior survey of elementary school principals. Creativity, however, was the third most highly rated broad educational outcome. (p. 78)

Abril and Gault's findings concluded music composition has not received enough broad attention among elementary and secondary schools.

Music teachers also reported low rates of composition practice similar to the principals' reports in Abril and Gault's (2008) study. Williams (2007) reported standards of improvising and composing ranked lowest in student achievement and teacher ratings. However, performance-oriented standards like singing and playing received the highest priority among teachers and students. Williams wrote, "Three standards were being reported as being infrequently implemented; skills for teaching students to create music, skills for teaching students to respond to music (analyze, evaluate), and leadership and music advocacy in the school and community" (p. 19). However, creative skills like composition should receive more attention because they require creative or artistic decision-making skills (Williams, 2007).

Strand (2006) studied Indiana music teachers (N = 98, randomly selected from 339 teachers) and their incorporation of composition into the curriculum. She found that most of the respondents used composition at some point during the school year however, only 6% used composition as a regular instructional practice. Additionally, 23% of the teachers reported using composition very rarely, and 11% reported never using composition in the classroom. The main reason teachers offered for not teaching composition was other competing objectives and lack of technology resources. Many

teachers reported music performance was the leading priority because of the need to meet school concert demands under limited instructional time. Teachers reported benefits of composition such as music compositions helping students learn greater musicianship and incorporating all the national standards. Strand found composition activities defined in broad terms like using composition to teach musical skills of pitch, rhythm, sight-reading, and other concepts and less focus on students creating original works. Further research is needed to address composition practices that achieve the most desirable results and clarification can lead to efficient instruction while balancing other priorities.

Antonetti (2013) conducted a study similar to Strand's (2006), researching music composition taught in Kansas. Most teachers surveyed ($N = 173$) used composition at least once per year. Although the participation was promising, many teachers reported never using composition in the classroom. Like Strand (2006), Antonetti found the main reason for lack of composition was a shortage of resources and instructional time. The lack of instructional time could be linked to other competing instructional priorities. However, Antonetti reported positive feedback from teachers who used composition in class. Teachers said students enjoyed composing, the opportunities to be creative, and wanted more composition activities in the future. Additionally, teachers reported enjoying the composition units as well. Composition could receive greater emphasis by rearranging other priorities, and positive feedback indicated regular composition lessons could be a welcomed endeavor.

Music technology is an area that can support more music composition instruction (Moore, 2003). However, music composition needs more widespread adoption among music educators for successful integration. Many teachers reported that lack of resources

and budgetary concerns impeded composition instruction. Others thought music performance demanded greater priority. However, teachers who used composition realized gratifying and valuable educational opportunities for their students and themselves.

Composition Roadblocks

As mentioned previously, in 2014 leading music educators developed updated standards for composition and theory (National Core Arts Standards 2014; NA*f*ME, 2014). Standards in composition could potentially motivate music educators to include composition instruction for their students. However, despite recent initiatives, the music education profession is still in search of improvements to integrate music composition in the curriculum.

> Educator and composer Deemer (2016) contributed to the standards and wrote, The fact that (the standard of) creating was being put front and center in these new Standards and Composition-Theory was to be included as a primary strand was heartening, and I was honored to take part on the writing team that crafted the Composition-Theory Standards. (p. 42)

However, Deemer (2016) believed teachers are unprepared to meet the demands of teaching composition and updated standards will not be effective until preparation is improved.

Efforts to assist the integration of composition in the classroom are supported by Music-Comp, formerly the Vermont MIDI Project. Music-Comp, founded in 1999, focuses on composition as an essential element of a well-rounded curriculum and promotes teacher use of composition (Music-Comp, 2017). Music-Comp's main mission is to provide professional support for teachers and create exciting opportunities for student composers like online mentoring with professional composers and live

performances of their works. Additionally, instructional practices exist to integrate composition lessons in the classroom for teachers (Hickey, 2012; Kaschub & Smith, 2012).

Crow (2008) suggested mixed views of creativity inhibit effective music instruction. Unfortunately, teachers have reserved creative activities, like composition, for professionals, not for ordinary music students. Additionally, Crow suggested music teachers avoid music composition due to lack of confidence or skills in this area. Hopkins (2013) wrote, "… composing pedagogy at the secondary level remains extremely undeveloped when compared to the pedagogy for performance skills" (p. 40), suggesting a low prioritization of music composition in the curriculum. Crow (2008) and Hopkins (2013) suggested teachers' skills in music composition are not ready to meet creative outcomes in the classroom.

A problem hindering music composition in the classroom lies within the teacher's own practice. Francis (2012) suggested music teachers have very little experience composing music themselves which makes it difficult for them to teach music composition to students. Francis suggested many teachers only interact with music composition personally from an academic perspective. Furthermore, research suggested teachers need to have a clear understanding of what music composition is and why they should be teaching it to their students (Berkley, 2004). Music educators should learn to compose music themselves for their own enjoyment, so they can share that same satisfaction with their students. If music educators can compose music with the same passion they exhibited learning their own instruments than they will be in a better position to teach composition themselves.

Studies of Teachers Effectively Integrating Composition into Curriculum

While integrating music composition into curricula presents many challenges, there are teachers who do so successfully. Many teachers integrate music composition while balancing other priorities such as performance. These teachers realize the diverse educational and personal benefits of learning composition. The following research suggests a different approach is needed for successful music composition instruction and integration.

Riley (2006) researched the effects of two different instructional approaches for middle school band classes. The study focused on individual music achievement, performance, and attitude. The control group focused on music performance and music listening. The experimental group approach added composition to listening and performing. Riley reported the experimental group responded more favorably to instructional activities that included composition than the control group who experienced no music composition. Riley (2006) wrote, "This suggests that the students enjoyed the addition of music composition activities to music performance and listening activities in their band classes" (p. 34). The data suggested adding music composition can create desirable activities for students without detracting from performance outcomes.

Competing priorities and focus on performance standards have made it difficult to teach composition. Lewis (2012) offered the "Seven-Minute Challenge" to integrate composition among other activities. The challenge allowed students to work in groups to complete a composition activity in exactly seven minutes. This process motivated students to make critical decisions quickly during composing. Lewis (2012) wrote, "Our experience shows that restricting activity time promotes a sense of focused urgency,

which eliminates early indecision and requires carefully considered selection of ideas and effective refinement. Immediately, students work smarter" (p. 157). The assignment deadline made room for students to compose music without detracting from other priorities suggesting teachers can structure class more efficiently. Lewis offered a constructive method of incorporating music composition into the curriculum without requiring a lengthy time commitment.

Menard (2015) researched music composition in the high school curriculum. She conducted a multiple case study of students from two public high schools. One school represented a traditional style of music education with a strong symphonic band enrollment of 74 students with no prior composition instruction. The other high school was a talented arts program (TAP) with 24 gifted musicians from an accelerated music program. Unlike those in the band program, TAP students received regular composition instruction. Menard (2015) found that TAP "band students identified personal expression, increased musical understanding, understanding of composer process, increased interest in music, and general enjoyment of benefits to composition instruction in their classrooms" (p. 127). Menard's findings indicated that adding music composition to the curriculum enhanced student outcomes without detracting from other priorities.

Research demonstrates music teachers can balance traditional musical priorities such as performance and concert preparation. Teachers can teach composition effectively if they are willing to readjust their lesson planning and routines. Students can experience exciting results by composing which can help them reach musical goals and personal gratification. Composition can also reach students with diverse abilities who want to express themselves in ways other musical areas cannot.

Using Technology to Teach Music Composition

The following section focuses on studies in which music composition is taught using music technology. In 2003, Moore wrote, "Technology can serve as a tool—a part of the music-learning and music-teaching environment" (p. 198). There are several benefits of using software-based composition tools. Students can quickly produce, experiment, and save musical ideas. Standard editing tools of copy, paste, cutting, dragging, etc., are available to refine work. The instant feedback of listening to your own music is possibly the greatest convenience of using technology. Moore (2003) suggested technological composition categories of notation, sequencing, digital audio, and the Internet. Although many research studies contain more than one of these categories, the research below is organized by the study's primary focus.

Notation

Villani (2014) conducted a case study of three teachers and the use of musical notation software such as Finale and Sibelius from a high school teacher's perspective. Villani investigated teachers' use of the software in the curriculum, what students learn through using the software, and how the software influenced the teachers' practice. Villani's findings indicated teachers used notation software to teach music composition, ear training, and music theory. The research showed students preferred notation software over traditional instruction methods. Villani's (2014) findings suggested students' preferences are consistent with previous research (Bayraktar, 2001–2002; Christmann & Badgett, 1999, 2003) as students enjoy working with technology in the classroom. Results also revealed an increase in instructional value for the class with higher student

engagement. These findings indicated technology meets students in an environment preferred over traditional teaching methods.

Kuehne, Lundstrom, and Walls (2013) studied music composition of fourth-grade students and assessed two different approaches; one with paper and pencil and the other with Finale Notepad notation software. Paper-and-pencil and Finale Notepad groups received instruction on composition related to their medium. Both groups were assessed using music knowledge, peer evaluation, and final self-evaluation assessments. The peer assessment produced the only significant difference favoring the music technology group using Finale Notepad. The researchers wrote,

> There was a significant difference for melody. One reason for this could be that the paper groups' compositions had to be performed by students. They were required to have a soprano recorder as one of their parts and, though the remaining lines did not have to be melodic, they also had to be playable by students. This may have limited what they could write for the melody line and could have subsequently influenced what they wrote for the rest of the musical lines, potentially limiting their creativity. In contrast, the technology group could write whatever they wanted, because they were not responsible for performing the music they wrote. (p. 46)

The technology group experienced greater freedom and flexibility since their music did not require performance skills. Additionally, instant playback provided the students with immediate listening to make critical decisions about their progress.

Dammers (2010) researched laptop-based music composition using Finale *Notepad* with twenty-four middle school band students. The band program was from a Midwest suburban school led by a veteran music teacher with little music technology or composition experience. Most students had four years of playing experience but little exposure to technology. Students regularly focused on their main priority of preparation for festivals and performances. During the study, students composed an original piece or

melody for their respective instrument based on a composition they were working on in class, *The Cowboys,* by J. Williams. Students were issued a laptop computer with Finale Notepad once a week during a 14-week period. Dammers (2010) found students demonstrated moderate levels of craftsmanship and creativity based on an inter-judge reliability panel. Students showed a reasonable correlation between their performance level and their composing ability. However, students displayed lower levels of conceptual understanding which the researcher attributed to their lack of compositional skills. These findings indicate more constructive practice of composition in the classroom can improve conceptual understanding.

Music notation software is a useful tool for composing and inspires critical thinking (Moore, 2003). Like other types of music software, notation software provides instant feedback and performance of the work through virtual instruments. Additionally, music notation allows users to share sheet music with real-life musicians for live performance. However, fluent reading and writing music notation is required and escapes many users lacking literacy skills.

As a music technology teacher, I have used music notation programs like Finale Notepad and Noteflight. These programs give students a visual sheet music representation of their music and offers playback features. Many of my students use notation programs to compose music and export their work as a MIDI file. MIDI files are then imported into DAWs such as Logic or Studio One, allowing flexibility in mixing, editing, and experimenting with virtual instruments. Although I appreciate many benefits notation programs can provide, I prefer other platforms as notation programs require students to read traditional musical notation to derive the greatest benefits from the

program. Therefore, I prefer to use this approach with students who already know how to read sheet music in order maximize the benefits of notation programs.

Sequencing

Music sequencing is the process of recording, editing, and manipulating MIDI based instruments with software and hardware. Each track is in the form of a programmable MIDI file and assigned to a patch. Each track is equivalent to an individual instrument. Moore (2003) wrote, "Each staff on a full conductor score could be represented by a track" (p. 199). Developing skills of improvisation and composition are the primary roles of sequencing. Working in real-time, recording, instant playback, editing, and manipulation of sound are many of the key features of sequencing. Some of its greatest features are flexible editing and programming capabilities. Users can literally edit and construct their own performance, change instrument patches, and make use of quantizing or rhythmic corrections. In this environment, technology skills are more important than music performance skills.

Music sequencing can demand expert music technology skills. Moore (2003) provided steps to facilitate this difficulty. The first step is to create musical ideas, then implement elements like pitch, rhythm, timbre, texture, and form. The third step involves improvisation and recording parts using a MIDI controller. Working with MIDI allows the user to record a part at any speed. Furthermore, programs contain elaborate editing capabilities to delete or add notes, quantized rhythms, adjust note velocities, or add automation and effects. Performance quality with MIDI is not as important as with acoustic performance because of editing capabilities. Moore (2003) wrote,

> In fact, sequencing can both assist in the making of music and enable music that is only possible with the technology. A piece of electronic music can only be re-

> created with sequencing technology. The technology now becomes not only tool but also technique. The process is also a product. (p. 200)

Moore suggested music sequencing provides users with more creative possibilities than traditional or acoustic instruments alone. Sequencing allows the user to think creatively and intuitively without the limitations of performance hindering creative thought (Moore, 2003).

Folkestad, Hargreaves, and Lindstrom (1998) conducted a study of computer-based music compositions of 15- to 16-year old students. The 3-year study included 8 boys and 6 girls engaging in music composition activities once a week after school. The students lacked composition experience and did not have a music teacher during the experiment. Students used a computer with a sequencer program, headphones, and a synthesizer. The *save-as* method of computer MIDI files was used by the researchers to track students' progress during the compositional process. Despite their having no formal training, all 14 students created music. The researchers collected 129 compositions in total from across the 14 students. Using qualitative analysis, the researchers found the students' compositions fell into two different methods: horizontal composition and vertical composition. According to the scholars, horizontal composition is the "completion of a song from beginning to end via keyboard only or with the computer" while vertical composition is "the completion of each section of a song with all instruments before moving onto the next section" (Folkestad, Hargreaves, & Lindstrom, 1998, p. 87). Horizontal and vertical types of compositions were strategies students used to create their works. Composing and arranging were separate activities in the horizontal strategy while composing and arranging became unified in the vertical strategy. The

researchers suggested the computer served as a tool to help students create musical ideas and organize their compositions.

Airy and Parr (2001) conducted a pilot study on undergraduate students' views on composing music with MIDI programs. There were 24 participants from a polytechnic college program in audio engineering and music production; however, most students had minimal formal music education. Most students reported their prior music experience from secondary schooling to be uninspiring and largely negative. Airy and Parr wrote, "Such students often had been unable to engage with the music curriculum on an equal footing with those with instrumental skills or prior training" (p. 43). Airy and Parr found using MIDI sequencing gave students a musical voice to compose and perform their own music. It gave students flexibility to create music in the style they most enjoyed and freedom to work on their projects. Many respondents found recording with MIDI allowed them to record small sections at a time with less emphasis on accuracy. Students felt more empowered to compose music as performance quality requirements were greatly reduced and they used editing skills to correct performance issues.

Seddon and O'Neil (2003) researched 48 adolescents and the strategies they used to compose music. Twenty-five of the students had between 2 and 4 years of formal instrumental music tuition (FIMT) and 23 had no prior music instruction. All students used a Yamaha PSR 530 keyboard connected to a computer via MIDI with a version of Cubase Score composition software. The participants received two 30-minute scripted training sessions and composed a piece of music they enjoyed. Participants did not receive models or examples of composition; they were permitted to compose music freely with no restrictions. The results showed students utilized different compositional

strategies, however, students without FIMT spent greater amounts of time in exploratory behavior than those with FIMT. The researchers wrote, “Much of the literature on general creativity and musical creativity identifies exploration (divergent thinking) as an important phase in truly creative behavior” (p. 131). Students likely made their musical decisions based on their prior knowledge suggesting individuals will compose music related to previous training.

Building on Folkestad’s (1998) earlier work, Nilsson and Folkestad (2005) wrote, “Digital tools offer a way for young, musically untrained children to express their musical ideas” (p. 24). Nilsson and Folkestad (2005) conducted a two-year empirical research study of eight-year old Swedish students ($N = 9$) creating music for various pictures such as landscapes, water, and finally artwork by Kandinsky. Students used a computer and synthesizer to create compositions. Researchers used the *save-as* method (Folkestad, 1996) to track the students’ progress. The *save-as* method was designed to save students’ step-by-step processes as opposed to the *save* command which over-wrote previous steps. This process allowed the researchers to track the students’ progress as they made changes to their composition and allowed the researchers to study the activities students used to create their music. Each composition was created during a single session without interruption. The results showed the participants used five different activities to create computer-based compositions (Nilsson & Folkestad, 2005):

1. Putting the synthesizer and the computer in the foreground of the activity. This included actions were the students are experimenting with the programs capabilities.
2. Using creative music making as a means to express personal fantasies and emotions. This process allowed the students to use their imagination to create sounds for their composition.
3. Putting the playing of the instrument in the foreground of the activity. This allowed the student to play, improvise and record musical ideas on an instrument.

4. Placing the music itself in the foreground of the activity. This allowed the students to intentionally place musical ideas as the primary focus.
5. Putting the task in the foreground. This allows the students to use a specific task to direct their compositional ideas. (p. 25)

The researchers suggested using digital tools allowed any student without formal music instruction to compose music and implement elements such as form and structure. Although more research is required, Nilsson and Folkestad showed technology can assist students to compose music regardless of musical experience.

Chen (2012) wrote, "Software affords an easier entry into this (composition) experience than paper and pencil by allowing the direct manipulation of sound and giving immediate feedback" (p. 159). Chen (2012) conducted a pilot case study of three college students in their early 20s using computer-assisted composition. Chen implemented Wallas's Stage Theory (1926), a thought process of preparation, incubation, illumination, and verification to analyze the students' creative processes. Chen found students composed music with greater ease using technology because it allowed them to record music instantly. Student composers created and edited their music in real-time motivating problem-solving skills. Additionally, the recording process helped to facilitate improvisation, develop introductory ideas, and the software assisted in organization of project content. Quantization features helped edit rhythms for performance accuracy. Students also reported positive use of mixing and panning features because it allowed their music to sound natural. Overall, Chen (2012) reported technology provided tools for recording, refinement, improvisation, and experimentation during the composition process.

Downton (2015) tracked 36 fourth-grade students using a computer-assisted composition curriculum. Students created music using Bamberger's (2000) computer

program, Impromptu, which used virtual blocks called tuneblocks. Impromptu, like loop software, gave users access to sound libraries to organize and create songs. The curriculum focused on establishing musical form. Downton used Hickey's (1998) rubric for composition to evaluate students' compositions on creativity, aesthetic appeal, and craftsmanship. Downton found significance in creativity and craftsmanship. A decline in creativity scores occurred over time because students lacked composition experience and had limited engagement with Impromptu. However, craftsmanship scores significantly improved as Downton (2015) reported students became concerned with the organizational content of their music. Participants strove to create cohesive music with defined beginning, middle, and end sections. Technology aided realizing musical elements of form and structure.

Music sequencing is perhaps one of the most exciting techniques in my practice. Students engage in similar techniques used by their favorite musical artists to create their own music. My students use controllers such as a MIDI keyboard, You Rock MIDI Guitar, iPad with GarageBand, and even the standard computer keyboard to record and play music. These devices simply act as a trigger to instruments and sounds built into the software. Users are not required to be professional musicians to create quality music. Users can record their performance and easily utilize editing features such as quantizing rhythms and correcting notes to improve mistakes in their original performance. Additionally, DAWs combines both sequencing and digital audio into one comprehensive program.

Sequencing with a DAW

Formerly, users sequenced music in stand-alone sequencing software. The digital audio workstation or DAW combines sequencing with audio recording environments. DAWs handle both MIDI and audio file formats. Brown wrote (2014),

> Digital Audio Workstations (DAW) software provides the ability to record and layer parts, and hear them back with a variety of synthetic or imitative acoustic sounds. In this way, a composition can be painted and modified with rapid aural and visual feedback. (p. 7)

In addition to recording and sequencing of audio and MIDI tracks, DAWs provide complete mixing and mastering capabilities with plug-ins such as gain staging effects (equalization and compression) and time-based effects (delay, reverb, and chorus). DAWs come with in-the-box (ITB) professional quality tools like effects without the added expense of external hardware tools giving users studio-quality capabilities. This section discusses the research literature focused on the use of DAW systems for composition in the K–12 classroom.

Marrington (2011) suggested using a DAW creates an efficient environment for composition and recording. Bell (2015) states, “Having an understanding of the functionality of the DAW is critical for the music educator because most music that passes through loudspeakers and headphones have at some point been mediated by a DAW during the music-making process” (pp. 45–46). Most likely, sounds students listen to in their own popular music were created using a DAW and students are probably curious of producing music themselves with this technology.

Nielsen (2013) researched musical creativity of students using technology covering three different technological environments: GarageBand (DAW), Sibelius (notation) and Yamaha MIE (comprehensive musicianship). Each student had a

workstation which included an Apple iMac computer, a MIDI keyboard, and headphones. All iMac workstations had Sibelius and Apple's iLife suite including GarageBand and iMovie. Students could use MIDI keyboards as controlling devices to work with Sibelius and GarageBand. Students used iMovie for multimedia when required and used headphones to listen and monitor their projects.

In Nielson's (2013) study, students worked with GarageBand from Apple's iLife suite in the first component. The second component featured lessons from Yamaha's MIE (music in education) curriculum covering music educational elements and fundamentals. Students worked with Sibelius in the last component which provided a visual score of their work. The students engaged in self-evaluation of their work using a frequency and means on student creativity survey which included technology, class activities, and creativity sections. Nielsen (2013) found four emerging themes directing creative outcomes of the student including technology background, musical background, music style preference, and type of learning activities.

Around technology background, students quickly learned content with GarageBand. Nielsen wrote, "Regardless of their musical background, the students can experience immediate success in this early stage of composition because of the absence of musical notation" (2013, p. 57). Nielsen found technology use had a positive effect on a student's creativity using GarageBand. Hoffman and Carter (2013) found similar results with GarageBand as it helped students create melodic and rhythmic ideas. Reading music is not required with GarageBand which allowed participants to focus on creativity and experimentation.

The MIE program also had a low learning curve similar to GarageBand. Nielsen wrote (2013), “The MIE comprehensive approach to learning music by performing, listening, and creating provided a logical approach to creativity development within the students” (p. 57). One student commented on its effectiveness for teaching chord progressions, especially since most students did not play piano. The Sibelius program presented the greatest challenge because it favored students with formal music training. Many students preferred GarageBand over Sibelius because it set them up for success,

> GarageBand provided a basic and easy approach for students to explore the structure and manipulation of musical sound. Regardless of their musical background, the students “can experience immediate success” in this early stage of composition because of the absence of musical notation. (p. 57)

Sibelius users favored classical types of sounds or instruments and it helped them learn about music more quickly. Students reported working with Sibelius required them to be original whereas GarageBand gave them access to previously recorded sounds. Similar findings were reported by Wise, Greenwood, and Davis (2011). Teachers reported mixed views with GarageBand because they found using loops provided a shortcut in composition. Although some teachers found loops in GarageBand generated ideas, other teachers found it useful but not creative, and not real composition.

Students without performance experience created music through unconventional methods (Nielsen, 2013). However, students participating in band, choir, or orchestra created music demonstrating form and tonality. GarageBand and MIE programs provided students with effective compositional techniques such as using ostinatos or repeating patterns. Additionally, students reported learning steady beat and chord progressions with the MIE program which assisted them in composition.

Musical style preference was another theme emerging from the study. Students from non-performance backgrounds favored sounds heard from their favorite styles of music such as country, pop-rock, or heavy metal working with GarageBand. However, Sibelius users preferred classical music featuring traditional orchestral instruments. While more research is needed, different styles of music may require different kinds of software tools.

The last theme in Nielson's (2013) study was learning activities teachers used to create final projects. Students combined music created in GarageBand or Sibelius with iMovie to make a student-centered multimedia project. One teacher reported multimedia provided students with personalized learning. Hoffman and Carter (2013) found similar results with technology use of GarageBand and technology provided student-directed environments. Research suggested technology created opportunities for interdisciplinary study and shared ownership in music learning.

Nielsen's (2013) study provided a dynamic context for music educators. His research demonstrated students experience three different interactions with music technology: digital audio workstations, notation, and music comprehension with positive results. However, GarageBand had the ability to reach more students than Sibelius because it did not require students to have previous musical experience or to read music. Additionally, GarageBand provided students the ability to make music in their favorite styles and its environment facilitated composition. Nielsen's study should be used by music educators to teach and include students who lack the benefit of formal music instruction to realize the benefits of music composition.

Moir and Medboe (2015) conducted a qualitative study of popular music composition with four undergraduates. All four participants created works using DAWs like Logic, Pro Tools, and Ableton Live. The participants reported working with DAW technology was like working in a recording studio. DAW technology provided immediate feedback and facilitated ideas and enabled participants to compose music at all stages. Additionally, software provided sonic and visual representations of their work which was helpful in the composition process. The participants made informed decisions through critical listening and technology facilitated the process of editing and refinement.

Cuadrado, Lopez-Cobo, Valverde, and Varona (2017) found more positive uses of Cubase in a recent study of high school students in Seville and Cordoba. Students from pre-formed popular music bands participated in the project of creating a song from start-to-finish using Cubase. This project, called Musicalizatech, found many noteworthy results including fostering problem-solving and emotional skill development. Researchers reported students developed strategies of teamwork, empathy, patience, and compromise in creating their music using Cubase as the creative environment. Cubase provided students with helpful technology tools also. Student's noted Cubase's HALionsonic virtual instrument provided a palette of sounds which helped the composition process. Most students had experience using Audacity previously, but only one student previously used Cubase. However, after five weeks of participation most students were using Cubase in their projects. This research suggests students can easily learn new software alongside musical, social, and relationship skills.

Sequencing with DAWs is one my preferred methods of music creation. Students are able to create their own music using various MIDI controllers and software offers

numerous editing features to correct performance issues. Loops do provide students with musical ideas and editing features like cutting, pasting, transposing, and other features which they can use to custom tailor their own unique patterns from preexisting sounds. Students can also record their own acoustic performances and combine audio tracks with MIDI tracks for many creative possibilities. Additionally, the software does help students organize and think critically about their music and fosters an environment to develop technical skills.

Digital Audio

Creating music with digital audio combines recording analog instruments such as voice, acoustic guitar, or electronic instruments in the digital domain. Loop-based programs (Sony Acid, GarageBand) and audio editors (Audacity) are prevalent in this environment. Digital recording with computers is industry standard in the 21st century (Brown, 2007). Sampling, recording, editing, and manipulating sounds with effects are key components of digital audio technology and require specific technology skills.

The digital audio environment allows creation, manipulation, and experimentation with sound. Audio equipment such as microphones and interfaces comprise much of the digital audio environment. Using audio equipment allows users to develop engineering skills, learn microphone placement techniques, and record live sound. Editing, mixing, and manipulating audio are important qualities in the digital audio realm. Working with digital audio requires mixing skills to create a cohesive uniform sound from multiple sources. Many users of digital audio are not composers but are interested in ways to interpret music or sound and develop critical listening skills. This skill set often requires training in acoustics and acoustics have a big impact on recording quality. Learning

effects such as delay, compression, reverb, and EQ are also important engineering skills in creating quality digital audio projects or works of artistry.

Savage (2005) stressed technology opened new doors for students with enriching musical experiences likely not possible years ago. Savage wrote, “The price of music hardware and software has fallen so greatly that it is now possible for young people to produce music of extremely high technical quality in their home environment” (2005, p. 167). Savage conducted a study of 11 students who were 16-years-old composing music with information and communication technologies (ICT). He found students engaged in the compositional process as a quest of curiosity. Savage wrote, “Pupils enjoyed exploring sounds within a pedagogical framework of exploration of and discovery rather than in the context of right or wrong compositional choice” (2005, p. 171).

Savage and Challis (2001) researched students in years seven through ten of GCSE (General Certificate of Secondary Education, UK’s equivalent to high school). Students studied a town in the United Kingdom called Dunwich. The town history served as focal point for a musical composition project. Students captured and recorded various sounds, including environmental sounds, through microphones and a portable MiniDisc player. They engaged in collaboration to edit sounds and added effects with software. One student commented, “The processor added sound, echo, character and depth to the piece” (p. 143). Comments suggested new sounds arose from experimentation with effects. Participants imported sounds into Pro Tools to mix and edit audio files. Savage and Challis wrote, “None of the technologies used in the project was designed specifically for educational use;” (p. 144) however, students used professional technologies to create personal educational experiences. Savage and Challis wrote,

> A central idea in the project was to give pupils collective autonomy over the selection, manipulation and combination of sounds within the performance group. Therefore, it was encouraging to note in subsequent evaluations that pupils felt strong ownership of the piece that resulted. (p. 145)

Students culminated their experiences with live performances of their work at Snape Maltings Concert Hall. This achievement provided the students with a sense of ownership.

Kennedy (2002) conducted a small research study with four high school students in Canada. Two boys and two girls were recommended by their respective instrumental music teachers to participate. While all four had some music experience, only two students had significant experience in performance, theory, and notation. The students completed two different tasks. The first directed them to create music for a short poem featuring acoustic instruments. The second task encouraged students to use their imaginations to create a popular song using their MIDI workstations. Students spent the most time with the technology task because this environment was foreign. A CD recording showcased the students' final compositions and Kennedy found listening to be the most important component during composition.

King (2008) researched 64 undergraduate students working in a digital music studio to capture a two-minute recording of a drum kit. Students worked within conventional studio facilities like a control room, studio floor, and corridor, using dynamic and condenser microphones, signal/tone generators, digital multi-track recorders, and a mixing console to record the project. King identified several tasks in the process: recording preparation like microphone setup, teamwork with musicians, working within time constraints, transferring technical skills from different environments, and scheduling to complete the project. King found the learning technology interface group

(LTI) experienced full collaboration and worked better than the manual group which worked more independently. King suggested the LTI group achieved their progress more efficiently than the manual group as result of their collaboration. King's research suggested a digital music studio presented opportunities for student collaboration where students carried out various responsibilities.

I have used digital audio at great length as a music teacher and as a musician myself. Early in my career, my students and I edited popular songs for our dance program's concerts. We would edit sections, change tempos of songs, add fade in/out, and prepare songs for live playback at their concerts. Audio editing possibilities are unlimited. My students currently create original songs with the help of digital audio. They record themselves singing and playing various instruments in our project studio and create several layers by laying down one-track at a time. Quantizing, cutting, pasting, and pitch correction are sophisticated editing tools to improve performance quality. Students use postproduction activities by editing audio, adding effects, and preparing files for multimedia productions as standard practice.

Internet

The Internet offers a platform of instruction, reference, research, collaboration, performance, and distribution (Moore, 2003; Brown 2014). The Internet has shown great strides in music learning as a whole. Wallerstadt and Pramling (2015) reported high school students using the Internet, especially YouTube, to learn popular music. Seddon and Biasutti (2009) showed students are able to plan, organize, monitor, and assess their own performance learning the 12-bar blues in an e-learning environment. Albert (2015) suggested the use of social networks like Facebook Groups, Edmodo, and Google

Classroom to share music and facilitate classroom discussions. Blogs also offer students opportunities to connect with others online using flexible tools audio, video, and discussion groups not found in traditional journal avenues. While the aforementioned findings report positive music education tools and outcomes, research in music education around Internet based composition is limited but poses great potential for growth. Below is a summary of research and resources to assist in making the Internet a viable music composition vehicle.

Moore (2003) originally cited the Internet as an environment for reference and research but now modern technology has fostered environments for collaboration, creation, and distribution. Moore wrote, "Internet technology allows MIDI instruments in different places and times to perform together in real time with each musician hearing what the others are playing" (p. 202). Savage and Butcher (2007) embraced Moore's idea of remote performance online as students created music in real-time from various sites. Staff at Egerton High School created a digital musical instrument, the DubDubDub player (referencing the Internet's three 'w's). The DubDubDub project featured multimedia integration of Google Video and the Avant Browser that provided the visual and mixing environment. Student musicians combined live classical music and found sounds from the Internet, and ran them through the DubDubDub player. Other students provided MC and DJ mixed sounds in real time over the Internet. The project marked an innovative use of technology enabling students to improvise and compose music completely online.

Brown (2007) wrote, 'The impact of the Internet on music distribution is more significant than any technological change in the music industry since the advent of music

recording in the nineteenth century" (p. 189). The Internet allows anyone access to download free creative software and share music on sites like Soundcloud or YouTube. Thorgersen (2012) suggested two portable digital tools to reach students in music education: cloud-based software and portable open source music software shared via flash drive or downloaded from the Internet. Cloud-based programs provide users with DAW capabilities of recording, editing, virtual instruments, MIDI, and sharing music. Open source music software such as Ubuntu Studio, provides users with free access to recording, MIDI sequencing, virtual instruments, audio plug-ins, and audio programming with online or desktop applications. The Internet presents many of the most flexible tools available for creative use and is likely to experience significant growth especially since current mobile devices are designed to connect to the Internet.

The Internet offers an environment to play and compose music with virtual instruments with surprisingly good quality sounds. Google, comprising 72% of the world's market share of search engines with an average of 1.6 billion monthly users (Ratcliff, 2016), furnished a novel and refreshing approach for Internet supported instruments. Google Doodles (the images that appear daily above the Google search bar at www.google.com) have become popular to celebrate holidays, events, people, and achievements. These Doodles potentially reach over a billion people. Hughes (2016) compiled a list of the best Doodles ever created; two of them allowed Google users to create music. A Doodle to celebrate Les Paul's 96th birthday in 2011 was ranked number nine by Hughes. Google users used their keyboard or clicked on the screen to strum the Doodle's guitar strings producing chords and melodies. Users could record up to 30 seconds of music and could share it online. The Les Paul Doodle became a huge hit. The

number one Doodle, as ranked by Hughes, celebrated Robert Moog's 78th birthday. Users played an authentic sounding analog Moog synthesizer using their computer. Like the Les Paul Doodle, it was also very popular. However, the Moog Doodle had a unique feature: it included a virtual four-track tape recorder which allowed users to compose multiple layers of music, much like in a recording studio, and enabled users to share their music online. Google was innovative in providing all users with free, high quality, user-friendly music technology resources. Users could play and compose their own songs making these Doodles ideal tools for music educators. The Les Paul Doodle and Moog Doodle are respectively located at https://www.google.com/doodles/ robert-moogs-78th-birthday and https://www.google.com/doodles/les-pauls-96th-birthday.

Working with digital audio online can present many challenges such as latency. Latency is the delay of signal we perceive as the amount of time it takes for programs to respond to our commands. Music technology programs require low-latency audio performance for best results because we expect to hear sound immediately when prompted and this is now possible with high speed Internet. Wyse and Subramanian (2014) wrote, "Reliable, low-latency audio output is a key requirement for interactive music applications" (p. 19). Previously, Internet applications failed to achieve desirable results. However, the researchers wrote of the Internet's improved flexibility,

> The browser can support music with multiple channels and reasonably high sample rates, it uses a language than can run demanding audio code, and it provides (or will soon provide) access to local I/O channels for MIDI, video, and audio. (p. 21)

Advancements in technology of low-latency audio and multimedia integration support online environments once reserved for thoroughbred systems. The added benefit of the

Internet is the collaborative and portable environment it provides for global collaboration such as music composition.

Seddon (2006) found e-learning environments facilitated the process of collaboration in composition. Students (13–14 years old) with FIMT (Formal Instrumental Music Tuition) were paired with students without FIMT to compose music with sequencing programs. Email communications were used to share text and music dialogue proved to be effective use of collaboration in composition. Also, Seddon's research in e-learning environments suggested higher levels of exploratory behavior with FIMT participants than previous research (Seddon & O'Neil, 2003).

Seddon's (2006) research could be repeated today with the convenience of real-time Internet tools rather than through email communications, similar to the work of Biasutti (2015). Biasutti (2015) researched music composition effectiveness using the online environment. Biasutti used Moodle for online interaction activities, ooVoo for real-time video connection with multiple people, and eJAMMING for audio. The participants composed and recorded a song using webcams to simulate face-to-face interaction. The participants favored the online setting over a face-to-face setting. The online environment encouraged greater flexibility, efficient use of time, and allowed users to reflect on their actions and problem-solve. Internet technologies have shown to be effective for creating music in collaborative environment.

My students access software like Studio One Prime by Presonus and forums for helpful tips. The Internet is used for research and sharing music with other students as well as with college professors for college admissions applications. My students access the Internet to submit projects for competitions and share music with the community on

sites like YouTube, Soundcloud, or through social media. The Internet also provides an efficient environment for peer-review and reflection through online discussion boards.

Using technology to teach music composition requires diverse skills for music educators. Music teachers need to be versed in music composition and music technology equally. Teachers need to stay current with technology as the field evolves constantly and be prepared to share information with their students. I suggest teachers should compose music themselves, record it using any suitable technology, and then share their music and process with their students. I have composed music in this fashion with successful outcomes. The transfer of knowledge and experience have made a positive impression on my students and models a constructive example for students to follow themselves.

Music Technology = Meta-Musicians

Research suggested working in an environment rich in music technology influences users to develop numerous proficiencies. Williams (2007) realized the impact technology had on users and suggested technology was changing the roles for musicians. Williams wrote,

> The lines between the traditional roles of listener, performer, and composer are blurring. Thanks to digital technologies, it's now possible to become the composer, performer, and the listener—and much more accessibly than at any time in history. (p. 21)

Technology has given users unparalleled access to a variety of programs and capabilities even without the support of music educators. To meet students' needs and transform musicianship roles, Williams suggested music educators design new classes driven by multimedia. Williams (2007) suggested courses featuring students composing, producing, and recording their own songs and creating music videos be the primary focus. Additionally, students should be playing popular instruments like guitar and MIDI

keyboards and using GarageBand and iMovie software as part of the curriculum. Student-centered assignments like listening to students' original music and reflection discussions would also contribute to this curriculum.

Tobias (2013) researched students from a progressive music class featuring many of Williams's recommendations. The songwriting and technology course or STC curriculum focused on the live sound, recording, production, and music business. Tobias studied several students' compositional processes and found they adopted various roles to meet their creative demands. Students were singers, songwriters, producers, engineers, musicians, and sound designers as they created their compositions. Tobias (2013) wrote, "Neither composition nor songwriting in their traditional sense fully encompass students' engagement in the STC due to the inclusion of production in their creative processes" (p. 218). As expected, the STC demanded various roles for music educators because students needed technical and musical support equally. Tobias recommended teachers develop teaching strategies that foster collaboration in creative spaces to help students achieve the most of this environment.

Tobias also found this environment supported technology skills development. Students worked through phases of recording, editing, and mixing much like their favorite artists in a recording studio. The recording process featured students recording audio and sequencing MIDI to create their own tracks. Tobias wrote, "In the context of studio production, however, recording one's music requires decisions and creative processes that transform the song into a track" (2012, p. 219). Students demonstrated critical listening and made creative decisions to realize their work. Additionally, students used editing skills in splicing and editing takes to construct performances to be heard as a

single performance. This editing process is also called comping, where the editor takes the best parts of each take and combines them to create a new sound file. The results would not be possible without technology which enabled students to exercise the roles of composer, performer, and listener. Music production facilitated this synergy. Tobias recommended popular music, with its strong music technology foundation, should find a home in music curricula throughout the country.

Behles (as cited in Mertens, 2017) suggested music technology is transforming the traditional role of a musician. Today, in the Ubiquitous Computing Era, musicians have become meta-musicians. Meta-musicians fuse many traditional music roles like performers, composers, producers, engineers, and listeners into a new breed of musicians. Access to mobile technologies and developing music production skills have enabled the rise of meta-musicians. In the previous century, musicians sought out engineers and producers to record their music in a studio, and composers needed performers to play their music. Today music technology mitigates these requirements as music technology users fuse these roles together on their own. Teachers should be fusing these roles as well.

Summary

Music technology and composition both need to be embraced more enthusiastically by the music education profession. The recent updated National Core Arts Standards (2014) is a step in the right direction as today's technology is ubiquitous. As a result, there has never been a better time for the music education profession to embrace this technology. Music technology can be the creative vehicle to drive our students' potential. Students can be performers, producers, engineers, composers, and

listeners as they undertake artistic endeavors and create exciting products. The evolving roles of musicians present an exciting time for educators to create student-centered curricula that focus on creativity and attract a wider student population, especially those who feel left out of the traditional music offerings. Students are likely to embrace making music in the same way their favorite artists create works; this is now achievable in schools with the help of technology.

Chapter 3: Methodology

In this qualitative study, the contemporary phenomenon was to use mobile technology to compose music. The mobile device used was the iPad and the app used to compose was GarageBand. And, the real-life context was my students' lived experience of using iPads and GarageBand to compose and share their music within a curricular unit of instruction in my class.

My study was a holistic single case design (Yin, 2014) because I examined a single curricular unit of music technology instruction which represents a *common case*. Common cases present opportunities to study ordinary, everyday occurrences. Discussing the rationale for common case studies Yin stated, "Here, the objective is to capture the circumstances and conditions of an everyday situation" (p. 52). The essence of my study was to understand the lived experiences of my students using mobile technology to compose and share music within the confines of a music technology curricula, occurring under normal working conditions, and teaching and learning practices. All of these factors justified a common case design because the objectives align within my ordinary practice.

The goal of a case study is to describe the particular situation in its entirety to allow readers to vicariously visualize themselves in the experience via participant reports viewed through the lens of the researcher (Creswell, 2014). Essentially, the reader of this study should understand what it was like to participate in the process themselves. Additionally, the reader should appreciate the many challenges and triumphs students encountered using mobile technology to create original music and to share it with their peers in a class setting.

The purpose of this study was to examine how using GarageBand for iPad affects the way high school students compose music in a music technology class. The following overarching question guided my research:

1. How do high school students experience music composition when using the *GarageBand* app for iPad?

The Case: The Unit of Study

Studying lived experiences of participants is rooted in phenomenological inquiry. Creswell (2014) described phenomenological research as a model of inquiry where the researcher describes the lived experience shared among the participants stating, "Phenomenologists focus on describing what all participants have in common as they experience a phenomenon" (pp. 57-58). The unit of study for this phenomenon was in a high school class involved in composing original music using the GarageBand app for iPad. The focus of the investigation is what happens within the overall experiential process and, in particular, how the experiences of student participants coincided with or vary from those of the instructor.

Experiencing the act of composing music with the iPad from my students' perspective constituted the heart of my study. I wanted to understand and learn from their experience of what it is like to compose music using the GarageBand app for iPad because it prompted me to reflect on my own instructional practice. To guide students toward an enduring understanding of creativity, I embed both the essential question (see Appendix A) developed for this study along with four additional questions from the National Core Arts Standards in Music Technology. The curriculum divided into three separate phases with data collection occurring during each phase.

This unit of study adopted Gilbert's (2016) recommendation for restructuring music education to incorporate technology relevant to our 21st century digital age. Gilbert suggested integrating all three of the essential conditions developed by the International Society for Technology in Education (ISTE) to assist students in learning with technology. The three essential conditions are: (a) student-centered learning, (b) equitable access, and (c) engaged communities. These three conditions guided the design of the unit and continued to guide how I implemented the unit as the teacher. I incorporated student-centered learning by encouraging students to compose and share their own original music using GarageBand for iPad. Student-centered learning was used to provide creative opportunities unique to each student through the act of composition. I used equitable access by teaching students to interact with digital media and the assistive technology of GarageBand's virtual instruments. Students used virtual instruments and editing features to mitigate aspects such as performance quality to achieve high quality results. I incorporated engaged communities by providing a supportive environment for students to share their music through peer-listening and review. Engaged communities provided an environment to foster collaboration, community, and reflection for growth. I designed my instruction with Gilbert's (2016) suggested essential conditions while my students shared their lived experience of composing music using GarageBand for iPad.

I implemented this unit in my high school music technology class during the Spring 2018 semester. I served as both the teacher and the researcher. All students received a school issued iPad version 2 with GarageBand for 9.3.5 iOS during the first session and continued to use the same tablet throughout the unit. All tablets were locked in the iPad cart in my classroom when not in use and were not permitted to take iPads out

of class without permission. Students received Apple supported resources, GarageBand help and GarageBand for iPad Starter Guide, for reference. I connected an iPad to the Hitachi Interactive White Board and speakers to model GarageBand so students could see and hear each feature during modeling. The following paragraphs include specifics on each of the three phases of the unit with appropriate appendix references.

Phase I - Acquisition Period (2 Weeks)

The acquisition period was designed to introduce and orient students to GarageBand's unique features and to help students navigate through the program. The acquisition period provided students with the necessary understanding of GarageBand to help them to become comfortable enough to create a project. My expectation was through direct instruction and independent student practice, students would develop a working knowledge to compose and share their music.

GarageBand has many powerful technology tools, features, and instruments for composing and music performance. I taught students to navigate through the touch instrument browser to use and record GarageBand's touch instruments: keyboard, drums, drummer, amp, audio recorder, strings, bass, guitar, and any complementary smart instruments. I also taught students GarageBand's graphic user interface (GUI) which includes the control bar, ruler, controls area, and play area for each touch instrument. Students learned to use mixer controls such as mute, solo, track controls, track's volume/pan position, echo and reverb effect levels, quantize, transpose, merging regions, and master effects. The aforementioned features were broken down into mini-units, so students learned one to three features per day. All students received exploratory time for individual practice to reinforce skills. Detailed lesson plans, the corresponding unit

outline (Appendix B) and essential questions for weeks 1 and 2 guided Phase I. Additionally, I provided two opportunities during the GarageBand Check-in (Appendix C) assignment, to gauge my students' understandings with GarageBand. Student reported feedback from this assignment helped me to mitigate problems, clarify misunderstandings, and encouraged students to share their experiences during Phase I.

Phase II - Music Composition (2 weeks)

The Music Composition phase was designed to give students opportunity to apply the skills learned in Phase I to compose original music in GarageBand. Students used class time to explore GarageBand and use its features to compose music with mobile technology. Students were expected to use mobile technology to complete an original composition to share with their peers by the end of this unit.

To help students in the composition process, instructional supporting documents, Moore's (2003) "A Process for a Creative Product" (Appendix D) and The National Core Arts Standards Music Technology Standard of Creating (Appendix E), were shared with students to assist them during this process. These documents contain steps that served as a guide through the creative process. The National Core Arts Standards Conceptual Framework's (2014) suggested standards inform teachers about what students should learn and be able to accomplish, and both Moore's process and The National Core Arts Standards can assist teachers to reach these goals. Both instructional supporting documents were used during one in-class session of a Socratic seminar that facilitated student understanding of the documents.

Moore's process covers seven different composition processes with corresponding skills and prompting questions or comments. Through the Socratic seminar, I elicited

students to develop an emerging document of student-centered ideas of the composition process based on Moore's process. The Socratic seminar was an effort to include student feedback in the composition process to give them a voice in the assignment. I documented their comments in my reflective journal (Appendix F) and shared them with all students in the next class session as a reference. Students were given exploratory time to experiment and apply GarageBand's technical tools learned in creating, refining, and preparing their composition. I facilitated their composition process by circulating through the classroom to provide musical coaching and technical support with frequent checks for understanding. Detailed lesson plans and the corresponding unit outline and essential questions (weeks three and four) guided Phase II as students engaged in the composition process.

Phase III – Music Composition Presentations and Peer-Review (1 Week)

Phase III was the final stage of the curricular unit where students were expected to share music they composed during Phase II of the instructional unit. Students were expected to have completed their composition before Phase III. Students were randomly selected to present their music at this time. All students wrote their first name and last initial on a small piece of paper, fold it, and placed their names in a coffee can. Before each presentation, a name was drawn to select the student to present. Selected students connected their iPad to our audio system and shared music with their classmates. All students were provided with peer-review critique sheets through Socrative.com (Appendix G) and completed one critique for each peer in the class. Students had at least two listening passes for review and sufficient time to complete the critiques. Students were then invited to share comments during in-class discussion. In-class discussions were

audio-recorded for student comment accuracy and to support my own reflective journal. Student composers received their peer-review critiques, for their own reflection and growth, after all students had presented and critiques had been collected and saved. Additionally, at the end of this phase, all students completed a self-assessment (Appendix H) of their work including their music, their presentation, and the manner that they supported their peers during our peer-review listening sessions.

Research Site and Participants

School Community

My case study was conducted in my classroom at a large urban high school, with a high poverty rate, located in the Northeastern portion of the United States of America. Creswell (2014) identified a natural setting as one of the main characteristics of qualitative research. I conducted research and gathered information from my students in a setting they were normally accustomed to because my research included regular music instruction within the district approved music technology curriculum.

My school district is a large urban school system with over 27,212 students enrolled for the 2017-2018 school year. District race demographics were reported as follows: 72% Hispanic, 18% Black, 8% White, and 2% Asian. Eighty-percent of district-wide students received free or a reduced lunch cost and 19% of the district student population was reported as Limited English Proficient (LEP). The district has seven high schools each with a different instructional focus. Students can choose the school they want to attend though an application process.

My high school is an open-admission public high school with a visual and performing arts focus. Our school enrollment was 1,170 for the 2017-2018 school year

and 13% of the student population was classified as a Special Education student. Additionally, 77% of our students received free or a reduced lunch cost. My school's demographics by race were reported as: 70% Hispanic, 21% Black, 8.2% White, 0.5% Asian, and 0.3% Native Hawaiian/Pacific Islander. While my high school has an arts focused curriculum, the demographics of the school population are similar to those across the entire school district.

One of the many arts related courses offered at my school is music technology. This is an elective that satisfies career and technical education (CTE) graduation requirements. The music technology curriculum is approved at both state and district levels and carries no required prerequisite. Students receive five credits toward high school graduation requirements upon successful completion of the course. The class meets five days a week at the same time for a 47-minute class period. State standards included the creative process, history of the arts and culture, performing, aesthetic responses, and critique methodologies (Schmid, 2014).

National Arts Standards included creating, performing, responding, and connecting. Students meet these standards by creating projects with notation, sequencing, digital audio workstations, and Internet technologies (National Core Arts Standards Conceptual Framework, 2014). Students perform on traditional and electronic instruments during their creative process and share their projects for peer-review and critique during class presentations. Connecting and responding are realized through creating projects from a variety of styles and genres of music to relate to technical skills within a musical context. Music elements like pitch, rhythm, form, texture, timbre, melody, harmony, and dynamics are incorporated while using technology tools to

implement the musical elements. Students learned the aforementioned musical elements prior to the study through teacher lecture, student research, small group presentations, and application of content. Music technology class also prepares students to use audio systems in real world applications such as plays, musicals, and concerts where live sound is required. Real world applications are supportive components preparing students for post-secondary education and careers.

Classroom Setting

The entire case occurred in my music technology classroom. My classroom contained 20 technology workstations. Twelve of these student workstations included a desktop computer and 88-key electronic weighted (MIDI) pianos with headphones. There were six additional freestanding keyboards of similar types with headphones but without desktop computers and a workstation desk. Additionally, all students were issued a laptop PC computer to be used throughout the day in all classes, and I was permitted to install licensed music technology software on their laptops. The classroom also contained an iPad cart with 30 iPads version 2 with Apple's GarageBand app. The teacher's workstation contained a desktop computer with a MIDI connected keyboard, desktop audio monitors, and connects to the Hitachi Starboard (IWB). The teacher also had iPad docking stations for student use that allow outside instruments such as microphones, electric guitars, basses, keyboards, etc., and contains MIDI, RCA, and monitoring audio connections for headphones or other speakers. My classroom had a small project studio with an isolation booth, condenser, dynamic microphones, 16-channel fire-wire mixer, and an Apple iMac computer and workstation where students recorded their own music

with professional sounding results. We had electric and acoustic guitars and basses that students use to create and record their music.

My classroom was equipped with many professional pieces of equipment, but during the curricular unit under investigation, students were limited to the use of iPads, the GarageBand app, headphones, Behringer iS202 docking stations, keyboards, and other instruments such as guitar or bass. Students could have used the desktop or school issued laptop for research purposes such as tutorials and other supporting educational sites or resources but were required to compose using only the iPad technology.

Student Participants

The participants in this study were students enrolled in my year-long music technology course. Students were in grades 9-12, and between the ages of 14 and 18. The guidance office assigned students to my class based on student class choice surveys and graduation requirements. All students enrolled in my music technology class were invited to participate in this study. I taught two class periods with a total of 30 students. Ten of these students were considered second year students as they were taking this course for the second time. I had a total of 18 students who returned the required permission forms and participated in my study. All but one student-participant completed the entire project. One of the 18 student-participants did not present his final project due to significant class absences. All 30 students received the curriculum described above and students were not required to participate as research participants. The consent process will be described in more detail below.

Students enrolled in music technology classes often come from varying experiences in music education. Some students already had previous music training in

band or choir during their elementary grades while others only had general music. Many students play popular instruments like guitar, piano, drums, or bass and have learned them through their houses of worship, community or school-supported programs like enrichment or after-school sessions. Most students lack proficient music reading skills and prefer to play-by-ear or through online tutorials and Internet sites like YouTube, Ultimate Guitar, or Songsterr.

Data Collection

Creswell (2014) suggested multiple sources of data are an essential characteristic of qualitative research. My primary forms of data included an initial student intake survey (Appendix I), student work products, student open response written questions (Appendix J), and my reflective journal. I planned these sources of data to capture both the student and teacher perspectives of the lived experience of composing original music with mobile technology tools. Additionally, structured forms of data were distributed and collected at each phase of my curricular unit to capture a holistic account of my students' and my own perspectives of the instructional unit. All written assignments were distributed and collected using Socrative.com.

The first piece of student data collected was initial intake questionnaire. This tool described students' previous music and technology experiences. The questionnaire was administered before the instructional unit began and provided me with student background data to assist my instructional practice during the curricular unit and helped establish themes and/or student groupings during analysis.

Student work products in the form of assignments corresponded with the curricular unit. One example was the weekly essential question assignment. Essential questions have been adapted from the creativity standard to develop the enduring

understanding and stimulate inquiry during instructional units (National Core Arts Standards Conceptual Framework, 2014). Essential questions and enduring understandings are supported by the National Core Arts Standards to help students to develop concepts and an overall understanding of the process. These responses provided me with weekly data on each student's individual progress toward the enduring understanding. Each week, a question guided students along the composition process from imagining ideas, planning, evaluation and refinement, through presentation of their work. Student feedback helped me gauge their understanding throughout the curricular unit. Another student work product was in the form of digital audio files of my students' musical compositions. Creswell (2014) suggested audio-visual materials allow students or participants an opportunity to share their experiences during the study. Students' digital audio files will serve as audio prompts for peer-review critiques. Peer-review critiques constituted another student work product and a component of my unit designed to integrate engaged communities into my instruction. All students used the peer-review critiques to provide support when listening to students' music during in-class presentations. Additionally, my peer-review listening sessions were audio recorded to capture in-class student discussion and contributed to my condition of engaged communities. The data assisted me to maintain accurate record keeping of the listening sessions to capture students' comments and class discussions. Audio recordings of in-class peer review sessions were transcribed prior to analysis which aided the coding process.

The last form of student data was the written reflections that were completed by students at the end of curricular unit. The open response written protocol (Appendix J)

reflected the entire curricular unit and was adapted from Verrico and Reese (2016). Verrico and Reese designed written reflection questions to be used with college music majors to describe their shared experience of performing and creating music in an iPad music ensemble. These authors' original questions asked students to describe their perceptions of using the iPad apps as well as using the technology to create and perform music. Verrico and Reese also asked students to focus on perceptions of themselves, their iPad ensemble, technology, overall thoughts, and group interactions when sharing their experiences. Verrico and Reese's protocol was appropriate for use in my study because the questions ask music students to describe their musical experiences using mobile technologies. Although I used the same media as Verrico and Reese my study differs because I am using mobile technologies for music composition and not performance specifically. Additionally, the questions were broad and open-ended which encouraged multiple answers from the students. As a professional courtesy, Professor Reese gave me permission to use her questions.

In addition to student data, teacher-centered data was collected in the form of a daily reflective journal. My reflective journal helped to serve two purposes. The first was an effort to set aside bias. As both a teacher and researcher of this study, my reflective journal allowed me to document both perspectives and review my work from an objective perspective (Creswell, 2007). The other purpose was to provide me with a different perspective of viewing student work. Watson (2010) suggested keeping a reflective journal helped to recapture experiences and develop strategies. My notes helped me to identify challenges or triumphs my students encountered, prompting me to intervene appropriately. My journal also assisted me to plan accordingly for the upcoming class

sessions, anticipate technical difficulties, and sequence material appropriately as my students learned new content and worked with unfamiliar technologies. In this case, I needed to change my teaching practice and be flexible to accommodate my students' needs. Reflections from my journal assisted me in this process.

Trustworthiness

In this research study I bore significant personal responsibility as I served in dual roles. First, I am employed as a teacher of music technology charged with carrying out our district approved curriculum and procedures, and to teach all students in my class to the best of my ability. Second, I was the principal investigator conducting this research study. In an effort to eliminate coercion and bias I had a fellow music teacher distribute and collect parental consent (Appendix K) and student assent forms (Appendix L). This individual also safeguarded these documents in a sealed envelope locked in his classroom safe. I did not have access to his safe and did not know who participated until the study was completed and grades have been turned in. This way, I could operate in the most professional way possible and to ensure that all students received the same instruction of curricular content regardless of their participation in the study.

Triangulation was used to as a tool to validate my findings (Bresler, 1992; Hartwig, 2014). As I collected multiple forms of data, both student and teacher created, at various points throughout the unit, triangulation of these data sources was used to arrive at and validate my analysis. All data and themes were examined with my external auditor, Dr. Cronenberg, for reliability. In addition, I used a thick description to convey a vicarious experience to my readers. Thick description was of particular importance for a case study because the goal was to help the reader understand the experiences of those

researched. By describing the context, specific events, or instances of learning, as well as a particular student's experiences composing using the iPad, I enabled the reader to experience the unit, understand the case, and draw his/her own conclusions alongside my own.

Confidentiality

Creswell (2014) suggested researchers need to build trust with their participants, to protect them from misconduct, and protect participants' identities. Additionally, conducting research in a school setting with minors requires greater ethical considerations (Creswell, 2007). In adhering to professional and ethical considerations, I have obtained permission from the school principal (Appendix M) and the Rutgers University Institutional Review Board (IRB) (Appendix N) has approved all aspects of this study.

Another ethical and required method of adhering to confidentiality was to inform parents or guardians and students of my study which gave them an opportunity to choose to participate or not. The parental consent form to have peer-review class discussions audio-recorded (Appendix O), and student assent form was distributed and collected by a fellow music teacher at my school and securely stored in his classroom safe, as described above. Having a fellow colleague read, distribute, and collect consent and assent forms was part of building trust with the participants, alleviating bias, and fostering reflexivity. My colleague read a script (Appendix P) when administering consent and assent forms to my students; I was not present during this reading.

Finally, I used two specific procedures to maintain student confidentiality. First, students who agreed to participate received a non-identifiable pseudonym assigned

randomly using a *stage name generator* located at http://www.fantasynamegenerators.com/stage-names.php#.WddjTmhSzct, after the study was completed and all grades had been turned in. Students are referred to by their pseudonym in this document. Second, participant surveys and questionnaires located in the appendices were securely shared through surveymonkey.com. This online service enabled me to easily separate students' names from their responses for research purposes.

Analysis

My data analysis focused primarily on thematic coding. Yin (2014) wrote, "Data analysis consist of examining, categorizing, tabulating, testing, or otherwise recombining evidence, to produce empirically based findings" (p. 132). In my case, I collected all student and teacher data gathered from each phase of the curricular unit and used them to uncover themes based on the lived experiences of the participants.

Saldaña (2009) suggested coding is used to realize outcomes or themes based on the data. Codes are generally categorized into either *a priori* or emergent codes. *A priori* codes are predetermined pieces of information developed prior to the study in question while emergent codes are those that materialize from the study itself (Creswell, 2007). As I am both the researcher and teacher of this instructional unit, only emergent codes were used. This decision was made because the establishment of *a priori* codes might unintentionally influence my reflections or teaching practice. Additionally, using *a priori* codes could skew my perceptions, impose bias, or prevent me from accurately capturing my students' experiences of the instructional unit.

Emergent codes were used to determine themes or outcomes of my study. I used Creswell's (2014) six-step approach to data analysis and interpretation. I first organized

and prepared data collected in order of occurrence within the curricular unit. Student reported data was organized in the following order: (a) initial intake survey, (b) weekly essential questions, (c) GarageBand check-in, (d) self-assessment, (e) peer-review critiques, and (f) open response written questions. My daily reflection log was organized to correspond with the student-reported items by date of occurrence. I read all data first and held all data as equally important.

The next step involved the actual coding process. At this time, I organized data by reading through all collected material, bracketing chunks based on patterns and then grouped the chunks of the data into categories. Creswell suggested assigning a word or a phrase that signifies a category, essentially a category title. I used Tesch's eight steps in the coding process to assist in the step (as cited in Creswell, 2104, p.198). Of particular importance, I looked for categories that are supported by data found in multiple sources in order to triangulate my data. Once a set of categories was established, I renamed and/or abbreviated these into codes, and then carefully reread all pieces of data and code all pieces of collected data.

Once all data was coded, I grouped the codes as they related to the research question that guided this study: How do high school students experience music composition when using the GarageBand app for iPad? From these groupings, I developed broad themes and then wrote descriptions that evoked each theme. Themes and Codes Definitions are in Appendix Q to help the reader understand the categories. Creswell wrote, "Description involves a detailed rendering of information about people, places, or events in a setting" (p. 199). I used the description to create a story line and present the data as they related to my research question.

In review, the central question investigated in this study is: How do high school students experience music composition when using the GarageBand app for iPad? Through careful analysis of my students' descriptions of their experiences as well as my reflective journal, I present an understanding of what it is like to compose music using GarageBand for the iPad in my classroom in the following two chapters.

Chapter 4: Results

This chapter reports the results of the instructional unit as described in Chapter 3 and provides introductions to my students, including their backgrounds, ages, grade levels, gender, and musical experience. Results are reported categorically and grouped into three unique themes: Music and Production Features, Thinking Creatively, and Instructional Roadblocks. Each theme contains sections that support the theme holistically. These themes are established and presented through direct and unaltered quotes from my students' and via our experiential descriptions that address the research question: How do high school students experience music composition using the GarageBand app for iPad?

Overall, students demonstrated positive experiences composing music with GarageBand. I noticed high levels of attentiveness and enthusiastic cooperation. In fact, on several occasions individual students assumed leadership roles by helping other students learn how to use some of the features in GarageBand, which increased the overall level of learning and engagement. Experiences such as these contributed to creating a judgment-free space for students to embrace the challenge of learning a new skill, share their work in the classroom, and understand the value of constructive critical peer review and feedback. At the end of the instructional unit, as students shared their original music, I was inspired by their enthusiastic support of each other and heartened as I observed initial anxiety about presenting their music dissipate as students perceived the effects that their music had on their peers.

In addition to the growth students experienced as they acquired and honed this new skill, I was pleased to realize that this experience affected their perception of

individuals involved in professional composition and production. Their comments demonstrated a deeper understanding of the challenges that accompany creating a finished, original piece of music. Several students also indicated that they had developed a new appreciation for instrumental music, whereas in the past, their primary focus had been directed toward lyrics. Many of their comments associated with their overall experience as well as specific experiences are included in the detailed thematic discussions that follow.

Unit Overview

The instructional unit started the new calendar year off on an exciting educational journey. We had just returned from a restful winter break eager to experience composing with GarageBand for iPad. The month of January was perfect for beginning the study because expectations for the class had been established, general musical and technological content had been covered, and an overall positive classroom culture existed. Additionally, January was a calm month, free of disruptions from school trips, standardized testing, or extended breaks, although we did encounter two snow days and schools closed for the Martin Luther King Jr. holiday. However, recovery time for days lost was tacked onto the unit and did not affect the remainder of the music technology curriculum. Consistent with my design, our instructional unit consisted of three phases: 2 weeks each for acquisition and music composition and 1 week for peer-review listening sessions.

My students attend a large high school in an urban community. Most of them walk to school, which can be troublesome during winter months when they must contend with snow or ice. All students are required to wear uniforms, and they often complain

about it. However, a favored accessory for my students is ear buds attached to their cellphones. I interpret this as one pathway to self-expression.

Both music technology classes begin early in the morning; Period 1 begins at 7:45 a.m., and Period 2 begins at 8:36 a.m. It is often a challenge to get students to focus early in the morning, especially as most of the seniors have after-school jobs. Between after-school obligations and balancing coursework from multiple classes, students often find early-morning classes challenging. My hope was to provide them provide them with a creative environment and encourage them to find their own voice in their work to incentivize participation in my class.

As previously noted, the study was self-blinded. I did not know who participated in the study until after the unit was completed and all assignments had been graded. Therefore, all students received the same instructional opportunities, and all were required to complete assignments, regardless of participation. Nine of 15 students in the first-period class participated, and 9 of 12 students in the second-period class participated, for a total of 18 participants (9 males, 7 females, and 2 who preferred not to answer).

Participants' previous musical experience varied. Only six students reported being able to read music; these students recorded their skill level on a scale ranging from not good to very good. However, most students (10) reported playing an instrument such as guitar (5) or piano (5). Although a few students reported being in other classes like piano, guitar, music theater, or music theory, the majority did not participate in traditional music classes (band, orchestra, or choir). Some students noted that they played several instruments like guitar, bass, and piano. Nearly all participants (17) stated they listened to

music daily; the remaining student indicated he/she only listened weekly. All students regularly used technology to complete school assignments and for entertainment purposes. In addition, all students indicated that they used technology to create music, ranging from daily (4), to weekly (8), to monthly (4). This experience was expected because they are enrolled in a music technology class. The initial intake survey revealed that the students were comfortable using technology and ready to use GarageBand for iPad.

The following tables describe basic characteristics about these students by section. In addition to student characteristics, demographics are also provided including race, special education status, free/reduced cost lunch status, and how my participants compared to the rest of the study body. All names have been changed to a randomly generated pseudonym to protect identities. The first-period class is entirely level one and consists of students in grades 9–12. The second-period class is mixed, with first-and second-level students, and all of them are seniors. Second-level students are those who are taking the music technology course for the second time.

Table 1

Period 1 Music Technology Students (First Level)

Name	Age	Gender	Grade
Erin Grant	15	Preferred not to answer	10
Ink	16	Female	10
Spirit	17	Preferred not to answer	12
Quill	16	Female	11
Jacket	18	Male	12
Linda Day	18	Female	12
Blair Duff	16	Female	11
Slice	16	Male	11
Owl	15	Female	9

Table 2

Period 2 Music Technology Students (First and Second Level Mixed)

Name	Age	Gender	Grade
Corey White*	18	Female	12
Brian Nolan*	18	Male	12
Blade*	18	Male	12
Blue	18	Male	12
Mirror*	18	Male	12
Jacob Fawn*	17	Male	12
Glen Cameron*	18	Male	12
Marcus Skye	17	Male	12
Chord	17	Female	12

Note: * denotes second level.

Table 3

Period 1 Music Technology Students Music Experience (First Level)

Name	Previous Music Class Experiences	Music Reading Ability
Erin Grant	Band, Choir, Guitar	Very Good
Ink	Guitar	None
Spirit	Band	Average
Quill	Choir	Not Good
Jacket	None	None
Linda Day	Choir, Guitar	None
Blair Duff	Musical Theater	None
Slice	None	None
Owl	None	Average

Table 4

Period 2 Music Technology Students Music Experience (First and Second Level Mixed)

Name	Previous Music Class Experiences	Music Reading Ability
Corey White*	Guitar, Music Theory, Piano, Music Theater	Good
Brian Nolan*	Piano	Not Good
Blade*	Guitar	Not Good
Blue	Guitar	Average
Mirror*	Music Technology	Not Good
Jacob Fawn*	Music Technology	None
Glen Cameron*	Band, Choir, Musical Theater, Guitar, Orchestra	Very Good
Marcus Skye	None	None
Chord	Guitar, Music Theory	Average

Note: * denotes second level.

Table 5

Period 1 Participant Demographics (First Level)

Name	Special Education Student	Race	Received Free/Reduced Lunch
Erin Grant	No	Hispanic	Yes
Ink	No	Black	Yes
Spirit	No	Hispanic	Yes
Quill	No	Hispanic	Yes
Jacket	Yes	Hispanic	Yes
Linda Day	No	Hispanic	Yes
Blair Duff	No	White	Yes
Slice	Yes	Hispanic	No
Owl	No	White	No

Table 6

Period 2 Participant Demographics (First and Second Level Mixed)

Name	Special Education Student	Race	Received Free/Reduced Lunch
Corey White*	No	Hispanic	No
Brian Nolan*	Yes	Hispanic	Yes
Blade*	No	Hispanic	Yes
Blue	No	Black	Yes
Mirror*	No	Black	Yes
Jacob Fawn*	No	Hispanic	Yes
Glen Cameron*	No	Hispanic	Yes
Marcus Skye	No	White	No
Chord	No	Hispanic	Yes

Note: * denotes second level.

Table 7

School Wide vs. Music Technology Participants Demographics

	School Wide Data *N* = 1170	Study Participants *N* = 18
Special Education Students	13%	17%
Free/Reduced Lunch	77%	78%
Race		
Hispanic	70%	67%
Black	21%	17%
White	8.2%	17%
Asian	0.5%	0%
Native Hawaiian/Pacific Islander	0.3%	0%

The acquisition period was an exciting time for the students because we began learning and composing with GarageBand. Most students had little to no experience using GarageBand, and this unit was the class's first contact with the program in a curricular context. Jacket wrote, "When I'm learning or doing something new, great. It makes life easy when you know something it would help for future thing[s] so it's good to learn something new" (EQ1). Most students shared Jacket's enthusiasm, however two

students reported that new experiences could be confusing or required much of one's attention and cognition to grasp concepts (Erin Grant & Chord, EQ1).

The acquisition period contained direct instruction and independent student practice with GarageBand's unique features, instruments, and tools. Students used their headphones while working with GarageBand and often used headphone splitters when listening with me or another student. This stage featured much exploration and offered a direct application of music technology content. We also thought critically about how musicians engage in the creative process—for example, how they develop new ideas. This gave students an opportunity to use the app to create patterns or themes. Marcus Skye reflected, "They [Musicians] find inspiration for creating music by playing with music. Musicians just play with their instruments until they find inspiration for a song" (EQ2). Blair Duff's statement sums up much of the beginning of the unit: "I've been using technology recently to create music with an app called GarageBand; I learned ways to create and learn music" (Socratic seminar). By this time, most students were acquainted with GarageBand and ready to begin their compositions.

The music-composition phase allowed students 2 weeks to complete their original compositions, which would be shared in the upcoming peer-review listening sessions. Students learned to use GarageBand's unique features and tools, and this phase was entirely devoted to applying the same resources for music creation. During this stage, students focused on the creative process of making decisions and refining ideas. I facilitated the process with technical support and by giving student individualized feedback. Ink reported,

> …everyone is different and everyone's mental thinking processes is different. Take me for example, I make decisions based on my mood or on something I know will always make me happy, even if it sounds gloomy or slow. (EQ3)

Mirror wrote about how to improve a musical work: "Musicians improve the quality of their creative work by either listening to other[s] and seeing what they did different, or using their [imagination] to always improve" (EQ4). Ink and Mirror provided differing perspectives, including incorporating personal views, learning from others, and using imagination to create music.

GarageBand for iPad enabled use by students at various levels of ability and allowed all users to have experiences with performing, composing, mixing, and listening to create their music. These roles helped them to achieve works to be proud of, as Quill highlighted, "A triumph I experienced during the class is realizing I could actually make a good project. This was my first time using the project and I think I learned quickly" (Q7, open response WQ). This was Quill's first time composing, and she realized she could do it well.

Furthermore, the unit also contained opportunities for advanced students to realize new experiences. Corey White, Brian Nolan, and Glen Cameron stretched their capabilities further to discover new skills they did not know they had, such as exploring instrumentation, sound design, and orchestration. The customizable features available when composing with GarageBand allowed students to capitalize on their preferences and abilities. This included both beginners and experienced learners as they interacted with GarageBand in their own unique way.

Learning and composing with GarageBand culminated in our peer-review listening sessions; these were like a high-school version of show-and-tell. Students

completed the creative process by sharing, reviewing, and reflecting on their experiences of music composition with music technology. One at a time, the students nervously or energetically connected their iPads to the starboard. Owl noticed the judgement-free, supportive environment as students were sharing work and receiving feedback (Q26, open response WQ). Students like Spirit and Corey White taught techniques they used to complete their music. I was especially proud to hear my students' music played throughout the classroom and the insightful class discussions that arose as a result.

Student- and teacher-reported data gathered from the entire unit represented a holistic account of experiences to answer the research question: How do high school students experience music composition when using the GarageBand App for iPad? Three major themes emerged to answer this question: (a) Music and Production Features, (b) Thinking Creatively, and (c) Instructional Roadblocks. The remainder of this chapter explores these three themes using direct quotes from students, student work, and my teacher journal as evidence.

Theme: Music and Production Features

GarageBand for iPad provides students with a mobile environment complete with studio-like features in a user-friendly app. Using the robust features of this app, students applied musical elements and music technology content to their work. The Music and Production Features theme emerged as a result of students working with digital tools to create, develop, and share their music. Technical features, production, and musical elements fostered the use of methods that we experienced using GarageBand for iPad. Additionally, these components in conjunction with GarageBand for iPad facilitated the creative process.

Technical Features

Students learned and used a variety of technical features contained in the program while composing with GarageBand for iPad. Throughout the unit, students integrated technology as part of the daily objectives, activities, and assignments. Students used GarageBand's features fully, including, for example, performing on virtual instruments, recording and editing parts, mixing, sharing, and presenting work. Both students and the teacher used technology to create, present, share, demonstrate, and interact with curricular content.

Consistent with the curricular design, I taught GarageBand's technical features through direct instruction and independent student practice. Students used various smart instruments, recording, editing, mixing, graphic user interface, and other technical features sequentially and began creating patterns or parts quickly (TL1-10). Many of GarageBand's technical features, such as session drummer, became popular with students. Students enjoyed the fact that they could find the right drummer for the style of music they wanted. As noted in a teacher log,

> Today, I taught all students to use the session drummer feature in GB, and many students commented on how natural the drums sounded. A student said it sounded like a real drummer. The different types of drummers and how they could play in different styles impressed students. (TL2)

Students experimented with the drummer feature to create a cohesive blend. GarageBand contains virtual drummers that can be used to follow drum patterns of a specific style such as rock or hip-hop. The following teacher log exhibited a positive interaction between Blade and me while he searched for complementary sounds for the style of music he was creating:

> I listened to Blade work and was very impressed. He combined loops, an original drum pattern with the session drummer to create a dance/electronica track. The session drummer, Kyle (a virtual drummer in GarageBand), he chose to work with did not blend with his song, so I suggested him to use Magnus (another drummer option); it matched the mood nicely. (TL8)

The various virtual drummers found in GarageBand like Kyle and Magnus produced drum tracks that could easily match the style and mood that students sought for their songs.

Students also enjoyed playing other virtual instruments, such as the keyboard. Corey White described how GarageBand's different synths and pads helped her to create new sounds and songs compared with those she used in prior music technology experiences (Q3, open response WQ). Chord also agreed with Corey White and wrote, "I liked the fact that I was able to explore more with synths since I've never used a synth before, so that was a pleasant new experience for me" (Q7, open response WQ). Other students, like Jacob Fawn enjoyed experimenting with the sampler instrument (GB Check-in, W1). Based on Jacob Fawn's experience, I taught students how to play with the sampler feature during direct instruction:

> I demonstrated how to use the sampler feature in GB based on several student's written comments like Jacob Fawn. I showed students how they can record live audio sounds, edit, and assign them to keys on the iPad or use sounds already in the GB library. (TL7)

The extensive library of various instruments provided students with options to explore and create music. Mirror and Ink wrote about how they enjoyed the plethora of available instruments (GB Check-in, W1).

Another technical feature students enjoyed was the capacity that GarageBand for iPad has for working with external interfaces. Throughout the unit, students used our Behringer iStudio docking stations and iRig interfaces to record both audio and MIDI

files. Marcus Skye used the electric guitar on his project, and the docking station made recording easy (TL15). He then used GarageBand's guitar amplifiers and stomp boxes to dial in the right sound that complemented other aspects of his song. Brian Nolan, Corey White, Chord, and Glen Cameron frequently used the Behringer iStudio to connect electric keyboards via MIDI. This helped them to input their own musical performances into their projects.

Editing features became an important tool in GarageBand, and the edit window facilitated this task. Blue edited and fine-tuned his project, as I noticed during my seventh day of the unit:

> Blue showed me his work that featured bass, drums, piano, and strings. He is making cohesive sounds however; his bass did not match the chords from the piano. I showed him how to change this using the edit window and then he heard how the bass aligned more with the project after. (TL7)

In Blue's case, the root notes from his bass line were fighting with his piano chords; he adjusted the bass notes until they blended with the piano chords. Brian Nolan recorded his piano performance via MIDI but played a few wrong notes, and I quickly taught him how to fix them using the edit window. Editing enabled Brian Nolan to fix just a few notes rather than waste time trying to get the "perfect take." Spirit noticed editing in GarageBand was similarly convenient to her previous editing in Studio One and wrote, "Another thing I like about GarageBand how it's the exact same way as Studio One when it comes to editing techniques" (GB Check-in W2). Editing skills Spirit learned in a previous program were easily transferrable to GarageBand, and that helped her refining process.

Quantization was another feature students used to edit and clean up rhythmic issues in their projects. Owl described how the quantization aspect helped her "keep

everything on beat" when rhythmic attention was needed (GB Check-in, W2). Several students noticeably improved the quality of their work using this feature. Erin Grant used quantization to clean up the rhythm of a chord pattern and melody she recorded using virtual instruments (TL11). Blade experienced a similar situation. I noted, "Blade came up with a cool piano pattern, however it was offbeat. I asked him to rerecord it but play with the metronome. He did and quantized it a little and added the sustain/pedal feature to make it sound more natural" (TL12). Quantization helped students sound more professional in regard to rhythmic accuracy and saved valuable class time by sparing students from having to do additional takes.

Production

Production is a broad topic in music technology that encompasses a wide variety of domain-specific skills. These include recording engineering, performing, MIDI sequencing, mixing, sound design, and mastering. Production integrates the aforementioned technical features; however, it takes them a step farther with the use of tools for artistic outcomes. Marcus Skye wrote regarding this capability, "I've become a more structured and formal engineer and producer since it was a new experience" (Q9, Open Response WQ). Quill wrote, "It [producing music with GarageBand] gives me an idea of how a certain job in the music industry might feel" (Q9, Open Response WQ). Quill's and Marcus Skye's responses capture their impressions of the production process. My students experienced performance, sound design, and mixing when using GarageBand for iPad to explore music production practices.

Performing

Most students with prior music experience recorded at least some of their project by performing on their MIDI-compatible keyboards through the Behringer iStudio. Blade initially input all his musical parts by playing them on the piano keyboard before editing (Blade's Peer-Review Listening Session, Class Discussion). During her peer-review listening session, Quill explained to the class that she performed and recorded all of her MIDI-based instruments, such as the synth (TL, Peer Review). Brian Nolan, Corey White, Glen Cameron, Chord, and Spirit also used their performance skills to complete their projects. Performing helped facilitate their production process, since they could play back and edit the parts they wanted to hear in their projects. Additionally, students performed on acoustic instruments like guitar or ukulele (Erin Grant) using the built-in microphone, and on electric guitar (Marcus Skye) via the interface. GarageBand's technical features allowed students to incorporate organic sounding instruments as part of their songwriting and production techniques.

Performance was also used with virtual instruments because students used the iPad as an instrument to trigger GarageBand's sound library. Additionally, virtual instruments allowed the students to expand musically beyond their performance abilities on physical instruments. GarageBand's virtual and smart instruments are integral parts of the program and were used by all students to complete their projects. GarageBand's sound library provided students with various sounds to use. GarageBand's instruments helped students' progress, because they could quickly swap different instruments to find their desired sound. Brian Nolan found this helpful when he created cohesive layers using piano, acoustic guitar, and bass that blended nicely (TL3). The piano was his featured

instrument, reinforced by acoustic guitar chords and a supportive bass line. Marcus Skye gave Brian Nolan the following feedback, “It was very nice, and the instruments were all well played.” In previous class projects, he only wrote for solo piano, and this new environment opened up greater possibilities for him (GB Check-in). Owl experienced similar success with her project with a driving bass line, distorted guitar chords, and hard drum sounds, combined with a haunting legato viola melody that mixed beautifully (Owl’s peer-review listening session). She struck a balance between a *dirty*-sounding rhythm section combined with a delicately smooth melody. I commented during her listening session, “I like the rock guitars with the pretty viola sound. I thought the contrast between the two tones, two timbres, was really cool.” GarageBand’s simple sound library gave students tools to audition different instruments that matched their needs like selecting instruments to match a genre or style.

Sound Design

Students demonstrated sound-design skills by tweaking the dials of the various virtual instruments to tailor the sound and go beyond presets. Marcus Skye used various dials like attack, release, cutoff, filters, and others in each of his virtual instruments to shape the pitches to achieve the sounds he sought. I observed his practice and wrote, “Marcus Skye’s project is really coming alive. It is really interesting because he is custom-tailoring each instrument’s sound and exploring possibilities like the dirty bass sound he designed” (TL15). Chord demonstrated similar skills by connecting Alchemy (which is a third-party instrument via the inter-audio app feature) and turning up the dials to create a sultry bass sound that impressed students like Corey White, who applauded

Chord's song for its warm and round sound (Chord's peer-review listening session, class discussion).

Mixing

Mixing techniques, such as panning, were another useful way that students experienced composing with GarageBand. Panning is a postproduction technique that allows the user to place the sound within the stereo field such as the left, right, or center to create a sense of acoustic space. Students experimented with panning sounds toward the left or right speaker to create space. Erin Grant recorded herself playing the ukulele and combined it with acoustic guitar; however, they were initially both panned towards the center. We listened to the work together and decided that the tracks should be panned left and right respectively to give each instrument some more aural space (TL8). Quill borrowed the same panning technique when creating parts for two different synths sounds for her project as well (TL17). Marcus Skye used panning techniques by repeating the same melodic synth idea but alternating it in different speakers to create a hypnotic, bouncing effect (Marcus Skye's peer-review listening session). Blair Duff used the same technique as Marcus Skye in her project as well (Blair Duff's peer-review listening session). In peer review, Corey White noticed how Glen Cameron could use panning techniques to create more life in his mix. Corey White suggested that he pan instruments that were playing the same rhythm but in different speakers to create a bigger space (Glen Cameron's PRC). Panning instruments in different speakers helps to give instruments their own space and avoid overcrowding the mix.

Balancing volume levels was another important mixing tool that students used. Slice applied volumetric changes by programing velocity on MIDI instruments and track

automation for different instruments for his composition (TL4, 12). Erin Grant used a fade-out at the end of her song that caught Quill's attention during her listening session: "…the sounds were smooth and had a nice flow, I also loved the fade-out at the end." Blade used velocity tools to refine the piano part in his project (TL16). Adjusting the velocity was also important because Blade performed his piano part during recording, and it required smoothing out the levels to create a uniform sound. Mixing levels is a challenging task that demands attention to detail. Mirror demonstrated that he had great listening skills during Corey White's peer-review listening session when he provided her the following feedback, "I like how your hi-hats aren't too loud, they're soft and follow the tempo." Mirror implied that Corey White achieved the appropriate volume level and space for the hi-hat pattern in relation to the other instruments. This was an instance of using mixing to balance volume levels.

Using effects is another feature that students incorporated into their projects. Corey White used a setting called "suspended animation" with an additional echo effect to enhance the melody she wrote for a synth (Corey White's peer-review listening session). The synth became a focal point of the composition and caught the attention of both her peers and me during her listening session. Corey White also used the compressor effect to bring out the drums in her music and the reverb effect to simulate a realistic space (TL8). Spirit also experimented with reverb settings in her song and taught the class how different settings are used:

> *Spirit:* When I do create a loop, it turns into this after I merge it, 'cause when you do something yourself its green but then when I merged it, it turned blue like those, like the loops that you find. And you get this where you can edit them and make them sound different. So, like, [Spirit plays the music and demonstrates different ways to adjust settings such as reverb].

> *Mr. Sabet:* Great job explaining that. Spirit.
>
> *Spirit:* Yeah.
>
> *Mr. Sabet:* So, the preset tries to simulate different rooms or spaces. (Spirit's peer-review listening session, class discussion)

Marcus Skye also used GarageBand's effects and guitar amps to sculpt his song. Marcus Skye asked me to play guitar on his recording. I recorded heavy-metal-style chugging power chords. After recording the part, he then used GarageBand's guitar amp menu and stomp boxes to get the sound he sought. This was a helpful feature, because we recorded the guitar directly through the Behringer iStudio but were able to achieve authentic guitar-amp tones using GarageBand's virtual amplifiers and stomp boxes (TL15). Effects enabled many students to custom-tailor various instruments as if the sounds came from actual recording studios.

Theme: Musical Elements

Students integrated musical elements into their projects by using GarageBand for iPad. Students learned many elements of music as part of our music curriculum and integrated them using technology in their compositions. Quill reflected on this process, "Some of the challenges I experienced are including musical textures and forms I learned about in class in my presentations" (Q6, Open Response WQ). Musical Elements contains the ability to apply musical content learned in class to help students structure their work. As the teacher, I noticed how students used musical elements such as style and instrumentation, texture, form, melody, and chords and harmony to create their projects and during peer-review sessions while responding to student work.

Style and Instrumentation

Students started with style or instrumentation when initially beginning their compositions. Erin Grant wrote, “What I feel like how they [musicians] generate new music is by having a specific music style in mind they begin to record. So, they begin with either the bass or begin with the drum pattern” (EQ2). Erin Grant referred to starting the project within a specific music style and the appropriate instrumentation. Spirit wrote, “Musicians generate creative ideas by listening to a plethora of music, along with a variety of genres. Experimenting with different instruments and sounds helps musicians develop the sounds they want along with expanding the number of instruments they play” (EQ2). Spirit suggested that musicians listen to a wide selection of music to develop ideas and explore different sounds as they add layers. Perhaps the musicians’ listening preferences influence the kind of music they compose. Blue wrote, “I want to create a new wave melody for the R&B artist with a crazy harmony with a nice strong bass and new drum pattern” (Socratic seminar). Owl suggested that a musician’s application of musical elements can evolve current genres and types of music and will affect their compositions (EQ4).

However, instrumentation and style need attention to detail. Mirror wrote, “If I wanted to create a jazzlike track, I would first study the different types of jazz music then learn the instruments” (Socratic seminar). Mirror implied that thoughtful research might be required to get it right. Quill proposed, “I would need to put together the correct sounds and establish certain relationships that make the sounds go smooth together in the upbeat/happy mood I was thinking about creating” (Socratic seminar). Quill recommended that the desired mood could help the composer organize the instruments

and create musical relationships that support the intent. Quill further demonstrated this understanding by providing feedback to Linda Day during her peer-review listening session,

> *Quill:* I like the timing that you used, that everything is well timed. And the sounds you chose worked together and I like the transitions you used from section-to-section. It sounded good.
>
> *Linda Day:* Thank you. (Class Discussion)

Several other students applauded Linda Day's selection and execution of sounds, including Erin Grant, during one of the peer-review critiques: "I feel as if all the instruments that you used went well together" and Owl wrote, "I really like the sounds you put together to create that song. I think it came out AMAZINGGG, I love the beats and the timing you chose" (Owl, Linda Day's PRC). Linda Day provided similar feedback to Owl during her critique and wrote, "I like your work—it is good. I like how you were able to combine a hard rock guitar with the cinematic strings and acoustic (guitar). It is interesting" (Linda Day, Owl's PRC). Erin Grant emphasized a specific sound in her critique to Quill and wrote, "my favorite sounds was the 'vintage lead' that sound made it really good in my opinion" (Quill's PRC). Blair Duff also received positive comments regarding instrumentation of her song as Quill wrote, "I really like the beat of your song—it reminded me of a pop song and I think you used the right instruments because they go well together" (Blair Duff's PRC). As a teacher, I was pleased to read my students' feedback and support for each other while highlighting the composer's strengths that caught their attention. Their responses indicated that they were critically listening to their peers.

Texture

The element of musical texture in relationship to instrumentation also became evident while students composed with GarageBand for iPad. I spoke on texture during direct instruction and wrote in my log,

> Ink referred to texture as smooth or a rough feel. Students shared examples such as monophonic, polyphonic, bi-phonic. I shared with students that most popular songs are homophonic that feature the singer with the melody with chordal accompaniment. Period 2—Jacob Fawn told us texture is the layers of sounds and how they interact with one another. (TL10)

Many students used texture during peer-review listening sessions as topic for discussion. After listening to Blade's composition, Blue wrote, "The beat is really good, I love how everything lay on the same path; no beat is stepping over each other" (Blade's PRC). Blade wrote a homophonic piece. Blue realized this and stressed how the accompanying parts supported the melody. Jacob Fawn also highlighted Blade's use of texture when he wrote, "The intro sound really nice; it had really nice lead-up" (Blades PRC). Blade started his piece with an arpeggiated piano pattern before introducing the melody and other supportive layers. Jacob Fawn appreciated Blade's techniques of layering parts from a thin to dense texture. Corey White also used a similar layering method with an introduction that featured melody played by a synth with a long bass drone that created a bi-phonic texture (Corey White's peer-review listening session). Blue wrote, "I like how it started really slow, and after like 20 seconds, the beat drop—it sounds really organized" (Corey White's PRC). Corey White used texture to create momentum for her music, which her peers noticed during her listening session. Blue's music used a call-and-response-like technique featuring independent piano and bass lines playing off each other

in a quick manner. However, Blue contrasted the piano and bass line with a smooth, long, and connected string part in the upper register. Mirror applauded Blue's technique:

> *Mirror:* The bass is short and choppy and the strings are long. They complement each other.
>
> Corey White expressed agreement with Mirror.
>
> *Mr. Sabet:* Big improvement over your last project. Good job! (Blue's peer-review listening session, class discussion)

Additionally, many students like Jacob Fawn and Linda Day, requested my help through our GB Check-ins in selecting instruments that worked well together for the style or mood they sought (GB check-in, W1-W2). Their responses helped guide my feedback to students during independent student practice when I was listening to student work (TL10-20). I provided feedback to Linda Day as described:

> I listened to her project, and she is writing a mellow ballad pop song. Great use of piano, drums, synths, and effects. I suggested quantizing the rhythm of several instruments to improve rhythmic accuracy. I showed her how to use automation to create fade-ins of different tracks. She had an electric guitar part that I suggested she change to an acoustic guitar because it could support the style more. (TL15)

In this case, we highlighted the instrumentation that was working well, but I recommended that she try the acoustic guitar instead of electric because of the style she wanted.

Form

Form was another leading musical element that students considered to create their music. Spirit reported that form could grab the listener's attention (Socratic seminar). Spirit informed the class verbally how students could organize their projects into sections using GarageBand. She later demonstrated to the class this feature by pointing to their location in GarageBand's tool bar (TL9). In a later class session, Spirit showed me,

during independent practice, defined A and B sections and we discussed techniques to improve the project,

> Spirit—she is doing great work and has a defined A and B section. However, her A section is a little too dense with layers. She said she is going to clean that up. I suggested that she also take some layers out and she asked how to remove parts of a track. I showed her to split 2 bars out from a few tracks and delete so it's only a beating kick drum. This could help set up her next section. (TL15)

From the teacher's perspective, it was easier to provide creative feedback to students when they understood the musical elements they were working with. Spirit needed to improve the focus of the A section, which she did by removing some layers. Ink had a similar experience as well. Ink created a project in ternary form (ABA) with a defined rhythm section of guitar, bass, and drums, but she lacked a melody on the B section, which she later created as result of our conversation (TL15). In the end, Ink expressed how satisfied she was with the ABA form she used to organize her music (self-assessment). Chord created a project in binary (AB) form; however, she needed to develop a cohesive transition between the two different ideas (TL18). Chord ultimately created her song with clear, distinct sections that were easier to define. Blair Duff created her project in ABA form, and I noticed that her B section had an extra bar that affected the timing before the return of the A section. I recommended that she remove this bar, and she agreed that the result sounded more cohesive (TL17). Knowing about the musical element of form assisted students in creating their compositions because they understood how form can help organize ideas, and GarageBand became the tool for implementing them.

Additionally, students used musical form by providing feedback throughout peer-review listening sessions in written and verbal critiques. Ink received positive feedback on her use of form in her project,

> *Jacket:* I like how its organized. I can tell what form it was.
>
> *Ink:* Thank you.
>
> *Mr. Sabet:* What form do you think it is?
>
> *Jacket:* It's ABA.
>
> *Mr. Sabet:* Excellent. I agree with that. [Speaking to Ink] You did an excellent job of differentiating the sections. It was clearly ABA, and what I liked about it, it was an obvious change, the mood changed. Her B section sounded brighter than the A section and a big improvement over your last project. (Ink's peer-review listening session, class discussion)

Quill noticed Ink's ABA form as well but offered feedback to improve the project's form, "creating a transition can help, but the sounds you chose to go together are really good since they complement each other" (Quill, Ink's PRC). Students' use of transitions also helped to support form. Chord wrote regarding Marcus Skye's project, "The transition towards the beginning and middle part was really good, it was a different sound from the rest" (Marcus Skye's PRC). Owl also applied ABA form for her project and received positive feedback as well. Quill wrote, "I liked how there was a clear form represented, (ABA), and I liked the one really small track you added to create the ending instead of just ending with the A section" (Quill, Owl's PRC). Quill noticed how Owl modified the recap of A to make a formal ending. Jacket noticed how Owl used contrasting moods in her sections and wrote, "I like how it's organized and how you can tell the form of the song, and the middle is what I like the most because it's more relaxing" (Jacket, Owl's PRC). Students showed that they understood several of their classmates' use of form

because they identified specific details from their compositions, which to me, evidenced learning.

Melody

Melody was another element that students used to create their compositions using GarageBand. Students created melodies using GarageBand's instruments and features. Owl suggested that many musicians think of a melody in their head and then have it played on an instrument (EQ2) or improvise an idea to create a melody by experimenting (Socratic seminar). Brian Nolan preferred to start his music with a melody before adding elements (Socratic seminar). He found emotions stimulate melodies, and he wrote:

> How can I make a melody? You can use your emotions. Whenever I feel an emotion, depending on how strong I feel, I will hear a melody in my head. It's in your nature, but also because everyone loves music. (Socratic seminar)

Brian Nolan found GarageBand's touch-screen keyboard was helpful to create melodies; he wrote, "I remembered being amazed that I could come up with melodies fast with this app than how long it usually takes me with the piano" (Q5, open response WQ). Brian Nolan created his piano performance by separating his right- and left-hand melodic parts onto separate tracks (listening session, class discussion). This technique gave independent control of the two parts.

Melody became a topic for discussion and critique during peer-review listening sessions. Quill used GarageBand to compose melodies just like Brian Nolan. She used the same melody in both sections; however, I suggested that she shape it differently during the B section to demonstrate some variation (TL17). She took my advice but experimented with the track settings to reverse the part to differentiate the melody in the different sections. Spirit asked Quill during her peer-review listening session, "How did

you come up with this melody?" (Quill's PRC). Quill answered the question by demonstrating the reverse feature in class. It quickly became a focal point during her peer-review listening session because she taught the class how she used this feature to create her melody, and some students were unaware of this feature (TL, peer-review). Blair Duff's project was unique because she chose to put the melody line in the bass part. The melody placement caught the attention of students like Quill, because students were accustomed to hearing the melody played by higher registered instruments (Blair Duff's peer-review listening session). Chord gave Jacob Fawn positive feedback about how he used melody in his project: "I really like the contrast between the bass and the melody and how the bass almost acts like a drum at times" (Jacob Fawn's PRC). I can understand what Chord was describing, because Jacob Fawn wrote his melody in a percussive, short, and choppy sound often associated with the quick decay of some drum sounds.

Glen Cameron was very proud of the melodies he created for his project. He wrote in support of the A grade he deserved, "I played all my tracks myself, and I came out with some interesting melodies and chords. I'm not a pianist, so I had to come out with the piano by just using my ears" (self-assessment). Glen Cameron's prior use of melodic writing featured him singing and recording his original popular songs. Glen Cameron also wrote, "The sounds, melodies I have in my head help me put it into GarageBand" (Q22, open response WQ). The new experience with GarageBand influenced him to compose melodies using the app and helped expand his writing ability. Spirit wrote on her melodic growth as well, "I discovered how I can easily figure out notes to certain melodies on my own along with rhythms" (Q4, open response WQ).

GarageBand for iPad helped students to further understand and define the importance of melody in their own work.

Chords and Harmony

Chords and harmony were additional musical elements that students used to create their music. Students quickly realized GarageBand's capacity with the auto-play chord features in the smart instruments (TL9). The auto-play chord features provide assistive technology to users to help mitigate performance errors. Ink created her bass lines to follow the chord progression of her strings pattern (TL12). Brian Nolan used acoustic guitar chords and corresponding bass root notes to harmonize his featured piano performance of his project (TL13). Brian Nolan wrote, "I think of the melody, then the chords, then combine the two together" (Socratic seminar). Brian Nolan's methods were consistent with his statement and he continued to share more about his process of creating chord progressions: "If I think the chord sounds terrible in my music I will remove it, hear the melody without any chords, think of what matches the melody, and then create some new chords and repeat this process until satisfaction" (Socratic seminar). Linda Day's piece started with a clear four-chord style progression that caught many students' attention. Spirit asked her, "How did you create your chord progression?" Linda Day experimented with several different patterns before solidifying it. Linda Day told the class, "… it took me a lot of time, like I erased a lot of times this to get to there" (Linda Day's peer-review listening session, class discussion). Experimentation and critically listening were important for Linda Day to find the right chord pattern to start her song. Blade experienced a similar process as well when he recorded the chord piano pattern

before layering other supportive instruments in a uniform manner (Blade's Peer-Review Listening Session).

Technology Facilitated the Creative Process

Students used GarageBand for iPad to compose their music and the technology itself assisted students to create their works. The technology helped to establish this theme of incorporating musical elements, technical features, and music production. Furthermore, the aforementioned components are enhanced when they work together during the creation of a project. The technology used can help glue a project together. The technology in this case was the iPad and GarageBand, which afforded students a robust environment for music creation, revising, listening, and sharing with fellow classmates and me. Access to the technology supported the learning process, because it provided immediate feedback for students, allowing them to monitor their progress and assisting them in improving or appreciating their music.

One of the greatest and most obvious conveniences of music technologies is that students can record and immediately listen to their work. Brian Nolan wrote, "Hearing my music through a recording helps find any mistakes quickly because everyone is their own critic" (Socratic seminar). Brian Nolan created his music using the iPad to listen to his work in real-time. This helped pinpoint areas to correct such as wrong notes or rhythmic inaccuracies (peer-review listening session). Linda Day wrote, "When I record something, whatever it is I play it many more times 'til I get to like how it is sounding, or if not, I adjust some ups and downs" (Socratic seminar). Monitoring your work can help to see what you are missing in the listening process (Jacket, Socratic seminar) Cory White wrote:

> I listen back to it and see if it all fits in well together. I like things when they are dramatic, and if something is lacking that balance, then I'll change it a bit. Or if something sounds off I would change it. Just to go back and look over it again. Maybe listen to it three times alone, aloud, and then with headphones. I like to hear if it sounds wide, and very open and realistic. (Socratic seminar)

I liked how Corey White distinguished listening back in different environments such as headphones, out loud using speakers, or listening to it alone. Most students used only headphones to create their music; however, many students noticed discrepancies between playing back their music on headphones versus the speaker system students used during peer-review listening sessions. Slice offered his perspective on this topic after sharing his music in class:

> *Slice:* I have to say something. It did not sound like that in the headphones. It sounded much neater.
>
> *Mr. Sabet:* That's a good observation. When you work, even professional engineers always have different monitors and headphones to work with. That's one of the limitations of only using one reference [headphones] because you don't get to hear it in a variety [of ways]. Is there anything you could tweak in the mixer?
>
> *Slice:* I feel that the acoustic one [guitar] is too loud. (Slice's peer-review listening session, class discussion)

Corey White suggested that it is best to monitor work with different listening setups because it helps to balance levels. Slice realized this situation firsthand, and Ink reinforced it by writing, "Listen to your work with and without headphones" (Ink, Slice's PRC). Listening to a composition with various monitor setups (headphones, speakers, etc.) can go a long way toward helping students achieve the right balance.

Tools, instruments, and features in GarageBand also helped students develop their creative process. After listening to Quill's music, Ink asked, "What track did you make first, and how did you determine your sound afterward" (Quill's PRC). I especially

appreciated Ink's insightful question, because it directed students to think about their choices and processes. Brian Nolan gave specific feedback about how GarageBand benefitted him: "I realize that this app allows me to make balanced layered music different than me just using my piano" (Q4, open response WQ). Spirit also used a similar approach and wrote, "It helps organize work with layering" (Q21, open response WQ). GarageBand's tools influenced the way students thought about their work such as organization and instrumental choices.

Instrument choices from the GarageBand sound library facilitated the creative process as well. Brian Nolan experimented with other instruments such as guitars, strings, and bass for the first time and stretched his instrumentation skills. Spirit's previous writings used only loops, but composing with GarageBand brought other instruments to her attention. Glen Cameron also grew as a musician with the help of GarageBand's tools, because accessing instruments like strings, piano, and trumpet influenced him to develop an orchestral piece (Q9, open response WQ). Previously, Glen Cameron had written only singer-songwriter songs featuring vocals and accompanying guitar, and now he began to write instrumental pieces featuring other instruments. Using a program like GarageBand for iPad can help students create music in numerous scenarios because of the access it provides.

GarageBand gave students many options to input their ideas into the program. Students performed on instruments like electric guitar, bass, and electronic keyboard to record and play ideas. Blade followed this method by triggering GarageBand's sound library using a MIDI keyboard to simulate actual instruments for his project (Blade's peer-review listening session). Other students sequenced parts using GarageBand's

virtual instruments and features like Owl did in her work (Owl's peer-review listening session). In some cases, a combination of both methods was used. Marcus Skye directed me to play electric guitar using GarageBand's amp simulations combined with his virtual instruments (Marcus Skye's peer-review listening session, class discussion). The combination of the two contrasting timbres resulted in a compelling sound. Additionally, Alchemy (third-party app) used in tandem with GarageBand's inter-app audio featured the same technique. Students like Corey White and Chord recorded unique synth sounds with the electronic keyboard and demonstrated sound-design processing (peer-review listening sessions).

User-Friendly— "Like App"

Successful use of musical elements, technical features, and production is more efficient with the help of an accessible program. GarageBand for iPad was an effective and user-friendly app for integrating composition with music technology. GarageBand offered my students many features such as auto-play with virtual instruments, loops for students with limited musical experiences, and recording live and MIDI instruments for more advanced students. Additionally, it was a full-service and flexible program as Chord described:

> The GarageBand app gave me the unique experience of being able to make my own music with an infinite amount of settings. I was able to use the instruments already installed in the app as well as Alchemy, which I could connect GarageBand to. I was able to play instruments directly on the app and also record by using an interface which let me use the piano. (Q2, open response WQ)

Regardless of a student's ability or program features, the app was widely received as a user-friendly tool with a quick learning curve. Students adapted well to using the iPad to

create music and responded verbally or in writing that GarageBand was an easy program to use compared to other Digital Audio Workstations (DAWs).

GarageBand for iPad was not the first DAW used during this school year. Previously, my students used Studio One Prime by Presonus, which is an excellent DAW for desktop and laptop computers that provides many software instruments and loops and contains professional editing features and plug-ins. Additionally, it is a free program, which makes integration of music technologies convenient. However, many students found Studio One to be more complicated than GarageBand. I recorded in one of my teacher logs, "Several students indicated that GarageBand was easier to use than Studio One (a previous DAW we with worked with) by a show of hands when asked which program was easier to use" (TL2). GarageBand received many supportive written comments, "It's much easier than Studio One because everything is simplified" (Chord, GB check-in, W1). Ink agreed with Chord and wrote, "I don't like Studio One it's too complicated, and GarageBand is easy" (Q19, open response WQ). Linda Day also shared the easy sentiment and wrote, "That it [GarageBand] is easier than other complex programs like Studio One..." (GB check-in, W2). Slice also favored GarageBand over Studio One, writing, "…overall, it's [a] pretty good app to make your music sound more professional… it's really easy to use, unlike Studio One" (GB check-in, W1). Student reports reinforced my perception that GarageBand is a more user-friendly program than is Studio One, and it is likely to affect my teaching approach because I will likely start with GarageBand before using a program like Studio One in the future.

Students reported that GarageBand gave them user-friendly tools to create their music. Brian Nolan found GarageBand helped him create melodies and layer parts

together, “I like that I can easily layer my songs easier than I ever could on Studio One. I enjoyed using the piano, as it helps me come up with a simple melody fast” (GB check-in, W1). Brian Nolan later reported, “I’m used to using electric keyboard but the app [GarageBand] helps come up with songs faster so that’s good” (Q7, open response WQ). Brian Nolan’s GarageBand experience was especially important to me because previously he only created solo piano music, and this was his first time writing music with other layers and instruments. It is my understanding that the user-friendly environment of GarageBand helped to influence his creative ideas, and I am happy he was able to further his musical abilities.

Other students shared how GarageBand made it easier to create music. Ink wrote, “The GarageBand app that we use in Music Tech, in my opinion, makes everything easier. You can make music from scratch or have a little help with the auto cord option available” (Q2, open response WQ). Ink also reported, “I like that we have control of how we want the instrument to be played” (GB Check-in, W1). Ink’s views showed how GarageBand adapts to your preferences, facilitating the ability to either start with your own ideas or use inspiration provided by the app’s auto-functions. Owl wrote, “it makes it easier to achieve the idea in which you have because the app is user friendly and simplified” (Q12, open response WQ). Chord shared a specific idea in which GarageBand was useful: “Something new I discovered while using GarageBand was that it was easier than Studio One because the fact that I was able to create my own drum or even experiment with different chords gave me more song ideas” (Q4, open response WQ). Chord found the ease of GarageBand helped her discover ideas that she could use in her music. Marcus Skye wrote on GarageBand for iPad, “Think it’s a great tool for

making music" (Q11, open response WQ), and "It provides an easy place to structure music" (Q21, open response WQ). Jacket also found that working with GarageBand helped with organization (Q2, open response WQ). Students' comments shed light on how GarageBand's user-friendly experience can help students initiate ideas, structure, and improve their music in a manner specifically suited to each individual user.

GarageBand's "smart instruments" feature also supported creation of the user-friendly "Like App." Ink wrote, "I like that we have control of how we want the instrument to be played. For example, the app gives us the choice of a chord pattern or playing on the fingerboard [referring to the smart guitar/bass]" (GB check-in, W1). Selecting chord patterns or playing individual notes on the smart instruments gave students like Ink a variety of tools to use when experimenting with various instruments. Quill supported Ink's view of the smart instruments, "I have been really enjoying the fact that is easier to interact with the [smart] instruments since we can basically actually play them on the iPad" (GB check-in, W1). Chord accentuated the user-friendly aspect, "Some benefits are that it made it easier for people who aren't familiar with instruments" (Q11, open response WQ). The taping feature of GarageBand gave participants a virtual experience of playing several instruments like guitar, bass, piano, drums, and strings even if the user did not play any of these actual instruments. Owl wrote, "The GarageBand app was super-user-friendly and helped you play instruments that you may not e[v]en k[n]ow how to play" (Q2, open response WQ). As to sound quality, Mirror wrote, "The instruments that were prerecorded sound amazing, so which gives anyone's work that authentic feeling" (Q2, open response WQ). GarageBand's smart instrument features gave participants access to high-quality-sounding virtual instruments, regardless of their

musical ability, and enabled them to play instruments that might have been physically unavailable to them.

The Music and Production Features theme demonstrated how my students incorporated musical elements into their compositions. These musical elements are likely taught in many music classes across the United States and beyond; however, my study showed how technology can serve as a viable method to apply these elements. Additionally, my students used the technology of the iPad to implement their musical ideas and developed technical and production skills by using many of GarageBand's features. Technology facilitated this process because students simultaneously applied traditional musical content while making meaningful connections with standard music production processes. This Music and Production theme demonstrated that by using music technology to create products, students can expand the role of being a musician.

Theme: Thinking Creatively

The theme of Thinking Creatively included strategies students engaged in to initiate, develop, and refine ideas to complete their musical works from beginning to sharing. I also observed various approaches students used to complete their work. Students drew from life experiences, desired flexibility, engaged in exploration, and used reviewing and editing to create their works. Additionally, students' creative processes were also examined, and technology facilitated this process.

Life Experiences

When asked about where creative ideas come from, the students had many insightful responses focused on life experiences inspiring musical creativity. Students used ordinary life events or experiences as initiating ideas to create music. In some cases,

students displayed their own experiences while others imagined scenarios. Slice wrote, "I think artists make music 'cause something happened in the past so they make their problems into a song" (EQ2). Slice also suggested that the music should be relatable to their listeners, because people often share the same types of experiences (EQ3). Blair Duff had a similar position and wrote, "I think musicians generate creative ideas from what they go through on a daily basis or something they have been through…" (EQ2). Glen Cameron offered that musicians' experiences provide meaning and create an appropriate setting for the music: "Music doesn't just come out of nothing. Music always has a mood and meaning behind it, so when musicians get ideas to create music they get it by experience" (EQ2). Glen Cameron suggested that the artist needs inspiration from life events to create.

Ordinary and everyday occurrences can be sources of inspiration for students. Jacob Fawn wrote, "Personally, I come up with my musical creations by being inspired by what I hear throughout my day, like car horns, laughing, and walking" (EQ2). These sounds or events spontaneously occur around us and can cause students to think of ideas. Linda Day shared Jacob Fawn's ideas as well and wrote that, "…sounds like bells, broken glass, or a motor from a car" can also serve as creative sources (EQ2). Linda Day's and Jacob Fawn's comments evoked environmental or atmospheric sources, and Corey White suggested they can serve as her inspiration

> Through life experiences and things we see. I think that whatever surrounds them inspires them to create something out of their atmosphere. I think this because one cannot just come up with something without anything, meaning imagination cannot come from nowhere—there is always a source. (EQ2)

Life experiences can be found anywhere, including the most ordinary situations to draw inspiration.

Some students drew on raw imagination to develop original concepts. Quill wrote, "I believe that musicians generate creative music ideas by using their imagination. For an example, musicians can put their feelings into music since music, even without words, tells a story and carries out a theme" (EQ2). Linda Day used her imagination to solve a struggle and wrote,

> While thinking about creating a theme or song, first we can look into experience, where you visualize where and when it happens, what … you wanted, and what did not happen. The problem to solve is what will you do for that to not happen again, and that is what you're telling at the end of a song. (Socratic seminar)

I found Linda Day's response enlightening because creating music can be a form of problem-solving based on the creator's conflict/resolution like those that exist in stories. Quill also suggested that the motivation to create a song in particular mood such as happy and upbeat can be a source (Socratic seminar). Brian Nolan stated that imagination and ideas are the result of hard work and emotion that creators put forth in their music (EQ3). These students' responses indicated that life experiences originate from hard work, emotions, moods, and imagination.

Some students used life experiences as a topic for discussion or critique during peer-review listening sessions as well. Brian Nolan wrote, "I enjoyed the remix you did to that song; it sounded like that song we're to play at prom" (Blade's PRC). Blade's ballad-like music communicated a sentimental setting for Brian Nolan. Brian Nolan also found Chord's music to inspire a life experience and wrote,

> I like that it sounds gentle and soft like the wind. I also am fond of the beat you made, because it sounded like something you'd hear in a movie scene where the characters are slow dancing or just dancing slowly in general." (Chord's PRC)

Chord's music evoked imagery and was relatable to Brian Nolan, just like Slice previously mentioned because the music one creates can relate to other listeners. Life

experiences can also include a student's imagination of real-life events that he or she can actually experience, such as a dance, prom, or imaginary scenarios.

Flexibility and Exploration

Students experienced composing with GarageBand within the structured pacing of the class, but with autonomy. The curricular unit featured teacher-led assignments, but students had freedom to complete them with a personalized approach. Students enjoyed their independent time to create music and explore the app's capabilities through student-driven means and engaging in exploratory behavior while learning to use and compose music with GarageBand.

Flexibility influenced much of my instructional pacing. I provided direct instruction during the first 15 minutes of each class throughout the acquisition period (Weeks 1 & 2) of my study. My expectation was that students would apply my direct instruction techniques during their independent practice time. While many students adhered to this expectation, I noticed others preferring to work in a self-directed approach, exploring components of the program not part of my focus lesson. Some students were taking self-directed learning further by going beyond what I planned for them to explore. I embraced this activity because students were curious in making their own connections with GarageBand and accepted this as a natural part of their learning. I reflected in one of my teacher's logs:

> I'm finding many students in both classes prefer to work in a self-directed manner (Erin Grant, Spirit, Corey White, Jacob Fawn, and Marcus Skye). I found myself wanting to explore the program when working with music technologies myself. I will permit this behavior, although I want all students to get the same information before we enter the composition phase of the study. (TL6)

I could relate to their experience because engaging in new activities and learning prompts curiosity, which, I believe, is an advantage. Despite my findings of their practice, I continued to provide direct instruction as planned; however, I also encouraged independent practice time for students to discover GarageBand on their own naturally.

Many of my students' comments and behaviors supported the flexible attitude. Jacob Fawn wrote, "When I am learning something new I tend to stay away from instruction and try to learn on my own" (EQ1). Erin Grant shared the same attitude:

> I like to learn new things, but I rather learn it myself than have it taught to me. It makes it easier for me to use instead of someone explaining it to me. So when I teach and learn for myself, I find it much easier to use. (EQ1)

Both Erin Grant and Jacob Fawn found that a teacher's explanation of material can be confusing and preferred to discover content on their own. This approach may permit students to have an original outcome, because some students benefitted by having options (Blair Duff, Q19, open response WQ). Glen Cameron wrote, "I discovered that I have the ability to set my mind free and just create what I hear and feel" (Q4, open response WQ). Some students found their own intuition to best guide them in their work.

The flexible nature of the class enabled the students to find the approach to composition that worked best for them. Brian Nolan wrote, "I experimented with the different instruments until I found one that best suited my taste and music style" (Q3, open response WQ). Brian Nolan and Glen Cameron's attitudes likely contributed to student reflections from peer-review listening sessions. Slice wrote, "I like how everyone [h]as the same instruments, but they made it their own style" (Slice, Q7, open response WQ). Slice's response indicated that while students all had access to the same tools, they developed their own methods. Another insightful comment came from Spirit, "I like

seeing the styles other students come up with that don't exactly match their personalities" (Q7, open response WQ). I thought both Spirit and Slice demonstrated an open mind listening to their peer's music that our environment fostered.

Many students appreciated the flexible approach mobile learning permits. Several students responded favorably to creating music with a portable tool. Glen Cameron wrote, "It's really awesome because you can take an iPad anywhere and create music anywhere" (Q11, open response WQ). Linda Day agreed and discovered benefits of using GarageBand for iPad: "It's good and you can take it with you whenever you want" (Q11, open response WQ). Students like Glen Cameron, Corey White, and Linda Day asked to take their iPads home to work on their projects. The mobility of the iPad afforded students the opportunity of creating music outside of class, something that is not practical with desktop devices (TL10-20).

The flexible environment provided students with opportunities for them to explore; which likely fostered the emergence of exploration. Students discovered various qualities while composing music with GarageBand for iPad. Quill wrote, "The GarageBand app is more complex than it seems, which is a good thing. Once you explore the app you find so many different features that can help create different outcomes" (Q2, open response WQ). It is likely that flexibility had a role in students' experimental behavior throughout the unit. In many cases, students found features not originally taught and made creative use of these features in their work.

From the beginning stages of the unit, students' curiosity led them to search the app's unique features for themselves (TL1). Early on in the unit, some students discovered GarageBand's sampler instrument and began creating patterns, although I had

not taught them this feature yet (TL2). Additionally, many students such as Corey White, Glen Cameron, and Erin Grant already played instruments and wanted to record their instruments directly into the iPad even though we had not arrived at that stage (TL3). I quickly updated my plans to accommodate their demands by providing interfaces and adaptors for recording (TL4). Through exploration students also discovered a number of GarageBand's many features on their own. I was impressed with Slice's exploratory behaviors of experimenting with an instrument's velocity,

> I asked Slice how he was doing with GB. He told me that it was fun, creative, and provided more options than previous programs. Later in the class, Slice showed me how he was using editing features such as changing the velocity even though I did not teach this aspect yet. (TL4)

Students used exploration to learn relevant content on their own, which indicated to me students can handle the responsibility of independent learning.

Another example of exploratory behavior was what Jacob Fawn and Marcus Skye found using the jam session feature in GarageBand. They taught me that with jam session, users could link their iPads together at the same time for collaboration (TL6). This feature can provide students with exciting ways to be creative and was another technique that I did not teach during the unit. I was especially impressed with Jacob Fawn and Marcus Skye's divergence because they taught me how to use GarageBand in a new way that will likely influence how I teach GarageBand in the future.

Exploration also led students to teach their findings to their classmates. Glen Cameron's project was the only one that featured brass instruments and he taught the class how he found the trumpet sound using the *other* sounds menu from the keyboard instrument (Glen Cameron's peer-review listening session, class discussion). The *other* menu gave him access to many different sounds, such as glockenspiel, clarinet, flute, etc.,

and is triggered by the touch-screen keyboard instrument. However, access to these instruments can be elusive to many because they are not easily found. Glen Cameron's trumpet sound caught the attention of his peers, including Chord, who wrote, "I really like the horns you used—it complements every other track" (Glen Cameron's PRC). Blade appreciated this technique as well and wrote, "I discovered how I [can] add trumpet and other instruments in the program GarageBand" (Q4, open response WQ). I was especially happy to see Glen Cameron teach his discovery to his peers, so they could use these sounds in future projects.

Other students shared features they found through discovery. Spirit taught the class how she created reverb effects for her song using her merge technique (Spirit's peer-review listening session, class discussion) and Corey White demonstrated how she created sliding effects using the *pitch* feature of the synth keyboards (Corey White's peer-review listening session, class discussion). Mirror approached his music in an unorthodox manner because he purposely put his drum sounds out-of-time with the rest of his instrumentation because he wanted to try "something different," and his peers noticed his technique (Mirror's peer-review listening session). Their discoveries resulted in unique ways to develop creative outcomes with a personalized touch.

Students reported experimentation is necessary to create their music, especially when they are deciding what works for them. Quill raised an important point about access to instruments because with GarageBand, "[You] can interact with instruments you've never used before" (Q21, open response WQ). Naturally, curiosity was likely to develop. Blair Duff wrote, "I think that I can actually create many different sets of music, just by messing around with the different instruments and seeing which ones I'd like to keep

together and if they complement each other" (Socratic seminar). Spirit wrote, "Experimenting with different instruments and sounds help musicians develop the sounds they want…" (EQ2). Marcus Skye reported, "Musicians just play with their instruments until they find inspiration for a song" (EQ2). Brian Nolan shared the same attitude after creating his music and wrote, "I experimented with the different instruments until I found one that best suited my taste and music style" (Q10, open response WQ). Owl shared similar attitudes by experimenting to create the viola melody she used in her song (Socratic seminar). Exploration of sounds is an essential component of music making because it allows the artists to discover new possibilities. Marcus Skye experimented with various settings of his synth instruments rather than stick with presets to design his unique sound (TL14). Like Marcus Skye, Chord abandoned presets in favor of adjusting dials to find her sultry keyboard sound (Chord's peer-review listening session, class discussion). Composing with GarageBand for iPad provided many students with enriching discoveries from their explorations that influenced their works.

Reviewing and Editing

Students used the process of reviewing and editing while composing using GarageBand for iPad. Creating music is an ongoing process that requires attention to detail that undergoes numerous changes. Much of this practice requires the creator to think critically about their work's strengths and weaknesses. Making original music demands refinement and often goes through several drafts before someone can say, "I'm finished." Reviewing and editing is an important component of thinking and creativity because it became a part of their creative process.

Students often began their compositions with an initial idea to make a first version or draft of their composition (Erin Grant, Socratic seminar). To create a first draft, Chord wrote, “Musicians make creative decisions by starting small and then building on it” (EQ3). Chord implied that composers start with a musical theme or other musical idea and then add other layers or ideas. Chord also suggested that it is best to start with chords and melody (Socratic seminar). This process unfolds as Quill noted, “[it] started with one idea and transformed that into something more complex” (Socratic seminar).

Addition is often a big part of the process because as Jacket pointed out, “You should go over and over and see what [you] could be missing in your song” (Socratic seminar). However, subtraction can also be just as important, Blair Duff wrote, “…taking out some [ideas] can also help” (Socratic seminar). Revising your music is likely a combination of reviewing work to see what needs to be added or removed, as Linda Day noticed: “By cleaning up mistakes, analyzing their work many times, search for little part where they can add or erase something, even though it’s little it would make a big difference” (EQ4). Adding or removing ideas is an important part of the revision process because it requires students to think about the focal point of their work.

Ideas also need to be balanced throughout the work. The goal is to get the work finished as Linda Day responded that the song is completed and, “It is ready to share when you had reviewed all your points. Every section of the song and it has to contain the basics, like the high, mid, and low [frequencies]” (EQ5). I especially appreciated how Linda Day identified the importance of balancing the frequency spectrum in her response because it pointed out a specific detail to consider when editing.

Many students paid close attention to fixing mistakes and cleaning problem areas, Brian Nolan wrote, “Musicians must review their work until they find any mistakes and repeat the process until they think it sounds perfect” (EQ4). Searching for perfection can be a daunting task as Quill wrote, “I always make sure to revise everything I create to make sure it matches with my initial thoughts and to see if there is anything I need to improve, most of the times there is something to improve” (Socratic seminar). Furthermore, Quill made two strong points. The first point is that revisions are consistent with the initial ideas of the work, perhaps to maintain focus, and the second point is that the work always needs some sort of improvement. Spirit wrote, “Whenever I create a song I revise it and change it, instead of just cutting out the aspect I don’t like about a song, I edit it to my liking” (Socratic seminar). Spirit’s technique is unique because many students may prematurely abandon a good idea rather than spending extra time to sculpt it to the creator’s preference. This indicates Spirit has developed a mature attitude toward the revision process.

Students also reported that sharing work with others is a helpful part of editing and revision because others can help you think of ways to improve your music (Blade, Socratic seminar). Linda Day wrote, “I do share it [with] one person to know if as [an] audience they get the feeling or idea” (Socratic seminar). Having others listen to your music can help you to be objective about your work as Chord pointed out, “They have to listen to their music from another perspective and be open minded about it. Approaching your music from new angles is always challenging but trying new things helps add a diversity to the music” (EQ4). Sharing music with others can help students solidify their work.

Ink wrote regarding receiving feedback from others, "[is] a benefit is that people can see mistakes that you don't and help you fix them" (Q25, open response WQ). Brian Nolan gave Jacob Fawn feedback to make his work sound less repetitive and wrote, "I think if you added a different verse for the ending it would sound improved so it's not repeating itself till the end" (Jacob Fawn's PRC). I agreed with Brian Nolan's observation, because Jacob Fawn's project only had one section and could have benefitted by adding another contrasting idea. Linda Day gave Spirit some insightful feedback: "Maybe it would be good if she concentrated one or two tracks, so people can focus…" (Spirit's PRC). Spirit's project was crowded with many dominant layers; she could have focused more on a primary theme with other supportive ideas instead of having several ideas fighting for space. Glen Cameron provided Corey White with some great feedback to develop her composition's sections and wrote, "Everything is good, but I think you should let the intro grow into the big part. It was just not enough—it should creep on us" (Corey White's peer-review critique). Corey White's piece featured a beautiful intro but moved quickly to an upbeat section that may have seemed abrupt. I think Glen Cameron's suggestion could have helped Corey White to think of transitioning ideas to make her sections more cohesive. Blair Duff asked Owl after her listening session, "If you had more time to work on this, what would you add or remove/change?" (Owl's PRC). Blair Duff's question to Owl can prompt her to think critically after sharing her music with others for further improvements. Brian Nolan adopted this approach after his peer-review listening session so he could fix the piano timing and some wrong notes because he realized he had some work to do (Brian Nolan's peer-review listening session, class discussion).

I also gave feedback to students while they composed with GarageBand that assisted in their revisions. As Chord wrote, “At this time I can expect critique and advice from others to gain an outside perspective” (Socratic seminar). Slice began his project with a cohesive guitar chord progression. However, his accompanying bass and string patterns clashed with the progression’s root notes. It sounded messy, and I helped him align it so they worked together (TL8). Marcus Skye needed help with his melody, but he added another layer that bore similarities regarding pitch and duration. I suggested that he contrast the higher staccato melody with a deep bass line with long notes instead of the other melodic idea. Quill, Linda Day, and Corey White also benefitted from similar feedback regarding register, as well as from the suggestion to balance the registers of their works (TL10-13, 17). Several students like Linda Day, Ink, and Blair Duff needed help to improve the rhythmic accuracy of their instruments; I recommended they revise their work using quantization (TL15-16). Reviewing and editing is labor-intensive and requires careful attention to detail to identify the corrections needed; this process is usually unique to each individual.

Composer Happy

Many participants reported the need to be fully satisfied with their music or *composer happy* before sharing their music for others to review. Based on participants’ personal reports and experiences during the curricular unit, my participants are most comfortable sharing and presenting their music when they are happy with their work. Brian Nolan’s comments provided a supportive perspective and wrote, “If you don’t like it [your music], neither will most of your audience” (EQ2). Composer happiness or satisfaction with one’s music can influence how one thinks about the creative process.

Students were required to share their music with peers as part of the curricular unit and interesting views emerged as a result. As I noted in a teacher log, “Spirit asked me how long does the project need to be? I said, ‘There is no time limit required. You need to ask yourself, do you feel it is complete? Have you created something you are proud of?’” (TL13). My response to Spirit’s question was to promote a student-centered approach to allow her to explore the parameters for herself. Chord wrote, “A creative work is ready to share when the creator feels that they have done everything they can to optimize the quality of their work” (EQ5). Chord’s response stimulates the creators to ask themselves, ‘Have I done everything I can to make my music the best it can be?’ Often times, the creator will know when they have met that mark. Marcus Skye wrote, “creative work is ready when producer feels it’s at its best quality” (EQ5); this also connects to Chord’s statement. Jacob Fawn wrote, “I feel as though creative work should be released to the public when the creator is truly happy with it, not when other people are happy with it” (EQ5). Jacob Fawn’s comment suggested the composer’s need to account for his or her own satisfaction and not what others may think before sharing.

Another student, Quill, offered an insightful and detailed response that incorporated several noteworthy ideas:

> A creative work is ready to be shared when the person creating the work is happy with the end product. This means that the person has reviewed their work and fixed most mistakes. When you share something, it’s usually because you’re proud to show what you have created. Therefore, something you show to someone is something you worked really hard on. (EQ5)

Quill’s response included many points including an appreciation for hard work, reviewing, and editing, and the desire to share the creator’s experience with others. The end product is the result of hard work, attention to detail, and satisfaction. Blue wrote that

> when you are done with everything and [you are] ready to share with an audience you know for fact your beat is fire. [W]hen the producer [has] the confiden[ce] that what was really an amazing work and he's done with everything that he needed to add into his activity. (Blue, EQ5)

Blue's comment suggested confidence as part of their satisfaction with an eagerness to share their work with others. Another student expressed that she would not like to share her work with others unless it was ready and wrote, "Share?.. probably not unless I feel comfortable" (Ink, Socratic seminar). While participants articulated their views differently, most indicated they are most ready to share their work when they feel satisfied, confident, or proud to have others listen to their music.

While requirements support instruction in many cases, student-centered or student-developed parameters may be more appropriate during assignments where the students are expected to be creative. Student-centered approaches acknowledge students' voice in creating a work that pleases themselves first before satisfying requirements set forth by others, including their teachers. As a teacher, I want all students to be happy with and proud of the work they create instead of striving only to satisfy requirements that are dictated to them. This is especially important when they share their work or music with others for the purposes of both enjoyment and learning. I believe they will be able to apply themselves more effectively when they are investing personal ownership in their work.

Empowerment

On many occasions, students, often without a strong musical background, created music they were proud of and realized they are skilled composers. Based on comments by students, empowerment is defined as newly discovered confidence in creating and sharing music using technology with new possibilities in a supportive classroom

environment. During this instructional unit, I observed students reporting they can be creative and musical even with limited ability. Composing with GarageBand for iPad was a positive experience for most students, who shared their personal thoughts on growth, learning, and passion that enabled them to create music. Empowering thoughts help fuel creative potential and thinking about their creative process.

From the beginning stages, students expressed enthusiasm about creating music and learning GarageBand. Blue wrote, “I feel different, open-minded and happy because when it comes to music I love working on new things and learning things that I didn't know” (EQ1). Glen Cameron wrote, “I feel excited to learn new things and go through a new experience. Doing something new and love will make me want to push myself and improve so I can be better in the future” (EQ1). Similarly, Blade expressed happiness in his response, “I feel good, when I’m doing something new because, it is that I like to do. Also, when I’m learning something I feel so very happy. Because I love that…” (Blade, EQ1). Blade, Blue, and Glen Cameron embraced learning GarageBand with optimism, a willingness for exploration, and a positivity the helped propel them to a successful unit.

Many students expressed working with GarageBand empowered them to realize they can create great music. Quill wrote, “A triumph I experienced during the class is realizing I could actually make a good project” (Q5, open response WQ), and “I didn’t know anything at all about creating music. I have learned a lot and realized it was actually fun” (Q8, open response WQ). Slice shared Quill’s experience and wrote, “I felt like I couldn’t do it like honestly I didn’t know anything about music and now I feel confident” (Slice, Q8, open response WQ). Both Quill and Slice did not have previous music composition experience but undertook it with confidence and enjoyment because

they were given proper support. Linda Day wrote that composing with GarageBand equipped her to be creative, stating, “I like myself as a musician I feel I can create a lot with the tools I have now” (Q9, open response WQ). Blair Duff found a similar position and wrote, “I thought I wouldn’t be able to put certain instruments together, and I did” (Q8, open response WQ). Ink summarized this empowering sentiment with, “I always knew that with the right tools, programs, etc., that I could make good music and now I have those tools” (Q4, open response WQ). Composing with GarageBand provided students with the necessary tools that stimulated their composition skills to emerge and facilitated this process encouraging more composition opportunities with technology in the future (Chord, Q16, open response WQ).

Students’ newly founded abilities prompted them to think of future prospects and roles as well. Quill reflected on this experience about related careers in music production and wrote, “It gives me an idea of how a certain job in the music industry might feel” (Q9 open response WQ). Blue wrote as result of him creating original music, “I could be a producer and a recording artist” (Q9, open response WQ), and Spirit wrote, “I never thought of or considered ever creating music before this class but maybe in the future I could because the college I got accepted also has music branches in their arts programs and works with technology heavily” (Q8, open response WQ). This experience made students like Spirit think of continuing with music technology classes down the road. Other students shared many of these attitudes as well, Glen Cameron reflected on the possibilities ahead as a result of this empowering experience,

> My ability as a musician grew. I’m not a pianist and I’ve never composed an orchestrated [piece] and to do this by just listening and feeling made me realize that if I keep on working with this talent I can be bigger than you think. (Q9, open response WQ)

Glen Cameron continued to reflect on his new abilities,

> I think an A because my project had a lot going on, especially with the piano. While working on this project I had to use them [in the] iStudio [workstation]. I played all my tracks myself and I came out with some interesting melodies and chords. I'm not a pianist, so I had to come out with the piano by just using my ears. This was kind of a challenge for me. I also challenged myself to do something new which composes an orchestrated piece. I've written/composed songs and composed a guitar piece, but never an orchestrated piece. I pushed myself and challenged myself. This is why I think I deserve an A. (GB self-assessment)

Glen Cameron stated that composing with GarageBand helped him develop the musical skills he desired but did not already possess such as piano skills and composing orchestral styled works.

Empowerment was not only limited to music and creativity but also communication and teaching skills. Several of my students exhibited these skills during presentations and reflections. Spirit wrote about the qualities she shared about her work during her peer-review session,

> I deserve at most a B+ for presentation because I was able to answer and demonstrate everyone's questions correctly about my techniques and basically gave a tutorial. I also explained how most of my patterns originally came from loops that I replayed myself on the piano and that my sound effects came from loops as well. (GB self-assessment)

Spirit demonstrated how she created different audio files and used production techniques like effects to create the sound she sought, and I applauded her during her peer-review session because she navigated through GarageBand with ease in front of her peers while she explained how she used the program (Spirit's peer-review listening session, class discussion). Other students like Quill, Corey White, and Chord experienced similar triumphs during peer-review sessions as well.

Corey White wrote, “I think my presentation can be at least an A because I believe I was able to answer and explain the questions that were given to me smoothly” (GB self-assessment). Many students were captivated by the legato melody created in her introduction. Corey White taught and demonstrated to the class how she used the pitch setting of the keyboard instrument to create a gliding (glissando) effect to the melody she created (Corey White, peer-review listening session, class discussion). Another student, Chord, revealed the same qualities as Corey White when she taught the class how she dialed in the right setting for one of her instruments. Below is the transcript,

> *Corey White:* The second track you have is a bass line.
>
> *Chord:* yeah
>
> *Corey White:* So how did you make that bass line so round?
>
> *Chord:* So the name of the synthesizer on this was smooth jazz, so basically I, so all the settings that it had, I just turned up so it had that sultry sound.” (Chord’s peer-review listening session, class discussion)

Chord later reflected that she deserved an A for her project because she explained how she shaped various sounds in her music to her peers (GB self-assessment). Students sharing their music became an empowering experience not only for the work they created but also for the communication skills; they demonstrated when they explained their musical techniques. This became more apparent during reflective segments of the unit.

The Thinking Creatively theme communicated how my students grasped the creative process. Students borrowed from life experiences as sources of inspiration but also found new ideas through exploration and discovering options through experimentation. A flexible environment is also beneficial because it promotes students to seek out their own possibilities. Students also realized that their work requires

refinement and editing to convey their best ideas. Additionally, for many students being creative became an empowering realization because my students recognized that composing music was well within their reach and expanded their potential. Therefore, composing music is more than a creative product but a process that encourages students to participate in many different experiences.

Theme: Instructional Roadblocks

The Instructional Roadblocks theme captured obstacles encountered by both participants and me throughout the instructional unit. Topics included in this overall theme include dislike app, challenging learning experiences, and presenting challenges. The factor dislike app emerged from participants who found GarageBand's features to be out of favor or lacking some advanced features they wanted. Challenging learning experiences recognized difficulties contained within in the instructional unit which at times involved redirection. Finally, presenting challenges, identified problems participants experienced when sharing their music with others to listen and review.

"Dislike App"

Although most students overall enjoyed the app, GarageBand for iPad had some challenges. GarageBand lacked some advanced technical features and the iPad screen size presented a challenge for some users, while other participants disliked the app for specific technical reasons. Some participants expressed a desire to use advanced features not available in our version of GarageBand or noted other challenges with the iPad hardware. This section will share many of these items.

Unfortunately, the school-owned iPads (Apple Version 3 with iOS 9.3.5 software) did not support the latest version of GarageBand (2.3.3). We were limited to the 2.1.1

version which lacked some powerful features many students would have enjoyed. One technical feature absent was Alchemy synth from the keyboard instrument. To work around this, I taught students to use the inter-audio app feature to connect the Alchemy standalone app to work with GarageBand. However, during recording, it tracked as an audio file not as a MIDI file, which created editing problems for some users. Chord wrote:

> A challenge I had was the fact that Alchemy [inter-audio app] tracks couldn't be edited the same way other instruments in the app could be edited so I had to record over and over until my tracks matched the 95 BPM tempo. (Q6, open response WQ)

Chord enjoyed the Alchemy app because of its sound quality and flexibility but expressed frustration editing her recordings (peer-review, in-class discussion). If Chord had had access to the latest version of GarageBand, her performance issues would have been easier to correct.

Another limitation related to the sounds available. Blair Duff wrote, "I wish there were more options to the different sounds" (GB check-in, W1). Spirit expressed a similar sentiment because although GarageBand offered her many sounds they left her feeling unfulfilled at times (Q13, open response WQ). The latest version of GarageBand provides users with more options such as world instruments, a sound library, live loops, and DJ mixing and effects. The options and sounds in the latest version could have possibly satisfied students like Blair Duff and Spirit.

Another technical problem was that GarageBand recording defaults to an 8-bar limit per section. Many students did not know how to change the default; Ink wrote, "...not being able to record more than 8 bars at a time is a little upsetting because sometimes I might record something I like that's over the eight bars and it doesn't

actually record" (GB check-in, W1). Jacket and Brian Nolan also agreed with Ink in regard to recording (check-in, W1). Brian Nolan wrote, "It was extremely difficult recording on this app because when I recorded a continued piece the sections behind it were deleted so that was mess" (Q13, open response WQ). Although the recording setting could be changed, it confused many students because this feature did not exist with previously used programs like Studio One; as a result, students experienced technical difficulties that I later addressed or corrected.

Corey White wrote a piece of music featuring meter changes. She started her composition in 6/8 and then moved to 4/4. While GarageBand supports different meters, it does not allow her to change meters within the same project. She attempted to work around this limitation and wrote,

> For the piano part, I had to change the time signature. Which means, I changed the beat that it falls in because if I did not do that then it sound[s] off. And I can't do that in GarageBand, I can't change the time signature [mid-way through] so I tried to blend it in so that's why the piano part sounds a little bit off from the beginning. (Peer-review in-class discussion)

While Corey White did an excellent job of transitioning the meter change on her own, aligning the meter change within the project would have been more appropriate for her music. Marcus Skye experienced another technical limitation with automated panning; GarageBand only supported automation for volume and wrote, "I had a lot of challenges using automation [of panning] but in the end it worked out fine" (Q6, open response WQ). Marcus Skye worked around this obstacle by duplicating the same part and assigning it to two different tracks. He then panned one hard left and the other hard right to create the mix he wanted. Notably, I was impressed to see both Marcus Skye and Corey White use this challenge as an opportunity to learn a viable workaround.

While the smart instruments with the auto-play feature received a lot of positive support from many students, others found them to be unoriginal. Spirit wrote,

> What I like least when working with GarageBand is how limited I feel when playing instruments like the piano, or how all the notes and the rhythms are mostly determined by the app by itself. Sometimes it just feels like a lot of hand-holding … (GB check-in, W1)

Owl shared a similar view and wrote, "I think that it's okay but like it does the work for you so it's not as creative or a challenge" (Q11, open response WQ). Linda Day found the auto-play feature could be limiting as well because, "…if you don't know how to play the instruments it just stays the same…" (GB check-in, W2). Jacket actually preferred to work with loops to instruments and wrote, "The least thing I like working with GarageBand is the auto play on GarageBand, [there] should have been more loops" (GB check-in, W1). Some participants found the auto-play feature could do all the work for them leaving them unfulfilled or less creative.

Some participants complained about general technical qualities on GarageBand and the iPad. Erin Grant and Marcus Skye disliked the graphic user interface of GarageBand (GB check-in) although they did not give specific reasons. Brian Nolan complained that he thought the sounds were too digital sounding and wrote, "…this digital stuff has never satisfied me" (GB check-in, W1). Many participants thought editing was difficult as well. Jacob Fawn wrote, "The way you have to edit tracks I would appreciate to be able to edit tracks on a laptop rather than a touch screen" (GB check-in W1). Chord thought editing on a laptop or desktop would be easier as well (GB check-in, W1). Blade wrote, "…when I need to use the all piano I can't because the tablet screen is small to have all notes on the piano…" (GB check-in, W2). Unfortunately, the iPad can only give the user a limited range of notes at a time and on occasion Blade wanted to use

notes outside the available range. Corey White complained that connecting external MIDI instruments such as a keyboard were more problematic than taping the virtual instrument on iPad's screen (GB check-in, W1). Connecting external MIDI compatible instruments was possible and used in this unit, however it did require a docking station or other interface to be successful.

From my perspective, students experienced normal problems associated with learning a new program to use it to its potential. Despite some dislikes or problems with GarageBand for iPad, 17 out of 18 participants completed their compositions and presented their work to the class. This outcome indicated that the program enabled the majority of users to complete a project and share with their peers. So, even in the face of some dislike statements, GarageBand for iPad was a constructive program for creating music.

Challenging Learning Experiences

Teaching a technology-dependent instructional unit was a big challenge. Technical and classroom management problems arose throughout the unit to varying levels. Although no challenge impeded the overall success, I had to redirect and correct problems regularly, which at times involved lengthy solutions or workarounds. Additionally, my students experienced challenges during the instructional unit that necessitated other attention.

Management of the iPads was troublesome because of organizational issues. All iPads were numbered and stored in order in the iPad cart. Each student received an assigned iPad at the beginning of the unit, which they were required to return to its appropriate slot to recharge. On many occasions, iPads were not returned properly, were

mixed up, or were not connected to the charger. Although this improved as the unit progressed, I had to verify daily that the iPads were organized and charged before leaving for the day. This was critical because I wanted to ensure all students had a fully functional iPad to use the following day. Although I did this daily, a couple of iPads still had problems holding a charge or refused to charge all together. I wrote,

> Despite being plugged into the iPad cart, some iPads are not charging well. Although this was not a sustained problem because I had available portable chargers and the MIDI docking station also powers the iPads. I realize the ongoing importance that portable devices are always powered on when needed and failure to do so or anticipate problems can ruin a student's daily experiences. (TL7)

I mitigated this problem by keeping wall chargers and USB cables handy. In addition, two tablets needed updates to the most recent compatible version of GarageBand, and those individuals received backup iPads to use during the interim. I did update their iPads on the second day of the unit so that students did not miss progress or learning to use GarageBand during this time.

Originally, my instructional unit was written to use only the iPad for students to compose their music with GarageBand because I wanted it to be a comprehensive mobile experience. However, I modified the unit based on student feedback. Corey White wrote, "That it [the iPad] cannot easily connect to a MIDI output, like other program on a normal laptop" (GB check-in, W1). Other students shared the same concern. Corey White wanted to hook up an external MIDI compatible keyboard, so she could play and record with the use of the keyboard and other students expressed the same frustration. As a result, I connected each student workstation with a Behringer iStudio iS202 docking station that supported MIDI and audio recording and received approval by all students

who used them. Additionally, this eased the charging problem because the docking stations helped to power their iPads while in use.

Another technical problem I encountered was the lack of administrative access to many of our iPad's settings. I was unauthorized to share student projects using the iPad's email feature and, on many occasions, the school's Apple wi-fi account did not work. To receive my students' projects, I had to upload their work using Apple's iCloud or Microsoft's OneDrive, or even had to reroute access through another wi-fi server at times. This was a wearisome process to collect student work, because I had to do it for each student in class, one at a time (TL20). However, this did not interfere with presentations because students shared their projects by connecting their iPads directly to our StarBoard and the class audio system and did not require wi-fi access.

Another challenge was differentiating according to individual student needs and abilities and providing enough time for student feedback. Erin Grant did not find GarageBand to be an appropriate program for her. She commented that she did not like GarageBand because she had used it before. However, I explained to her that we could record her playing a ukulele (an instrument she plays) on it during an upcoming lesson. She commented that she liked that idea (TL2). I tried to accommodate her preference by encouraging her to use the audio recording feature to record her ukulele, and she reported that she enjoyed recording (Erin Grant, GB check-in W1). I also encouraged her to integrate her piano skills with the program, but in the end, she continued to dislike GarageBand (Erin Grant, Q11, open response WQ).

Another challenge was supporting individual student progress. On a daily basis, students engaged in independent practice with GarageBand to learn and compose their

music. I visited several students to provide feedback and assistance. Unfortunately, I was unable to help all students every day and made a note in my journal of students I visited (TL14-20). By documenting the students who received attention, I was able to remind myself to set aside time for others during the week.

Presenting Challenges

The following section discusses the challenges related to presenting creative work because students experienced nervousness or anxiety when sharing or presenting their work with others to listen or review. As a professional practice, I have assigned all students to share their music technology projects with their peers during in-class presentations at the end of the assignment. While I have noticed students being nervous before, this was the first time I documented these experiences or comments as part a curricular unit of study. Although some students reported legitimate challenges when presenting their work during my study, these comments were limited to only a few of the students, and most students who participated in the study did not encounter presenting challenges. Nonetheless, their comments and experiences deserve consideration when designing a unit for instruction.

Some participants experienced presenting challenges during the peer-review listening sessions. This is the stage where students shared their compositions with classmates for critique and growth. Students were required to stand in front of the class and play their music over the classroom PA system for their peers to review and engage in discussion about their work. Many students found this opportunity to be stressful. Erin Grant wrote that presenting her music is, "…kind of scary since you don't know if people you'd show it to would like it or not" (Q25, open response WQ). Erin Grant's comment

indicates she wondered if her work would meet peers' approval. Brian Nolan wrote, "I expected bad commentary considering some of them are more familiar with music than I am" (Q24, open response WQ). Brian Nolan compared his musical experiences to his peers' musical abilities and expectations. Brian Nolan also wrote, "If you can't take constructive criticism it's a challenge" (Q25, open response WQ). Brian Nolan expected presentations to be a challenging experience based on his peers' comments. Owl, wrote, "…it's tedious because your listening to the same sounds you listened to while creating it over and over again and I get a little nervous because I don't know what people will think" (Q23, open response WQ). Owl's response points to a unique position because the creator listens to their work throughout the process, from beginning to end, and their peers are only hearing it a couple of times during the presentation from an outsider's perspective. Owl's comments related to listening from different perspectives. Another challenge was that Jacket failed to present a project to the class and was the only student without a presentation. Unfortunately, he missed many classes and did not feel ready to present. He received an F for this missed assignment and he expressed his disappointment (Q26, open response WQ). Nonetheless, he completed all other assignments of the unit and has since improved during subsequent presentations.

I can empathize with my students that sharing one's work with others for critical review can be stressful or even scary, as Erin Grant suggested. However, it also presents wonderful opportunities for growth to learn from others engaging in the same activity. While Brian Nolan expected bad commentary, he later reported, "I felt good about my piano skills since most of them seem to enjoy it…" (Q27, open response WQ). Brian Nolan received positive comments that validated his piano performance and while he

experienced the stress of presenting his work, he received encouraging remarks from his peers because of his presentation. In this case, the constructive criticism was rewarding.

Additionally, much of the stress lay within the *anticipation* of presenting and not the presentation itself. Owl later responded, "…I was a little nervous because I didn't know what people would think and after I realized that no one in the class is judging at all…" (Q27, open response WQ). Owl's response suggested that our class was a safe place to share work because she felt it was a place without judgment. Blair Duff shared a similar point of view about the presentation process, "Nervous and then okay about it" (Q26, open response WQ), indicating a sense of calm after the stressors of the presentation was over.

Students used their iPads to share their compositions with the class. Certainly, it is conceivable that these students' experiences could have occurred in any medium where presentations exist; however, harnessing the mobile experience that the iPad allowed, facilitated the process with greater efficiency than my experiences using desktop programs for presentations. My experiences with desktop programs require students' projects to be shared from the teacher's workstation, and oftentimes problems arise from inconsistencies between the workstations where they created their work and my computer where their projects are shared. These inconsistencies often contributed to technical challenges that could influence the presenters' comfort levels. Many times, technological problems would delay or compromise the presentation adding other stressors for the student. However, in the present study, each student connected his/her iPad to the StarBoard, which eliminated these types of technical challenges from affecting their presentations. Chord wrote,

> Using GarageBand helped me to share my musical works but it's an easy platform to create and share music with my peers. And I was able to share it from the iPad itself so there were no difficulties in that. (Q22, open response WQ)

I found for participants like Chord, using their own iPads to share their compositions was more conducive for presenting work, which alleviated some anxiety when presenting.

The Instructional Roadblocks theme was significant to communicate various challenges I experienced when integrating an instructional unit requiring technology and student presentations. Problem-solving is an important part of mitigating encounters regardless of the setback and should be met with anticipation and corrective action. When challenges arose, notable alternatives or workarounds were implemented to circumvent the problems with technology. Additionally, addressing student concerns such as presenting challenges was handled appropriately and is to be expected during most instructional units, regardless of technology integration. My results may be helpful to other teachers when designing a similar unit of instruction with technology to anticipate possible problems that may arise and with viable solutions.

Conclusion

GarageBand for iPad provided technology that helped my students engage in music composition. Some students experienced music composition for the first time during this unit, and GarageBand helped them navigate that experience. In addition, students with more experience found powerful tools and features that enabled them to experience composition at a deeper level. Regardless of their abilities, students composed and shared their music in a nurturing environment that fostered a wide range of student talents. A structured but flexible curriculum containing appropriate assignments and activities supported their efforts. Three themes emerged: Music and Production Features,

Thinking Creatively, and Instructional Roadblocks. Music and Production Features integrated musical elements and technical skills that resembled a model music-technology curriculum. Thinking Creatively accounted for the ways students think about composition and the ideas that fuel the creative experience. Instructional Roadblocks provided challenges that many teachers and students face when rolling out a similar model of instruction. GarageBand for iPad provided my students with a comprehensive music technology curriculum applicable to today's digital environment. The results of this study can help with music-technology integration in the classroom, a topic to which I will return in the next chapter.

Chapter 5: Discussion

The results of my instructional unit and study represented a method that corresponds to the Ubiquitous Computing Period of music education discussed in Chapter 1. The Ubiquitous Computing Period is one that may have the potential to improve education with the help of technology because of its widespread access and appeal to digital native students. Additionally, my students experienced one-to-one learning with iPads and created meaningful products with digital tools.

I integrated a comprehensive music curriculum with the iPad, applying current mobile possibilities and consistent with the Creating Standard from the 2014 National Core Arts Standards. Participants learned to use GarageBand for iPad and created original music to share with their classmates for critique and reflection. They composed original works guided by imagination, creation, evaluation, and refinement, and finally presented their music to their peers for growth, all by using the mobile technology of the iPad.

Spirit wrote in favor of iPad technology, "I believe the iPad is a higher step in technology than using the laptop" (Q11, open response WQ). Using iPads in music technology class is an important and relevant practice for students at this time. Many music educators are behind in technology integration in the classroom compared to non-music educators (Gallo, 2018), and instruction like that described in the present study can help them become more technologically savvy. Corey White spoke of the importance of staying current with technological developments, "…technology is evolving and becoming a part of our everyday life therefore I do believe one must learn and search for technology opportunities in order to get ahead and not fall behind" (Q14, open response

WQ). The instructional unit presented here is an innovative use of technology that helps achieve music education objectives and realize student potential in the classroom.

My research question was: How do high school students experience music composition when using the GarageBand App for iPad? During a 5-week period, students experienced outcomes with GarageBand for iPad that answered the question supported by three themes. Student experiences composing with GarageBand for iPad included Using Music Elements and Production Features, Thinking Creatively, and Overcoming Instructional Roadblocks. In this chapter I will describe how my participants experiences relate to the existing literature, bring forth the theme's meanings of the three themes, express my study's limitations, and make recommendations for music teachers and for future research.

The Experience of Participants

The participants were well equipped to handle the responsibilities of iPad learning. Diemer, Fernandez, and Streepey (2012) reported that college students had high comfort levels with mobile devices prior to learning with iPads in the collegiate classroom. I found my students to be comfortable using iPads in a high school setting as well. Participants reported daily and frequent use of technology for schoolwork and entertainment prior to this study. Participants grasped working with iPad quickly, and 17 of 18 participants completed and shared their music during peer-review listening sessions. The one student Jacket, that did not present his work but completed all other assignments from the unit. Additionally, all 12 remaining students who did not participate in the study completed and shared their music.

The participants in this study were similar to other students enrolled in music technology classes from prior research. The participants resembled much of what Williams (2012) defined as the nontraditional music (NTM) student. Consistent with Williams's definition, the participants in the present study were at the high school level, and most of them did not read music. Additionally, participants with instrumental experience played mostly popular-music-oriented instruments like guitar or piano as opposed to traditional band or orchestral instruments. Furthermore, the majority (13 of 18 participants) of the participants were not enrolled in traditional school music ensembles like band or choir, which was another definable NTM quality.

The type of music technology curriculum my participants received during the unit was aligned with the Music Production model of Technology-Based Music Classes (TBMC) (Williams, 2012). The Music Production model focuses on musical styles, form, and listening skills. Music notation skills are not required in this model nor did the participants in the present study use notation skills to complete their music. This model includes music recording, looping, sequencing, and live music performance to create student work. My student participants engaged in these activities, thus matching the Music Production model description.

Synthesizing Musical Knowledge through Technology

Composing music with GarageBand for iPad is an effective approach to working with technology features and applying the elements of music. As a result of this unit, the participants learned musical elements through hands-on activities as they engaged in the music production process. Fusing both musical elements and production allowed students to experience the various roles required in the modern-day music production process

while composing music with GarageBand for iPad. Naturally, it is reasonable to expect students to integrate technical features, musical elements, and music production features in a music technology class. However, my students exhibited a robust integration of these skills, ranging from initiating ideas to composing music and sharing work with classmates for critique. Ultimately, the instructional unit delivered an exemplar for integrating technology in the classroom to achieve outcomes consistent with recent 2014 National Core Arts Standards and Partnership for 21st Century Learning's intentions. The unit of study presented here is one that can help bring music curricula in line with 21st century demands and provide a successful integration of technology in the music classroom.

Using GarageBand for iPad can be a constructive way to apply musical elements through digital media. My students used elements such as melody, harmony, style, form, instrumentation, and texture in their work, during class discussions, and in the course of peer-review sessions. Many of my results are consistent with previous research as well. Similar to the findings of Downton (2015) and Nilsson and Folkestad (2005), musical form was an important component of the compositional process for the students in my study. My participants composed music in forms such as binary and ternary form. Interestingly, my participants highlighted their peers' use of form during peer-review listening sessions. This realization indicated to me that my students were listening to musical form at a critical level of understanding and evaluation. Like Nilsson and Folkestad (2005), a number of my participants experienced these realizations even with no previous musical training. My research suggests that, with the proper tools, students can create and understand music regardless of musical training.

GarageBand for iPad is an effective tool for composing original melodies and dispels the notion that GarageBand is only for making loops. Kuehne, Lundstrom, and Walls (2013) found students to be more creative when using technology to compose melodies because they were not required to perform them on an instrument. With the help of technology, participants composed and thought about melody with creative techniques such as reversing melodies, gliding sounds, and playing with melodic register. Hoffman and Carter (2012) found that music technology facilitated original melodic and rhythmic patterns; my students experienced similar outcomes. GarageBand for iPad is a helpful tool for creating melodies. In essence, the iPad became a musical instrument to help students realize those melodies.

GarageBand for iPad assisted students in understanding and creating chord progressions. My students used GarageBand's smart features to create chord patterns, and these features helped them to understand how chords shape a song. In an addition to melody development, Nielsen (2013) found other benefits, such as ease in learning about steady beat and facility with creating chord progressions using GarageBand. I also found the software to be especially helpful with creating chord progressions, particularly with the auto play and tap chord features. GarageBand's technology played chord progressions with steady timing, making it hard to make rhythmic errors. Creating chord progressions using GarageBand's features can help students, regardless of their previous training or musical ability, create professional-sounding progressions.

GarageBand for iPad encouraged students to create music in the styles they wanted. Nielsen (2013) reported students could use GarageBand to create music in the user's preferred style, and this also happened frequently in the present study. My students

created music in various styles, and GarageBand contained features that could be tailored to accommodate various styles. Examples of these features included the virtual drummers that played in defined styles, sound libraries based on various genres, and the ability of students to manually record their own performances. Nielsen found that students with prior musical training were able to create music that resembled that of students who had been trained with notation-based programs like Sibelius. However, creating music with GarageBand does not require the use of music notation; therefore, students were not restricted based on their notation literacy.

Using GarageBand for iPad is a tool that can help students develop proficiencies with technical features to create musical products. The technical features my students experienced also related to prior research. Sequencing parts and sections using GarageBand's instruments was an important application of using technical features. Airy and Parr (2001) found students use of MIDI sequencing to be an effective way to create music; they placed less importance on musical accuracy because of editing capabilities. Chen (2012) found quantization techniques helpful for fixing rhythmic problems. My findings yielded comparable outcomes. My students also used MIDI sequencing and GarageBand's quantization features to create and refine their music. Quantization helped participants align rhythms correctly, making them sound more professional. GarageBand's simple quantization tools made it easy to understand and execute the task.

GarageBand for iPad provides an environment for students to experience the music-production process. My participants assumed various roles such as performing, listening, mixing, sound design, and others to create their desired sounds; this is consistent with prior research. Tobias's (2013) research supported the notion that creating

music with technology encourages the development of various roles: composer, performer, engineer, and producer. The participants engaged in all the aforementioned roles to complete their music. Chen (2012) reported that students engaged in music production qualities such as mixing and panning instruments to balance levels and create space in their music. Savage and Challis (2001) reported students engaging in sound design and experimenting with effects such as echo using Pro Tools to mix and edit audio files. My findings are similar to those of Williams (2007), who reported the roles of listening, performing, and composing have become fused together into one integrated musical activity. GarageBand for iPad is a program rich with features, and it gave my students a studio-like experience.

Using programs like GarageBand provides students with a wide selection of instruments. Having a wide sound palette for students to select instruments from facilitates the creative process because students can try out various sounds before making a final decision. Cuadrado, Lopez-Cobo, Valverde, and Verona (2017) found that using a program with a wide palette of sounds and instruments helped students to compose their music, especially to tailor the compositions according to the creators' personal tastes. My students performed on the iPad or MIDI keyboard to record on virtual instruments from GarageBand's extensive sound library. Additionally, I found that having a sound library allowed my participants to experience playing instruments previously unavailable to them. With GarageBand, students could virtually play any instrument in the sound library in addition to creating their own sounds, as Corey White and Chord demonstrated with the Alchemy synth. GarageBand's instruments provide students with plenty of sounds and instruments, offering almost limitless possibilities.

GarageBand for iPad also facilitated the creative process because students were able to play back their music for monitoring and revisions. Previous research also supported my findings. Chen (2012) wrote, “Software affords an easier entry into this [composition] experience than paper and pencil by allowing the direct manipulation of sound and giving immediate feedback” (p. 159). Kennedy (2002) highlighted the fact that listening skills were important components of the feedback process. Moir and Medboe (2015) extended these findings by suggesting that using Digital Audio Workstations (DAWs) facilitated the listening process because they allow for immediate feedback for refinement during all stages of composition. Other research suggests that listening and refinement help improve melodic content when students use music technology (Kuehne, Lundstrom, & Walls, 2013; Hoffman & Carter, 2012). These findings were consistent with the present study; my students used GarageBand’s playback features to craft and improve their music. Technology ultimately facilitated the creative process because the participants made improvements based on their listening skills. I found listening encouraged my participants to experiment and manipulate sounds to their liking, for example, when dialing in the right synth sound or drum kit. Additionally, the same playback features were used to present and discuss student work during peer-review listening sessions. Students’ listening to their music then became more than editing and revision. The use of this technology facilitated the processes of reflection and growth.

The user-friendly technical and production features fostered a positive classroom environment that led to students’ constructive experience during the unit. GarageBand for iPad was a relatively easy program to learn and use to create music, and Riley (2013) also reported that teachers had similar experiences with it. My participants expressed ease

with the app to create, play, and share their work. With a user-friendly program at hand, students became focused on creating their work rather than being discouraged by technical frustrations and difficulties. The user-friendliness of GarageBand was further amplified because many students recommended that GarageBand be taught first before other music technology programs such as Studio One by Presonus.

Synthesizing musical knowledge through technology was influenced by the Using Music Elements and Production Features theme. Composing music using GarageBand for iPad can satisfy educational standards such as the National Core Arts Standards of Creating. Additionally, my students' use of technology with GarageBand for iPad supported the Media, Information, and Technology Skills component from the Framework for 21st Century Learning. Specific areas from the Framework were *creating media products* (music compositions) and *applying technology effectively* (using iPad to create music compositions) while learning and applying meaningful musical content. My students used GarageBand's instruments and features during the music-production process in ways that paralleled findings of prior research; however, my study extends the literature to sharing and presenting student work for peer-review and feedback. Students were able to respond and connect their learning to that of other students and benefit from the influences and critiques of their peers. Students engaged in the creative process by using iPads to generate ideas, organize and develop ideas, refine their works, and finalize their ideas to share and present music. Synthesizing musical knowledge through technology can help other music educators to meet technology demands while providing effective methods to learn core musical content.

Student-Directed Creative Process

Composing music with GarageBand for iPad provides a conducive environment for students to think creatively and respond critically about their work. McBeth, Turely-Ames, Youngs, Ahola-Young, and Brumfield (2015) wrote, "With the use of mobile technology, we can help them [students] apply their critical thinking skills to their digital worlds" (p. 5). My study realized their statement in a real unit because my students used mobile technology to think critically about their music and how they completed their work.

Notably, my contribution of adopting Gilbert's (2016) ISTE's essential recommendations extends the literature of using iPads in music technology classes. This is important because I integrated student-centered learning and equitable access that fostered the creative environment. Student-centered learning was realized by using GarageBand for iPad for listening and self-assessment of student work. In this capacity, students used technology to address specific individual concerns during the composition and revision process. Equitable access was integrated because students used GarageBand's smart instruments as a form of assistive technology. Additionally, GarageBand provided students with digital media interactions of audio-visual content, an identifiable equitable-access quality. Assistive technology and digital media interactions facilitated the creative process and provided opportunities for exploration and self-expression. All these elements are manifestations of constructive uses of technology in 21st century.

A defined but flexible instructional unit featuring GarageBand for iPad can encourage creative exploration in the classroom. Hickey (2003) stated that students need

to explore musical sounds during the creative process to decide what works for their compositions. Seddon and O'Neil (2003) reaffirmed this by suggesting that exploration is an important phase of creativity. I found this to be true, especially in the early stages with GarageBand as students experimented with various features and virtual instruments. Savage (2005) suggested that using technology to compose music was a quest of curiosity, and Chen (2012) proposed that working with music technology promotes experimentation. I often found my participants exploring to learn and experiment with GarageBand's instruments and features in a self-directed manner. In many cases, students found additional features like jam session, programming velocities, and the other sound menus of the keyboard on their own without my guidance. These findings indicated to me that my students embraced their curiosity as a natural part of the learning process. Therefore, an instructional unit featuring technology should allow sufficient time for students to make their own curricular connections or divergent thinking.

The instructional unit and GarageBand for iPad prompted students to evaluate their music and to subsequently refine and edit their work. Younker and Smith (1996) wrote that both expert and novice composers engage in revision as a natural part of the composition process. Downton (2015) found that students realized improvements in their compositions throughout the process. My students used the process of reviewing and editing to improve their compositions, similar to the results of the Downton (2015) study. Additionally, my students thought about what was needed to improve their work, such as adding or even removing sections or ideas. From my perspective, I was impressed to see students remove ideas because, in my experience, students are more likely to add rather than subtract ideas, and that can make the project lose focus. Reviewing and editing

became part of my student's compositional experiences with GarageBand to improve their work.

Student peer-review was an effective strategy for student reflection and growth as part of the creative process. The instructional design featuring GarageBand for iPad encouraged students to share their music during peer-review sessions. The participants supported their classmates during peer-review sessions by offering, through verbal and written feedback, ways other students could improve their music. The peer-review comments added an outside perspective to the revision process. Many of the participants reported that sharing their work with others for constructive feedback helped to improve their music. McBeth et al. (2015) found peer review to be a beneficial learning strategy when using iPads. Participants such as Blair Duff reported helpful feedback from peers because it presented ways to learn from other students and their methods when using the app.

Student peer-review also provided a platform for students to serve as teachers to others. Corey White, Chord, Spirit, Glen Cameron, and Quill taught other students several of their compositional strategies and production techniques during their peer-review discussion sessions. Aristotle once said, "Teaching is the highest form of understanding," and my students realized this understanding by teaching their individual techniques to each other. These participants shared their craft with others through modeling and explanation that extended their compositional experiences. The process empowered them to become teachers and help fellow classmates. One important aspect of using digital technologies is that the teacher is not always the most knowledgeable expert.

Student knowledge should be valued and used to augment the learning experience for all students through peer-teaching.

Additionally, mobile devices such as iPads provide students with convenient tools to share ideas with their peers. Verrico and Reese (2016) reported exploration was an important theme from their study when creating a collegiate iPad ensemble. Their participants indicated that they learned how to use iPads to create music through group exploration and sharing their discoveries. In the present study, participants shared their discoveries during peer-review sessions and in many cases taught the class specific techniques of using GarageBand when composing their works. From my perspective, watching students teach their techniques was a one of my favorite aspects of the study, and mobile devices made it easy to achieve. Verrico and Reese (2016) also reported that some of their participants preferred a more structured environment based on their previous musical experiences. However, I found that my students enjoyed a flexible setting, and I encouraged them to interact with content in a playful manner. Additionally, Hancock (2014) suggested that flexible or play-based activities can be beneficial when learning to use music technologies. Hancock's suggestions were consistent with my findings because my students had ample time to use GarageBand in a self-directed manner.

Differentiated Music Learning

GarageBand for iPad provides opportunities for students to interact with content and engage students. The iPad and app likely involved students because these technologies responded to multisensory input (listening, viewing, tapping, etc.). Diemer, Fernandez, and Streepey (2012) reported high levels of engagement and learning with

iPad in the classroom. McBeth et al. (2015) reported that effective iPad use in the classroom contributed to a positive learning climate such as increased classroom participation, critical thinking, and improved peer-relationships. I found this to be true in the present study as well because students both learned through direct instruction and enjoyed independent practice time to explore and create music with GarageBand. Participants, overall, also responded positively to receiving feedback and supporting classmates during peer-review listening sessions. Many participants gained confidence from presenting their music and gained valuable insight from their peers. Additionally, on many occasions, participants taught the class techniques they used to create their music during presentations which enhanced our class culture.

Programs like GarageBand provide comprehensive opportunities for students. Using GarageBand for iPad gives students without strong performance skills a positive musical experience and encourages them to think beyond their physical limitations. Riley (2013) reported positive uses with iPads from teachers because they can adapt to student needs. Playing an iPad can be more inviting than playing a traditional instrument. John, a teacher from her study, reported,

> I think that by nature, the iPad's musical interface is less daunting than say, a saxophone. You don't have to be proficient in music to sound decent in an app like GarageBand. I think students that have little to no musical experience are less likely to be intimidated by making sounds on iPads than on traditional instruments. This could be a great way to initially get these students interested in music. (Riley, 2013, p. 84)

I agree with John from Riley's (2013) report. Using iPads to create music in an app such as GarageBand empowered students to take risks and create original music. Additionally, GarageBand afforded my non-instrumental students the opportunity of performing on the virtual instruments in the app. Criswell (2011) interviewed music technology expert and

professor William Bauer and he suggested that students like mine without traditional music instruction may benefit most from using iPads in music education,

> Bauer believes that students who don't have a traditional music background or who aren't currently active participants in their school music program may stand to benefit the most from using tablet computers in music class. The multitude of apps that allow one to be expressive without requiring an understanding of notation or other musical formalities make the iPad in particular extremely accessible to this part of the student population. (p. 30)

Bauer's statement resonated with my study because the instructional unit with GarageBand provided an all-encompassing educational experience regardless of prior musical training. Nilsson and Folkestad (2005) wrote, "Digital tools offer a way for young, musically untrained children to express their musical ideas" (p. 24). The researchers found students capable of creating music despite having had no formal instruction. Nielsen (2013) found GarageBand to have a positive effect on students' creativity because it did not require music literacy to make music. I found this previous research pertinent to the present study because I noticed that as my students became empowered to create music with GarageBand for iPad, they exhibited a sense of pride in their creations, even though many did not have a strong musical background.

The instructional unit featuring GarageBand for iPad encouraged students to *own* their work. I think that more opportunities should exist for students to be personally invested in their work, because it may result in better instructional outcomes such as empowerment or a sense of ownership. Additionally, teachers should motivate students to do work that they are most internally proud of rather than satisfying external grading requirements. My students' empowerment to create music also provided a sense of purpose in their work and contributed to a student-centered culture. Savage and Challis (2001) found that creating music with technology supported a sense of ownership, and I

also found this also to be the case when students created music for themselves first. Additionally, my participants expressed they were most comfortable sharing their work when they were satisfied or "happy" with their music. Teachers should consider their students' satisfaction of their own work when designing instruction because it can motivate students to complete assignments with a greater sense of purpose.

Student directed creative process was influenced by the Thinking Creatively theme. Students realized their own effective strategies with an invested interest of creating their own music. Student-centered learning and equitable access were driving forces of students' experiences with GarageBand because each student created their own work with the appropriate tools and teacher support to produce that same work. By the end of unit, students realized their new founded compositional abilities or enhanced their existing ones, unique to each individual student. Creating music became greater than an aural product but an empowering educational experience that other teachers, including myself, can participate and learn from.

Teacher Flexibility

Teachers need to be flexible when designing a unit that requires large amounts of technology usage. Oftentimes common teaching practices can become challenging when technology use and its maintenance is thrown into the mix with the other responsibilities. With these assumptions in mind, I created the unit in three phases: acquisition (2 weeks), composition (2 weeks), and music composition presentations and peer-review (1 week), with enough time to allow for effective learning and problem-solving along the way. Three systematic phases of instructor-planned objectives were created but featured ample time for students to explore content, learn GarageBand for iPad, and apply the same to

create and share original music. Nonetheless, while the unit was adequately planned, I still needed to be flexible to accommodate some challenges that lay ahead.

Teachers need to show students how a program's features can be used for creative implementation beyond their initial impressions. Some participants thought GarageBand's auto-play features and loops to be limiting or less creative. A few participants implied that GarageBand does the work for you. Wise, Greenwood, and Davis (2011) reported similar sentiments from teachers they studied during the educators' use of GarageBand. A teacher in the Wise, Greenwood and Davis study suggested that working with GarageBand is not real music composition; rather, that "…the use of looping software as 'just cutting and pasting, and to me that is not composing'" (p. 126). Certainly, GarageBand's "smart instruments" can do much of the work for you, and loops found in the app are created by others. However, the question is how one decides to use those features. One can create an entire composition with GarageBand without using loops or the smart instruments' auto-play features. "Smart instruments" and loops are options, not requirements, when working with GarageBand for iPad. Teachers need to listen to students' complaints about features but be prepared to direct them to options within the program that will satisfy their demands. Naturally, this requires the teacher to be well-versed in the program's offerings.

Teachers need to show students how limitations of the program can become opportunities to exercise problem-solving skills. Some participants complained that GarageBand lacked some advanced features like the capacity to change meters within the same project and limitations with mixing. However, my students demonstrated adequate accommodations through unconventional thinking. In this case, Corey White overcame

the meter change problem by focusing on the "feel" of the desired meter rather than its mathematical values. The result was a natural-sounding performance for her introduction that was well received by her peers. Instead of the meter, her peers noticed the tone and contour of her melody. Marcus Skye and Blair Duff wanted to pan some of their tracks at different points by using automation. Unfortunately, GarageBand only allowed automation changes for volume, not panning. They worked around this limitation by copying the chosen parts to separate tracks and panning them to their desired position. Both students achieved satisfactory results working around the need for automation. The results described were possible because I listened to my student's objectives and showed them how we could overcome their obstacles with some ingenuity.

Teachers need to accept the technology they have in their classrooms and use it to the best of their ability. Konstantinou (2016) suggested that teachers use the technology they have on hand when integrating technology in the classroom. I followed this suggestion and made the best use I could of the available resources. Our iPads were outdated and not compatible with the latest version of GarageBand. The latest version would have made editing easier and provided students with more desirable sounds and features, including live loops and even DJ mixing. Certainly, these conveniences could have mitigated some of my students' frustrations. However, the absence of the having latest iPads and most recent version of GarageBand did not impede the overall success of my students' work. Instead, many participants found desirable alternatives.

Teachers need to realize their strengths when rolling out a unit with technology, but they also need to be open to learning from their own shortcomings. Dorfman (2016) suggested that the teacher's competency is a leading factor in successful technology

integration in the classroom. Overall, I was pleased with my skills in integrating technology into the instructional unit. However, there were some areas in which I could have taught more effectively. Many students desired more sound options, and I could have helped them by instructing them to use the "more sounds" menu of the virtual keyboard, which includes options such as brass instrument sounds. Another area I could have done better in was instructing students to extend the 8-bar section default. In many cases students experienced frustration because they thought recording was limited to only 8-bar increments. I later corrected this misunderstanding as a result of my GB (GarageBand) check-ins. In future lessons, I will anticipate similar problems and continue to embrace my teaching flaws as an opportunity to learn and improve my practice.

Managing technology resources is time-consuming, and teachers need to plan accordingly. Blume (2013) reported improper usage of iPads with students from the Los Angeles Unified School District who hacked through the school's Internet security to inappropriately surf the Internet. Walling (2014) reported improper usage with iPads as well. I also experienced technical roadblocks with iPads during the present study. However, my roadblocks were not due to improper usage or security issue, but rather with the general management of the iPads. In several instances, iPads failed to charge well overnight in the cart. I overcame this obstacle by having wall chargers available and making use of our Behringer docking stations, because they did a better job of powering up the iPads. Also, iPads were regularly misplaced by students in the cart, and I had to reorganize them daily before leaving school for the day. This was time-consuming before, during, and after class. In future classes, I plan to assign responsible student

volunteers to organize carts and make sure iPads are charging correctly. Other teachers might try to establish more specific procedures for the end of each class such assigning a device manager to make sure each student returns their iPad to their appropriate slot.

Teachers of music technology need to be given administrative access to the resources with which they are expected to teach. Although I was the manager of the iPads, I lacked administrative access to them, which impeded my ability to share student work via e-mail using the iPads, or to sync work to another computer. In many cases, our Apple wi-fi did not work, and I have since had our school's technical support team fix this problem. However, this correction required additional problem-solving from our school technician. I worked around this setback by moving the iPads to other locations to retrieve student work from other wi-fi connections via Apple's iCloud and Microsoft's OneDrive. This was extremely time-consuming and, I imagine, might deter most teachers from implementing the unit altogether. However, I overcame the obstacles so I could share with students the music they had created and so they could listen to their work whenever they chose, even after the unit. It is important for teachers to have convenient access with their devices, especially for sharing student work and creating digital student portfolios. Digital portfolios have become increasingly important in the today's educational climate, and teachers need to be given the proper resources to meet this expectation (McBeth et al., 2015). I had to problem-solve to create an archive of student work. Adequate administrative access needs to be granted to teachers to avoid this problem.

Teacher Flexibility is significant and was influenced by the Instructional Roadblocks theme; it included some of the frustrations, limitations, and work-arounds

students and I experienced with composing with GarageBand for iPad. It provided me and, I hope, others with some challenges they might expect or, better yet, avoid when implementing a similar unit. Furthermore, the theme represented the obstacles that, in spite of our frustrations, we overcame to implement, complete, and share student compositions in class. It also presented me with valuable teachable moments through which to better instruct students in the future. Overall my instructional plan was successful, but teachers need to build time into the unit to handle unexpected problems.

Limitations

One limitation of my study relates to those who participated in my study. My instructional unit was limited to the 18 participants out of 30 possible students enrolled in my classes. Although the remaining 12 students received the same instruction, opportunities, and assignment obligations, I could not include their responses or experiences in my results. Findings might have been different if they agreed to participate. Therefore, their assignments served only as ordinary classwork and could not be considered as data.

Additionally, my students are from a public high school with a visual and performing arts focus that attracts students inclined to join in the arts. Additionally, my participants were from a music technology class, and our class is an elective, not a requirement. Although music technology fulfills the Arts and the Career and Technical Education (CTE) graduation requirements, students can choose the electives they want to take. As a result, my students may have a bias toward music technology and favored the curriculum over other elective options. Results could be much different if the same study

was conducted in traditional music classes such as choir, band, or orchestra or at traditional comprehensive high school.

Another limitation relates to my bias as both the researcher and teacher of the unit of study. As both the researcher and teacher, I may not be able to see my own experience clearly. As previously mentioned, I did not know who participated in the study until after the study was completed and all assignments had been collected and graded. My colleague handled the distribution and collection of all permission forms and did not share with me who participated until the end of the unit. This process helped me to treat all students as fairly as possible. However, some bias still may have existed, even if I was unaware of it at the time because I was unable to observe my own teaching. Therefore, I relied on my own memories of what happen within the classroom and could not view teaching objectively. This is another component of serving as both the teacher and researcher.

Furthermore, a final limitation relates to how students interacted with the mobile technology of the iPad in ways unforeseen at the outset of this study. Upon request, students were permitted to use their iPads outside of class on case-by-case basis; doing this required my verbal permission. While I viewed their participation outside of class as a positive addition to their classwork, I was unable to interact with them during this use or observe these experiences as part of the study. Lastly, I did not collect data regarding student access to GarageBand at home or on a personal iPad or iPhone. This additional information might have influenced my interpretations of student work as I was unaware of students' previous experiences with GarageBand.

Uniqueness of Study

My participants composed music in wide variety of styles including pop, rock, R&B, classical, experimental, and EDM. I encouraged them to create music they would enjoy listening to and creating. Students learned about basic musical elements and music technology concepts during the school year, and I gave individual feedback to students using these elements and concepts to assist them in their work. However, I made no special demands, nor did I assign requirements, in terms of style, form, production, genre, etc. An example of this philosophy was demonstrated when Spirit asked during class, "How long does the song have to be?" My response was, "There is no required length. You need to ask yourself whether your music is complete with what you want to express and if you are satisfied with your work" (TL 12). Music composition was broadly defined as original music created and presented by the students in the style of their choice.

Teachers often foster creativity at the mini-c level and should include the appropriate assessment methods that can help nurture creativity and reach higher levels of creativity. Kaufman and Beghetto (2009) wrote, "mini-c was designed to encompass the creativity inherent in the learning process" (p. 3). Grading was done in order to cultivate creativity and not for students to merely satisfy grading or assignment requirements. Adhering to this approach, I graded my students' assignments on a pass/fail basis. Students received an A grade for completed assignments and an F for incomplete assignments. All students except one, Jacket, presented their work, and all other assignments were completed. As a result, students focused more on creating their work and less on the grade. Assessment was limited to peer-review feedback and self-assessments. This was intentionally done because I, the teacher, did not want to *label*

student creative work with the judgment of a letter grade. My intention was to motivate my students' creative thinking about their work and to support fellow classmates and their creative environment.

Kaufman and Beghetto (2009) wrote, "The primary purpose for assessment at the mini-c level would be to support creative ideation and nurture student creativity" (p. 8). Kaufman and Beghetto recommended self-assessment methods because these methods prompt students to reflect about their work and to nurture creative potential at the mini-c level. I found this to be true because my students highlighted many of their strengths and weaknesses in their work as a result. Amhag (2103) wrote regarding students sharing work, "…peer assessment processes may develop students' creative-and critical-abilities, and support meta-cognitive learning" (p. 8). Peer review in this context is an appropriate assessment method (versus teacher review) to facilitate the creative process because it supported a creative culture for learning. Additionally, peer review encouraged students to listen critically and support their peers in a constructive learning activity by using the musicianship and technical skills they had developed.

I originally conceived this study to be an all-all-encompassing iPad mobile experience. I began the instructional unit using only the iPad; however, many students described some limitations that were hindering their progress. As a result, I set up each student workstation with docking stations that allowed students to connect their iPads to external devices such as a MIDI keyboard or an electric guitar. Although these are accommodations that iPads can provide, the study featured some music technologies similar to traditional desktop environments. Essentially, the study incorporated some non-mobile technologies at the request of students.

Recommendations for Music Teachers

Gallo (2018) wrote, "The growing importance of technological literacy and fluency in U.S. society calls for schools to integrate more opportunities for student learning and use of technology" (p. 181). However, Gallo found that music educators' use of technology in the classroom to be much less important than that of non-music educators. In terms of professional development, music educators in Gallo's study favored conducting and performance-related activities to improve their professional practice and found technology-related professional development less useful. These findings are discouraging given the almost ubiquitous technologies available today and the increasing demands to integrate technology in the classroom. Additionally, positive outcomes like mine can be achieved as a result of adequate music technology integration. As a result of this study, I would like to suggest recommendations for music teachers to incorporate ISTE's essential condition recommendations into practice, to seek professional development with music technologies, and to use music technology for their own use to make it easier to transfer skills into the classroom.

Unfortunately, Gallo's recent study does not mention the quality or kind of technology-related professional development the music teachers received. Professional development needs to target the music technology domain. Gilbert (2016) suggested that music teachers integrate ISTE's essential condition recommendations of student-centered learning, equitable access, and engaged communities. Examples of student-centered learning include using technology to compose with programs such as GarageBand and students having choice in the selection of activities. Equitable access includes the use of digital media to interact with content in a multisensory (hearing, seeing, manipulating,

etc.) environment. Modifying instruments in order to attract students with differing abilities is another example. GarageBand's smart instruments offer a viable option. Engaged communities are important for students to communicate in class or online through social media to share work with their peers in class and beyond. Engaged communities can foster collaboration and community. Using Gilbert's essential-condition recommendations as a starting point, music teachers can help make professional development focused and a practical use of time.

Gilbert's recommendations are excellent initial ideas, but teachers need to develop skills to integrate them. One way to meet these recommendations is for teachers to develop Digital Audio Workstation skills. Scher (2014) found that music teachers are more likely to integrate technology into the curriculum if they have proficiency and access to recording technologies such as DAWs in the classroom. My study supports Scher's findings, because GarageBand for iPad is a mobile DAW example. Moreover, my skill set with these programs aided in the both the practice and outcomes with my students. Music teachers need specialized training in music and production technologies. Teachers in the 21st century would benefit from learning recording techniques such as microphone placement/setup and signal flow. Teachers also need to be proficient in using DAWs for recording, editing, mixing, and mastering audio. In our current multimedia environment, we need to have skills that interact with these media. DAWs skills can equip teachers to meet these demands.

Music teachers should pursue specific professional development to develop music technology skills. Music technology training and certifications are available at the postsecondary level, for example, through community colleges, four-year colleges, and

graduate schools. Institutions like Rutgers University allow students to study these programs in conjunction with the music education curriculum. Additionally, continuing education programs are available through software developers and their educational partners. I became a certified Pro Tools user in a 2-week summer program at a local Avid (Pro Tools Developer)-approved state college and received mixing and mastering certification at a local Waves Audio Ltd.-accredited learning center during a 3-day intensive training. What I learned enhanced my skills and how I perceive them, as well as how I can translate them into my own instruction. Multiple avenues exist to train and prepare music educators, and teachers need to take advantage of these options.

Another recommendation is for music teachers to use music technology for their own purposes. Composer and educator Rob Deemer (2016) wrote, "To teach composition effectively and confidently, music educators need to experience it for themselves" (p. 41). Music teachers spend the majority of their time teaching performance-related content, likely because they know what it's like to study, practice, and perform on their instruments. Therefore, performance is a natural part of their practice. Deemer suggested that music teachers need to compose music themselves in order to teach their students how to compose. The same is true with music technology; to teach music technology effectively and confidently, music educators also need to experience it for themselves as well. Music teachers should use technology for themselves to do their own projects. Examples include writing, recording, and producing their own music or even music of another artist using music technology. In this regard, the teacher will have invested a personal interest to learn how to use the programs for themselves before integrating them

in the classroom. This can help them become more effective and confident with music technology.

Recommendations for Future Research

My unit of study prompted me to think critically about future possibilities for research of integrating technology in music education. These recommendations are influenced by the results from my practice and consider possibilities that reflect modern times. I propose research to include using music technology as a medium for collaboration, to be more comprehensive and embrace a wider music student population, and to make use of online resources to create an environment of learning beyond the classroom.

Recommendations for future research with iPads should include student collaboration with iPads much like musicians write and perform live music together. Much of the existing music technology research contained collaboration as a prominent quality or theme. Cuadrado et al. (2017) found their participants collaborating together which fostered team-building and empathy skills while creating original music in Cubase. Verrico and Reese (2016) reported students collaborating and performing together in an iPad ensemble. King (2008) reported working together on a studio recording project, and Savage and Challis (2001) reported students collaborating during the editing and mixing process on a recording project.

In my study, students created individual projects and collaboration was limited to sharing student projects and the peer-review process. However, GarageBand for iPad is built to be a collaborative tool, notably with its Jam Session feature. Jam Session allows up to three players with iPads to connect to the host iPad or “band leader” via Wi-Fi. The

devices become synchronized together to collaborate with others for playback and recording. During my study, two-participants, Jacob Fawn and Marcus Skye, experimented with Jam Session during the individual practice time of the instructional unit. They quickly taught me about this unique tool, and I imagined nearly limitless possibilities through which students could compose and perform the music they created using GarageBand for iPad. Using GarageBand for iPad in group mobile settings is needed in the next stage of research on the Ubiquitous Period.

Music technology education needs to be more all-encompassing and engage multiple populations to achieve mainstream acceptance. The participants from my study displayed qualities consistent with the nontraditional music students described by Williams (2012). Consequently, music technology needs to a part of the traditional music student's learning as well. iPads are musical instruments much like the violin or trumpet and can be included in traditional ensembles. Williams (2014) wrote, "Although some might balk at considering the iPad a real musical instrument, the reality is that it offers myriad possibilities for ensemble playing and music learning" (p. 93). Additionally, my participants experienced tangible results by applying musical elements like form, melody, harmony, and texture in their works. Musical elements are curricular components of all music classes, and students from traditional music classes can further their understandings with the use of music technologies. Therefore, a study like mine needs to be conducted in traditional music classes like bands or orchestras to embrace the broader student population and account for traditional music students to use technology.

Another recommendation for research is to embrace engaged communities and capitalize on the wondrous potential of the Internet. Research should include classes to

establish an online presence of student work to create opportunities to create, reflect, present, and respond to student work to create a broader community. The students in my study used Socrative.com as an online communication tool to complete assignments, and to facilitate the peer-review process. Unfortunately, the tool was limited to in-class activities; however, future research should include the use of online tools outside of the classroom. Gilbert (2016) recommended engaged communities to foster collaboration and community by using sites like skype in the classroom, YouTube, SoundCloud, or wiki sites. Students should share their music online much like their favorite artists do as part of the creative process and welcome feedback from other students in classrooms all around the world.

Conclusion

My study represents an example of how a modern music technology curriculum can foster a positive place for creative learning and give teachers a plan of action in their practice. The instructional unit featured students composing original music with GarageBand for iPad at a public high school with demographics encompassing students from around the United States. I provided a method complete with lesson plans, pacing guides, and assignments that teachers can adopt and incorporate into practice to make technology integration easier. The curriculum reflects the standards set forth by the National Arts Standards for Creating in Music Technology and included the Partnership for 21st Century Learning's recommendations. Additionally, my work incorporated Gilbert's (2016) recommendations from the International Society for Technology and Education (ISTE) in a constructive learning activity. These recommendations fostered an environment of student-centered learning, equitable access, and engaged communities

and are constructive ways to integrate technology effectively in the classroom. Students demonstrated tangible understandings of these standards and demands both verbally and in writing throughout the curriculum. My intention was to deliver a holistic unit of instruction based on modern standards and scholarly demands and add to the literature of effective music technology integration.

However, while I incorporated various standards, demands, and skills into my instruction, the students are what I value most. I was especially pleased to hear my student's compositions and how they arrived at the level of knowledge and understanding that permitted them to complete their work. Each student created music that was unique and inspiring. They all composed music and shared it with their peers in a supportive environment and learned from this experience, regardless of what opportunities are next in their lives. They can also take their music with them and play it back whenever they choose, which they might do years from now when they reflect on their positive high school experiences. That may be the best benefit of all, knowing the work you created can be played back whenever you wish, and to be able to reflect about how you got there and beyond. I think all students should create music and use whatever tools they can. Our tool was GarageBand for iPad, and I'm happy have used it. I also look forward to whatever music-creating tools become available in the future.

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Appendix A

Weekly Essential Questions

(National Coalition for Core Arts Standards, 2014)

The following Weekly Essential Questions are from the National Core Arts Standards Music Technology Strand on Creating (except for week 1). Essential questions are designed to direct enduring understandings and to foster learning of core content.

Students are to answer the following questions at the start of each week. Essential questions address the creative process of ideas, decisions, composition improvement, and sharing their musical work.

Start of Week 1: How do you feel when you are learning or doing something new?

Start of Week 2: How do musicians generate creative music ideas?

Start of Week 3: How do musicians make creative decisions?

Start of Week 4: How do musicians improve the quality of their creative work?

Start of Week 5: When is a creative work ready to share?

Appendix B

Lesson Plans for Case Study

Below are three lesson plans with coordinating unit outline, one for each phase of the study:

- Phase I: Acquisition
- Phase II: Composition
- Phase III: Presentations and Peer Review

Lesson plans are written using the format required by my district. The three phases are designed such that each lesson repeats throughout the period of implementation. Each lesson plan contains a corresponding outline highlighting the day's learning activities.

Week of: January 1, 2018 – January 12, 2018 **Teacher:** Mr. S. Sabet
Grade/Content Area: 9–12 Music Technology **Unit:** GarageBand Acquisition—Phase I

	Week 1/1–1/12
Standards	**NJCCS Performing Arts** 1.1 The Creative Process, 1.3 Performance, 1.4 Aesthetic Responses & Critique Methodologies **National Core Arts Standards** Creating: Imagine MU:Cr1.1.T.Ia: Generate melodic, rhythmic, and harmonic ideas for compositions or improvisations using digital tools
Lesson Objective	Students will be able to imagine, play, and record patterns with various touch instruments in the GarageBand App for iPad and orient themselves to its graphic user interface and features by Friday, January 12, 2018.
Resources	• iPad Cart of 30 Tablets with iOS 9.3.5 and IWB adapter • Interactive White Board • GarageBand app • Headphones and headphone splitters • GarageBand Help Guide and GarageBand for iPad Starter Guide • A Process for the Creative Product by Brian Moore Handout and National Core Arts Standards – Music Technology Standard of Creating
Lesson Description	
Anticipatory Set ***List specific statements or activities you will use to focus students on the lesson*** State clearly what students are learning and how it connects to prior learning. 8 minutes	Essential Question: Week 1: How do you feel when you are learning or doing something new? Week 2: How do musicians generate creative music ideas? • Mr. Sabet will model virtual instruments using the GarageBand app on the iPad and share music he created using the software. Each day, a different instrument or feature will be modeled for the students to practice in class.

Direct Instruction ***What information is essential for the student to know before beginning and will this skill be communicated? How will you be demonstrating this skill? Identify strategies to be used to determine if students have learned the objectives.*** 10 minutes	• Modeling: Mr. Sabet will model desired performance of iPad activities with GarageBand. • Interactive class discussion with frequent checks of understanding. • Guided notes with step-by-step tasks. • See pacing corresponding phase outline
Guided Practice/Monitoring ***List activities which will be used to guide student practice and provide a timeframe for completing this practice.*** 10 minutes	• We do activities (teacher and students) of playing touch instruments with GarageBand. • Peer review of activity. • Q and A discussion class activity.
Independent Practice **Assignments to be given to students to ensure they have mastered the skill without the teacher's guidance.** 15 minutes	• You do (student practice) activity of creating and recording musical patterns using the virtual instruments. • Critical listening and evaluation. • Construct questions for reflection.
Closure **What method of review and evaluation will be used to complete the lesson.** 5 minutes	• Review major points daily. • Checks for Understanding—Exit Slip Question On a scale of 1–5 (5 = Fully Understand – 1 = Don't at all Understand), how would you rate your understanding of this day/week's content? Provide me with areas in which you need further help.

Differentiation Strategies	
<u>Addressing English Language Learners</u> **Language Objective for ELL students, Language Domains & Language Development Level:** (Refer to CAN DO Descriptors, appendix A, to identify language levels and methods of specific language differentiation according to grade cluster) **<u>SIOP Sheltered Instruction Strategy</u>** Questioning • Use a variety of question types. • Ask open-ended questions that require true communication from and between students.	**<u>Addressing Special Education Students</u>** **IEP Accommodations and Modifications:** (Refer to individual IEP and for further strategies of differentiation, see Appendix B)
<u>Addressing 504 Students</u> (Refer to school's 504 Committee)	**<u>Addressing Gifted and Talented Students</u>** Allow students to create their own tasks and questions.

Phase I—Acquisition Period Coordinating Outline

Day 1 and 2: Getting Started and Play the Drums and Smart Drums

1. Students to complete essential question and exit slip exercises.
2. Get started with the sound browser and touch instruments.
3. Learn common elements across all instruments including the control bar, ruler, controls area, track header, and a play area.
4. Learn that the top screen has navigation, playback, and volume controls.
5. Learn that the ruler contains musical time of bars and beats.
6. Open Smart Drums from the sound browser list.
7. Choose drum kit for Smart Drums.
8. Preview drums.
9. Add drums to the grid.
10. Learn to use the XY pad for volume and complexity of patterns.
11. Create drum grooves automatically using the dice feature.
12. Edit the drum grooves after recording.
13. Solo and mute the recorded track.
14. Open the Drums instrument from the sound browser list.
15. Choose drum kit from the list of available traditional and electronic sets.
16. Tap the drums in the kit, and create a pattern.
17. Record a drum groove, and learn to add other layers of drum sounds.
18. Use the track controls button, and experiment with the touch sensitivity and quantizing.
19. Time for independent practice.
20. Frequent checks for understanding
21. Save song to be used for the next class session.

Day 3: Learn to use Virtual Session Drummer

1. Open the virtual session Drummer instrument using the sound browser window.
2. Choose drummer from the available drummer's name with a style description.
3. Choose drummer patterns from the available presets and play it using the Play button.
4. Adjust the loudness and complexity using the XY pad.
5. Mute and unmute any of the available pieces of the drum kit.
6. Choose a different pattern for the drummer to play by using the percussion, cymbals, and kick & snare features.
7. Change the feel by adjusting the swing value of the drummer's performance.
8. Adjust the amount of fills the drummer plays.
9. Have the drummer follow another instrument in your song such as the bass guitar by clicking on the follow feature.
10. Time for independent practice.
11. Edit and delete regions or replace them.
12. Frequent checks for understanding.
13. Save song to be used for the next class sessions.

Day 4 and 5: Play the Smart Bass and Smart Guitar

1. Open the song created during the previous class session.
2. Open the Smart Bass from the sound browser and choose the sound of the bass.
3. Play notes of a chord.
4. Play a bass line.
5. Use the Autoplay feature to create bass lines.
6. Play individual notes and learn the scale feature.
7. Record a simple bass progression on the following chords – C, G, Am, and F.
8. Open the Smart Guitar from the sound browser and choose the sound of the guitar.
9. Play chords with the following techniques; guitar strum, play full chord, and mute the strings.
10. Play strumming patterns with the chord strips using the Autoplay knob feature.
11. Play individual notes on the fingerboard and learn the scale feature.
12. Turn Stompbox effects on/off.
13. Record a simple guitar progression that conforms to the bass chords on C, G, Am, and F.
14. Solo and mute the recorded track.
15. Time for independent practice.
16. Frequent checks for understanding.
17. Save song to be used for the next class session.

Day 6 and 7: Play the Smart Strings

1. Open the song created during the previous class sessions.
2. Open the Smart Strings instrument from the sound browser.
3. Choose a string sound to play with.
4. Play different string instruments in chords view and experiment with the 1st and 2nd Violins, Violas, Cellos, and Basses features.
5. Play chords using the bowing, staccato, and pizzicato features.
6. Play rhythm patterns with the chord strips using the Autoplay features.
7. Play individual notes using legato, short legato, bowing, and pizzicato articulations.
8. Learn how to use the scale feature with the strings instrument.
9. Record a simple progression using the C, G, Am, and F chords over the previous recorded instruments.
10. Solo and mute the recorded track.
11. Time for independent practice.
12. Frequent checks for understanding.
13. Save song to be used for the next class sessions.

Day 7 and 8: Play the Keyboard and Smart Keyboard

1. Open the song created during the previous class sessions.
2. Open the keyboard from the sound browser list.
3. Choose a keyboard sound from the list of available traditional and synthesized keyboard sounds.

4. Touch the keys of the keyboard and play with octave down and octave up arrows
5. Experiment with the sustain, glissando, and scroll features while playing the keys.
6. Learn how to use the scale feature as it is consistent with the guitar, bass, and strings instrument.
7. Run the arpeggiator icon and use its' note order, note rate, and octave range features.
8. Record a simple passage by playing or touching the keys.
9. Open the Smart Keyboard instrument from the sound browser.
10. Open Choose a keyboard sound from the list of pianos and synths.
11. Play chords by touching the chord strip. The Smart Keyboard has some unique features including: play chords higher or lower, play a bass note or sets of bass notes, and play chords and bass notes together.
12. Experiment with the sustain feature like the sustain pedal used in a traditional piano.
13. Experiment with the arpeggiator icon and run it using the note order, note range, and octave range features.
14. Play with the Autoplay features and experiment with the comping accompaniment patterns. The upper segments of the chord strip showing the chord names play chords and bass notes together. The middle segments play chords only. Tapping with two or three fingers plays variations of the pattern. The lower segments play bass notes only. With this feature, you can combine chords with different bass notes of belonging to other chords to create interesting patterns found in piano accompaniments by professionals.
15. Simply tap the strip for the chord or notes to stop playing.
16. Create and record a chord pattern using the C, G, Am, and F chords.
17. Solo and mute the recorded track.
18. Time for independent practice.
19. Frequent checks for understanding.
20. Save song to be used for next class session.

Day 9 and 10: Learn to use the Audio Recorder and Sampler

1. Open the Audio Recorder and record a sound such as voice.
2. Adjust the microphone input level and automatic setting.
3. Reduce unwanted noise through the noise gate.
4. The external microphone feature will not be used as the class does not have the equipment.
5. Change sound using a preset such as small room, large room, dreamy, etc. how to edit their settings.
6. Open the Sampler and record a sound to be used as a sample.
7. Add an audio sound, and play it using the keyboard
8. Edit the sample's features such as the shape, tune, or trim controls.
9. Frequent checks for understanding.
10. Time for independent practice.
11. Save song to be used for the next class session.
12. Review Phase I.

Week of: January 15, 2018 – January 26, 2018 **Teacher:** Mr. S. Sabet
Grade/Content Area: 9–12 Music Technology **Unit:** GarageBand Composition—Phase II

	Week 1/15–1/26
Standards	**NJCCS Performing Arts** 1.1 The Creative Process, 1.3 Performance, 1.4 Aesthetic Responses & Critique Methodologies **National Core Arts Standards** Creating: Plan and Make MU:Cr2.1.T.Ia: Select melodic, rhythmic, and harmonic ideas to develop into a larger work using digital tools and resources. Creating: Evaluate and Refine MU:Cr3.1.T.Ia: Drawing on feedback from teachers and peers, develop and implement strategies to improve and refine the technical and expressive aspects of draft compositions and improvisations.
Lesson Objective	Students will be able to plan and make music using virtual instruments and features in the GarageBand App for iPad. Students will also evaluate and refine the same by Friday, January 26, 2018.
Resources	• iPad Cart of 30 Tablets with iOS 9.3.5 and IWB adapter • Interactive White Board • GarageBand app • Headphones and headphone splitters • GarageBand Help Guide and GarageBand for iPad Starter Guide • A Process for the Creative Product by Brian Moore Handout and National Core Arts Standards—Music Technology Standard of Creating
Lesson Description	
Anticipatory Set ***List specific statements or activities you will use to focus students on the lesson*** State clearly what students are learning and how it connects to prior learning. 5 minutes	• Essential Questions: Week 3—How do musicians make creative decisions? Week 4—How do musicians improve the quality of their work? • Students decide on an idea and compose pattern(s) for music composition in GarageBand.

Direct Instruction ***What information is essential for the student to know before beginning and will this skill be communicated? How will you be demonstrating this skill? Identify strategies to be used to determine if students have learned the objectives.*** 5 minutes	• Modeling: Mr. Sabet will model desired performance of iPad activities with GarageBand. • Mr. Sabet will circulate throughout and provide feedback to students. • Interactive class discussion with frequent checks of understanding. • Socratic Seminar based on A Process for the Creative Product by Brian Moore Handout and National Core Arts Standards—Music Technology Standard of Creating
Guided Practice/Monitoring ***List activities which will be used to guide student practice and provide a timeframe for completing this practice.*** 10 minutes	• We do (Teacher and Students) activities of playing instruments and learning features with GarageBand. • Peer review of activity. • Q and A class session before independent practice.
Independent Practice **Assignments to be given to students to ensure they have mastered the skill without the teacher's guidance.** 23 minutes	• You do (Students) activity of creating and recording musical patterns using the virtual instruments. • Evaluate and refine musical parts for cohesion. • Construct questions for reflection.
Closure **What method of review and evaluation will be used to complete the lesson.** 5 minutes	• Review major points daily. • Checks for Understanding—Exit Slip Question On a scale of 1–5 (5 = Fully Understand – 1 = Don't at all Understand), how would you rate your understanding of this day/week's content? Provide me with areas in which you need further help.

Differentiation Strategies	
Addressing English Language Learners **Language Objective for ELL students, Language Domains & Language Development Level:** (Refer to CAN DO Descriptors, appendix A, to identify language levels and methods of specific language differentiation according to grade cluster) **SIOP Sheltered Instruction Strategy** Questioning • Use a variety of question types. • Ask open-ended questions that require true communication from and between students.	**Addressing Special Education Students** **IEP Accommodations and Modifications:** (Refer to individual IEP and for further strategies of differentiation, see Appendix B)
Addressing 504 Students (Refer to school's 504 Committee)	**Addressing Gifted and Talented Students** Allow students to create their own tasks and questions.

Phase II—GarageBand Composition Coordinating Outline

Day 11: Framework for Music Composition and Socratic Seminar

1. Teacher will provide students with Brian Moore's framework for "A process for the creative product" and the National Core Arts Standards—Music Technology—Creating
2. Teacher will elicit student responses through Socratic Seminar and create a master list of possible compositional ideas for students to use.
3. Teacher will answer student questions and set expectations and deadlines for completed music composition.

Day 12–20: Build an Original Song with GarageBand Song

1. Students to complete essential question and exit slip exercises.
2. Use touch instruments from Phase I to create an original song.
3. Create original tracks and sections.
4. Revise and evaluate tracks and sections.
5. Listen critically to own music and peers' music.
6. Build a song in tracks view.
7. Create and save songs.
8. Play and navigate songs.
9. Change song settings.
10. Use the Notepad.
11. Add Apple loops.
12. Import audio.
13. Edit regions.
14. Edit notes in regions.
15. Automate volume changes.
16. Extend song with sections.
17. Merge tracks.
18. Mix levels, and prepare song for presentation.

Week of: January 29, 2018 – February 9, 2018 **Teacher:** Mr. S. Sabet
Grade/Content Area: 9–12 Music Technology **Unit:** Presentation/Peer Review—Phase III

	Week 1/29–2/9
Standards	**NJCCS Performing Arts** 1.1 The Creative Process, 1.3 Performance, 1.4 Aesthetic Responses & Critique Methodologies **National Core Arts Standards** Creating: Present MU:Cr3.2.T.Ia: Share compositions or improvisations that demonstrate a proficient level of musical and technological craftsmanship as well as the use of digital tools and resources in developing and organizing musical ideas.
Lesson Objective	Students will be able to present their finished composition in class with their peers for reflection and critique by Friday, February 9, 2018.
Resources	• iPad Cart of 30 Tablets with iOS 9.3.5 • GarageBand App • Headphones and headphone splitters • Teacher workstation and audio setup for playback • Student critique sheets
Lesson Description	
Anticipatory Set ***List specific statements or activities you will use to focus students on the lesson*** State clearly what students are learning and how it connects to prior learning. 3 minutes	• Essential Questions: When is creative work ready to share?
Direct Instruction ***What information is essential for the student to know before beginning and will this skill be communicated? How will you be demonstrating this skill? Identify strategies to be used to determine if students have learned the objectives.*** 5 minutes	• Mr. Sabet will have all students write their name on a small sheet of paper, fold it, and place it in a coffee can so students can be drawn at random for presentation. • Mr. Sabet will provide instructions for critiques. At the end of each student presentation, peer-students will provide the following feedback; one positive comment, one constructive comment, and ask one higher order question.
Guided Practice/Monitoring ***List activities which will be used to guide student practice and provide a timeframe for completing this practice.*** 35 minutes	• In-class student presentation of music compositions. • Peer review and critiques. • Ask/answer questions related to presentation.
Independent Practice **Assignments to be given to students**	• N/A

to ensure they have mastered the skill without the teacher's guidance.	
Closure **What method of review and evaluation will be used to complete the lesson.** 5 minutes	• Review major points daily. • Checks for Understanding – Exit Slip Question On a scale of 1–5 (5 = Fully Understand – 1 = Don't at all Understand), how would you rate your understanding of this day/week's content? Provide me with areas in which you need further help.

Differentiation Strategies	
Addressing English Language Learners **Language Objective for ELL students, Language Domains & Language Development Level:** (Refer to CAN DO Descriptors, appendix A, to identify language levels and methods of specific language differentiation according to grade cluster) **SIOP Sheltered Instruction Strategy** Questioning • Use a variety of question types. Ask open-ended questions that require true communication from and between students.	**Addressing Special Education Students** **IEP Accommodations and Modifications:** (Refer to individual IEP and for further strategies of differentiation, see Appendix B)
Addressing 504 Students (Refer to school's 504 Committee)	**Addressing Gifted and Talented Students** Allow students to create their own tasks and questions

Phase III—Presentations and Peer-Review Coordinating Outline

Day 21–25: Listening Sessions - Student presentations and critiques

1. Students to complete essential question and exit slip exercises.
2. Students will enter their names for random drawing for presentation order.
3. Students to share their original music with their peers.
4. Peers will provide written critiques and feedback.
5. Mr. Sabet will facilitate in-class discussion of feedback.

Appendix C

GB Check-in (Week 1 and 2)

Directions: Please answer the following questions. Your responses will help me to gauge your understanding of GarageBand and provide me ways to assist you going forward.

1. What have you enjoyed most by working with GarageBand?

2. What do you like least when working with GarageBand?

3. What help do you need as we continue to use GarageBand?

Appendix D

A Process for the Creative Product

(Moore, 2003, p. 206)

Process	Skills	Questions/Comments
1. Find an interesting problem to solve.	• Musical thinking and problem solving • Open-ended vs. clearly defined • Internal vs. external	• Identify the situation • What's the current state of affairs? • What is needed? • Is there a problem that needs solving? • Who will be the audience?
2. Create something (the germinal idea).	• Initial idea(s) • Elements of music (a chord, a phrase, a form) • Emotion of music (a mood, a feeling, an image) • External to music (a poem)	• Create something-anything. • What you create may not have been done before! • You don't need to worry about labels, structure, etc. Think outside the box!
3. Develop "first draft."	• Brainstorming • Connections • Variations • Relationships • Balance	• Put your creation in context • Did it fill the need or solve the problem?
4. Evaluate	• Function as listener rather than composer • Decide what works and what doesn't • Try to hear with "new ears."	• What do you think? • Can you view your creation as if perceiving it for the first time?
5. Revise? (May need to go back to # 3 or 2)	• You may want or need to go back to try again or just make some changes.	• You might need to rework ideas. • You might need to throw away ideas. • You might need new ideas. • You might need to say, "It's Done!"
6. If done, analyze for future use.	• What did you create? • What labels and vocabulary would you use?	• Now figure out what you did! • How did you do it? • Why does it work?
7. Share.	• Live performance • Technology (recordings) • Email and Internet	• Let your creation be shared and enjoyed!

Appendix E

National Core Arts Standards – Music Technology Creating Standard
(Adapted from National Coalition for Core Arts Standards, 2014)

Imagine
Anchor Standard 1: Initiating and drafting musical ideas to create work. Enduring Understanding: The ideas, thoughts, feelings, or other factors that inspire musicians to create works from a variety of sources. Essential Question: How do musicians generate creative ideas through imagination?

Plan and Make
Anchor Standard 2: Organizing ideas to develop creative ideas and work. Enduring Understanding: Musicians' artistic decisions are determined by their level of experience, vision, and creative intentions. Essential Question: How do musicians make creative decisions through planning and creating?

Evaluate and Refine
Anchor Standard 3: Refine and complete artistic work. Enduring Understanding: Musicians evaluate, and refine their work through openness to new ideas, persistence, and the application of appropriate criteria. Essential Question: How doe musicians improve their creative work through evaluation and revision?

Present
Enduring Understanding: Musicians' presentation of creative work is the culmination of a process of creation and communication. Essential Question: When is a creative work ready to present and share with others?

Appendix F

Daily Teacher Reflection Log

1. What situations or students stood out today and why?

2. What situations or students need more help or attention and why?

3. What went well today, and why?

4. What did not go as planned, and how can I correct it going forward?

5. What do I need to do now to prepare for next week's agenda?

6. Any experience that relates to my own music technology experiences?

Appendix G

Listening Session: Peer-Review Critiques of Compositions

Directions: Students will be randomly selected to present their composition for in-class listening. All students will present their work and all students will provide written feedback to each presenter. Students will receive their feedback after all students have presented their music.

Listen to your fellow student's music compositions. Your goal as a listener is to give your fellow students your undivided attention, listen with an open-mind, and provide supportive feedback for creative and musical growth.

After listening to each student's music, you will get a chance to share your responses and ask the student questions regarding their music, creative process, challenges, triumphs, etc. Your peers will receive your comments after all listening sessions are over.

Write and prepare the following comments for class discussion after listening to your peer.

1. Provide 1-2 compliments or positive statements specific to the music your peer shared in class. (Be specific, don't just say "I liked it.")

2. Provide 1-2 comments for growth that can help your peer improve his/her music. (Your comments can be on improving musical content, music technology use, or anything else relevant to improving the project.)

3. Ask a higher order question to the student specific to the music you just heard. (Suggestions can be techniques, skills, or ideas heard in the music and how your peer used them. Example: Why did you pan the electric guitar to left speaker and the acoustic guitar in the right speaker?)

Appendix H

GarageBand Self-Assessment

Directions: Please read and reflect on your progress throughout our unit when working with GarageBand and answer the following questions to the best of your ability. This self-assessment will help to support your grade.

1. What letter grade do you think you deserve on your GarageBand project. You must give specific reasons to justify your answers. Think about music content, technology, use, musical ideas, time management, etc.

2. What letter grade do you think you deserve on your GarageBand presentation? You must give specific reasons to support your answers such as your ability to answer questions, showed the class how you used GarageBand to be creative, demonstrating how the program works, etc.

3. What letter grade do you think you deserve on supporting your peers during presentations? You must give reasons for your answers such as giving detailed responses during critiques, being attentive, respectful, etc.

Appendix I

Initial Student Intake Questionnaire

(All questions will be entered into surveymonkey.com which will be used to distribute the questionnaire to the students).

Student Instructions: Read and answer each question.

1. What is your first name and last initial? (Example John S.)

2. How old are you?

3. What gender are you?
    a. Male
    b. Female
    c. Prefer not to answer

4. Do you currently play an instrument?
    a. Yes
    b. No

5. If yes, what instrument(s) do you play and for how long?

6. Do you currently read music?
    a. Yes
    b. No

7. If so, how would you rate your music reading skills
    a. Excellent
    b. Very good
    c. Average
    d. Not good
    e. Don't read at all

8. What other music classes are you currently taking of have taken in the past? Check all that apply:

__Music Technology	__Guitar	__Piano
__Band	__Music Theory	__Musical Theater
__Choir	__Orchestra	__Marching Band
__Music Theater Orchestra		
__Other_____		

9. How often do you typically use technology such as a computer, laptop, or mobile device to complete school assignments?
    a. Only for major projects
    b. Once a week
    c. Daily
    d. Never

10. How often do you use technology such as a computer, laptop, or other mobile device for personal or entertainment purposes?
    a. Monthly
    b. Weekly
    c. Daily
    d. Never

11. Do you currently listen to music through online streaming services such as Pandora, Spotify, YouTube?

    a. Yes
    b. No

12. Approximately, how many hours per week do you listen to the online streaming service?

13. Approximately, how many hours per week do you listen to music in general?

14. Do you currently use technology such as apps, software, online sites, etc. to record and create your own music?
    a. Yes
    b. No

15. How often do you create your own music using technology?
    a. daily
    b. weekly
    c. monthly

Appendix J

Open Response Written Questions

(Verrico & Reese, 2016)

All students will provide open responses to the following questions at the end of the unit.

Student Instructions: Write your first name and last initial on this open-ended questionnaire. Read and answer each question. Remember to think about your experiences throughout this unit when answering each question.

1. What is your First Name and Last Initial? Example, Steven S.

GarageBand App

2. Describe the GarageBand App you explored on the iPad. Feel free to offer other Apps on the iPad that can be useful in music technology.

3. Describe how you used GarageBand on iPad to explore, create, and perform music.

Perceptions

4. Describe something new you discovered about your ability to use technology or your ability to create and perform music while using GarageBand on the iPad.

5. Describe *triumphs* you experienced during class or on your own throughout this process. Responses can include thoughts about the technology, music content, or group interactions.

6. Describe *challenges* you experienced during class or on your own throughout this entire process. Responses can include thoughts about the technology, music content, or group interactions.

7. In the space below, share anything else you'd like to about your experiences during this unit.

Perceptions of Self

8. Consider what you thought about your abilities to create and perform music prior to joining this class. Have your perceptions of your abilities changed during this experience? If so, how have they changed? Do you think this experience has affected your musicianship (performing/creating) outside of class? If so, how? (listening/performing/creating) Why do you think your perceptions of have changed or remained unchanged?

9. How do you think this experience informed your concept of yourself as a musician? Your perception of yourself as creator of music using roles such as performer, composer, recording engineer, producer, listener, etc.?
10. Compare your music you created previously using other programs or approaches to your music created on the iPad. How are your experiences creating music similar? How are they different?

Perceptions of Technology

11. What do you think of iPad technology for creating music? (Remember you can incorporate any process such as recording, performing, producing, listening etc. in your response)
12. What are some of the benefits of the technology?
13. What are some of the challenges of the technology? Did any of your responses improve over time, if so, how?
14. Do you think you will continue searching for opportunities to create music using technology as a result of this unit? Why or why not?

Perceptions of experiences – general

15. What are some things you might suggest keeping the same about this experience, if we were to continue?
16. What are some things you might suggest changing about this experience, if we were to continue?
17. What would you say to someone who was considering joining a music technology class?
18. Did you share your technology experiences with your friends and family outside of class? If so, what was that like?

Perceptions of Creativity

19. How does using GarageBand allow you to generate creative ideas?
20. How does using GarageBand influence you to make creative decisions?
21. How does using GarageBand improve the quality of your musical works?
22. How does using GarageBand help you to share your musical works?

Perceptions of Peer-Review and Reflection

23. How would you describe sharing your song with your peers during the listening sessions?
24. Describe some things that surprised you about your experiences during the listening
    sessions?
25. What are some of the benefits and challenges of sharing your music?
26. Describe how you felt before and after you shared your music with your peers?
27. Describe how you felt before and after reading your peer's critiques of your music?

Appendix K

Informed Consent

Dear Parents,

I am Mr. Sabet, the music technology and guitar teacher at Thomas Jefferson Arts Academy. In addition to teaching here in Elizabeth, I am currently working on my doctorate in Music Education. As part of this degree, I must complete a research study and dissertation. The title of my research project for this degree is: Study in Music Technology: High School Students Composing with GarageBand for iPad

The Thomas Jefferson Arts Academy has given me permission to conduct this research in the Music Technology lab. I am now asking for your consent as a parent to allow your child to participate in the study. To participate, the students will be required to complete one survey in addition to their normal classroom assignments. The survey requires about 5–10 minutes to complete, and will be done during regular class time. A music composition they would normally complete over the course of the semester will be recorded from the iPads onto a CD or USB Drive to be included in the study. These compositions will be shared with their classmates for peer-review and reflection. Peer-review class sessions will audio-recorded to capture student discussions. There will be no additional class work necessary to participate in the study and participation in (or exemption from) the study will in no way affect your child's grade in the class. Your child will receive a certificate for 6 hours of community service for participating. They will receive a prorated amount if they withdraw before the study is over.

There are no known risks to your child for participating in the study. Your child may benefit from participation in that he or she will think reflectively on their work in music class, possibly yielding better future work. The data collected may also help future students achieve greater success in music composition and music technology.

The research conducted will be kept confidential. Confidential means that the research records will include some information about your child, such as their first name and grade in school. I will keep this information confidential by limiting individual's access to the research data and keeping it in a secure location. In addition to me, only the Institutional Review Board at Rutgers University will be allowed to see the data, except as required by law. If a report of this study is published, or the results are presented at a professional conference, group results will be stated not an individual student. If individual compositions are ever referenced, they will be referred to by pseudonym. At no time will your child's individual work be referenced by name.

If you have any questions about the research, you may contact me at:

Steven Sabet
Thomas Jefferson Arts Academy
27 Martin Luther King Jr. Plaza
Elizabeth, NJ 07201
Tel (908) 436-6767 | email: sabetst@epsnj.org

_____
(initial)

If you have any questions about your child's right as a research subject, you may contact the Sponsored Programs Administrator at:

Rutgers University Institutional Review Board for the Protection of Human Subjects Office of Research and Sponsored Programs 3 Rutgers Plaza New Brunswick, NJ 08901-8559

Tel: 732-932-0150 ext. 2104 Email: humansubjects@orsp.rutgers.edu

Your child's participation in this study is voluntary. Please sign and return the attached permission slip if you are willing to have your child participate. Your support is greatly appreciated.

Sincerely,

Steven Sabet

****

_____ has my permission to participate in the
(Child's name)
Study in Mobile Music Technology: High School Students Composing with GarageBand for iPad research study that will be conducted by Steven Sabet.

Signature of Parent or Guardian _____ Date _____

Appendix L

Letter of Assent

Dear Students,

I am Mr. Sabet, the music technology and guitar teacher here at Thomas Jefferson Arts Academy. I am also a doctoral student at Rutgers University. In order to complete my degree there, I have to complete a research study on technology and music composition of high school students. You are invited to take part in this study.

If you agree to participate, I will record your music composition with GarageBand on the iPad in the Music Tech Lab this year and you will be asked to fill out a survey in class that will take about 10-15 minutes. Your first name and last initial will be on the questionnaire and the survey only to match them up with your compositions, but at no time will your name ever be linked with your work in publication. Your identity will be kept confidential. You will be asked to write your age, grade, and gender (whether you are male or female) on the form.

Your grades will not be affected in any way by your decision to participate or not participate in the study. I, your Music Tech teacher, will not be aware of which students are participating in the study and which are not. Participating in this study could help you to understand your own composition process, music technology, musical creativity better, and your participation may increase understanding of the factors that influence students' musical experiences. There are no foreseen risks to participating in the study. If you decide to participate, you will receive a certificate for 6 community service hours that you may turn in to the guidance department. If you withdraw from the study, you will receive a pro-rated amount.

You may skip any questions that you are not comfortable with, and you may decide to stop participating at any time without any penalty to you. One of your parents will also be required to provide permission for you to participate in the study, and they will be given my phone number in case you or your parents have any questions about the research. They will also have a phone number for the Office of Research and Sponsored Programs at Rutgers University, in case there are any questions about your rights as a research subject. You will be given a copy of this form to keep.

If you agree to participate in the study, please sign below:

Student signature _____ Date _____

Student name (printed) _____ Date _____

Investigator signature _____ Date _____

Appendix M

Site Letter of Cooperation

Thomas Jefferson Arts Academy

Olga Hugelmeyer, Superintendent

Michael Ojeda, Principal
Alexandra Mickens, Vice Principal
Cheryl Ann Popielarski, Vice Principal

Date: 09/29/2017

Re: Letter of Cooperation For Thomas Jefferson Arts Academy, Elizabeth, NJ

Dear Steven Sabet,

This letter confirms that I, as an authorized representative of the Thomas Jefferson Arts Academy allow the Principal Investigator and study staff, if any access to conduct study related activities at the listed site(s), as discussed with the Principal Investigator and briefly outlined below, and which may commence when the Principal Investigator provides evidence of IRB approval for the proposed project. I also agree to authorize Steven Sabet, the Principal Investigator, access to the site located at Thomas Jefferson Arts Academy to conduct this research study.

- **Research Site(s)**: Music Technology Class located at the Thomas Jefferson Arts Academy, 27 Martin Luther King Jr., Plaza, Elizabeth, NJ 07201
- **Study Purpose:** To research music technology students composing music using the GarageBand App on the iPad and investigate its effects on student engagement, learning, creativity, and instructional practice.
- **Study Activities:** Students will be asked to take an initial survey related to their use of music and technology before the first instructional unit. At the end of the final instructional unit students will answer surveys and open response questions related to their perceptions of learning, engagement, creativity, and their overall educational experience composing music using mobile technology.
- **Subject Enrollment:** Students regularly enrolled in music technology course(s) at Thomas Jefferson Arts Academy with enrollment of no more than 40 students.
- **Site(s) Support**: Thomas Jefferson Arts Academy will provide resources already available to Principal Investigators worksite including a classroom, iPad cart(s) with iPads, computer access for educational purposes, and support services such as reasonable photocopying and survey distribution.
- **Data Management:** Students will use their first name and last initial (example Steven S.) on all assignments, surveys, and forms of data. Data will be de-identified using pseudonyms to protect student identity for publication. Data will be distributed and collected using surveymonkey.com. The principal investigator will keep data secured with password protection in which he will have the only access. Any paper work such as consent and assent forms will be kept in a sealed enveloped locked in a safe located in the Thomas Jefferson Arts Academy music department.

27 Martin Luther King, Jr. Plaza, Elizabeth, New Jersey 07201 • Ph: 908.436.6767 • Fax: 908.436.6733
Email: ojedami@epsnj.org • Website: www.edline.net/pages/thomas_jefferson_arts_academy

Thomas Jefferson Arts Academy

Olga Hugelmeyer, Superintendent

Michael Ojeda, Principal
Alexandra Mickens, Vice Principal
Cheryl Ann Popielarski, Vice Principal

- **Other:** Students will create audio files of their music using their first name and last initial but will be identified only under their pseudonym for research publication. Audio recordings of student discussions on music composition, technology, and student reflection will be taken during one unit of instruction as a form of data.
- **Anticipated End Date:** January 1, 2018 – February 28, 2018.

We understand that this site's participation will only take place during the study's active IRB approval period. All study related activities must cease if IRB approval expires or is suspended. I understand that any activities involving Personal Private Information or Protected Health Information may require compliance with HIPAA Laws and Rutgers Policy.

Our organization agrees to the terms and conditions stated above. If we have any concerns related to this project, we will contact the Principal Investigator. For concerns regarding IRB policy or human subject welfare, we may also contact the Rutgers IRB (see orra.rutgers.edu/hspp).

Regards,

[redacted]

Signature **Date Signed**

[redacted]

Full Name **Job Title**

Letter of Cooperation for Study: **Study in Mobile Music Technology: High School Students Composing with GarageBand for iPad**

27 Martin Luther King, Jr. Plaza, Elizabeth, New Jersey 07201 • Ph: 908.436.6767 • Fax: 908.436.6733
Email: ojedami@epsnj.org • Website: www.edline.net/pages/thomas_jefferson_arts_academy

Appendix N

Rutgers IRB Approval Letter

RUTGERS

Office of Research and Regulatory Affairs
Arts and Sciences IRB
Rutgers, The State University of New Jersey
335 George Street / Liberty Plaza / Suite 3200
New Brunswick, NJ 08901

orra.rutgers.edu/artsci
732-235-2866

September 29, 2017

P.I. Name: Sabet
Protocol #: E18-080

Steven Sabet
23 Lakewood Ave
Cerdar Grove NJ 07009

Dear Steven Sabet:

This project identified below has been approved for exemption under one of the six categories noted in 45 CFR 46, and as noted below:

Protocol Title: "Study in Mobile Music Technology: High School Students Composing with GarageBand for iPad"

Exemption Date: 9/18/2017 **Exempt Category:** 1,2

This exemption is based on the following assumptions:

- **This Approval** - The research will be conducted according to the most recent version of the protocol that was submitted.
- **Reporting** –ORRA/Arts & Sciences IRB must be immediately informed of any injuries to subjects that occur (within 24 hours) and/or problems (e.g., subject complaints) that arise, in the course of your research within a timely manner (within 5 business days). Visit our website for more information on reportable events, https://orra.rutgers.edu/reportable-events; **Modifications** – Any proposed changes MUST be submitted to the IRB as an amendment for review and approval prior to implementation;
- **Consent Form (s)** – Each person who signs a consent document will be given a copy of that document, if you are using such documents in your research. The Principal Investigator must retain all signed documents for at least three years after the conclusion of the research;

Additional Notes:	▪ Exemption Granted, Category #1 &2, on 09/29/17, Not Funded

Failure to comply with these conditions will result in withdrawal of this approval.
Please note that the IRB has the authority to observe, or have a third party observe, the consent process or the research itself. The Federal-wide Assurance (FWA) number for the Rutgers University IRB is FWA00003913; this number may be requested on funding applications or by collaborators.

Sincerely yours,

[redacted]

Acting For--
Beverly Tepper, Ph.D.
Professor, Department of Food Science
IRB Chair, Arts and Sciences Institutional Review Board
Rutgers, The State University of New Jersey

cc: Stephanie Cronenberg (MW:dv)

Appendix O

Audio-Recording of Class Discussions Consent Form

As part of this research study, class discussions of our student's peer-review music listening sessions may be tape-recorded for data analysis, and portions of recordings may be presented in a professional context. Although real names will not be used in presentations of the research, and responses will be treated with confidentiality to anyone outside of the project research staff, participants might be identifiable to people who recognize them in audio taped artifacts. Recordings will be kept until completion of degree and destroyed immediately thereafter. Please sign below if you are willing to have your comments(s) recorded on audio-tape during regular class discussion. You may still participate in this study if you are not willing to have the interview(s) recorded.

_____

_____

Parent Signature Date

-

_____

_____

Student Signature

Appendix P

Script for Oral Consent

Mr. Sabet is a doctoral candidate at Rutgers University and as part of his degree requirements he is conducting a research study. The topic of his research is to study high school music students describing their experiences composing music using the GarageBand App for iPad. Our school principal, Mr. Ojeda, and Rutgers University has approved this study. You are asked to participate in this study and contribute to Mr. Sabet's findings. You are not required to participate in the study and Mr. Sabet will not know who is participating until after the study has been completed and all grades have been turned in. All students will be asked to complete assignments that correspond with his study. These assignments include regular instructional practices such as answering questions, student-reflection responses, completing and presenting music technology projects, peer-review critiques, and in-class discussions. All assignments will be completed in-class. If you decide to participate in the study, Mr. Sabet can use your assignments as data for his study. If you decide not to participate then your assignments will only count as assignments and cannot count as data for his study. If you decide to participate you will be given a certificate for 6 community service hours that you can turn into our guidance department. Community service certificates will only be distributed after the study has been conducted and grades have been turned in. Your identity will be kept confidential and your names will not be published on any documents. Your names will be changed to a pseudonym to protect identify for publication. I will now pass out all consent forms and assent forms for your parents and yourselves to complete and return them to me. Do not return them to Mr. Sabet.

Appendix Q

Themes and Codes Definitions

Theme: Music and Production Features
Technical features – Students/musicians and teacher used technology to create, present/share, demonstrate, and interact with content. \ **Production** – Students used domain-specific tools to create music such as recording, midi sequencing, mixing, monitoring, producing, performing, etc. Students applied production skills to create their works and teacher noticed how students described how they used production skills during peer-review sessions. **Musical Elements** – Students applied music content learned in class to help them structure their work. Teacher noticed how students used music elements such as style and instrumentation, texture, form, melody, and chords and harmony to create their projects and during peer review sessions while responding to student work. **Technology Facilitated the creative process** – Music technology provided feedback for students to monitor progress for evaluation and revision. **User-friendly – "Like app." –** Students adapted well to using the iPad to create music and students responded verbally/writing that GarageBand was an easy program to use compared to other DAWs.

Theme: Thinking Creatively
Life Experiences – Students/musicians use life events as a source of inspiration to communicate mood, thoughts, emotions, and ideas in their music. Students/musicians use or teacher notices/observes students using life events as a source of inspiration to communicate mood, thoughts emotions, and ideas in their music **Flexibility and Exploration –** Teacher noticed students engaging in exploratory behavior or students described exploratory behavior while learning to use and create music with GB. Teacher recognized students investing time and energy that was student-centered and not teacher-centered. In many cases, students found out features note originally taught on a certain day made creative use of these features in the works. **Reviewing and Editing** – Students reported or teacher observed students evaluating their work to make improvements based on self-assessment, peer, or teacher reported feedback. **"Composer Happy" –** Students/musicians are most comfortable sharing and presenting their music when they are happy with their work or the teacher noticed that students are most comfortable presenting their works when they are happy/satisfied. **Empowerment** – Students discovered confidence creating and sharing music using technology with new possibilities. Teacher observed students reporting that they can be creative and musical, even with limited ability.

Theme: Instructional Roadblocks
"Dislike app" – GarageBand lacked some advanced technical features, and the iPad screen size can be a problem for some users; other students disliked the app for other reasons. Students expressed a desire to use advanced features not available in GarageBand or expressed other challenges with the iPad hardware. **Challenging Learning Experiences –** Students and teacher experienced difficulty during the instructional unit and teacher observed ways to redirect instruction because of these challenges. **Presenting Challenges** – Students experienced nervousness or anxiety when sharing or presenting their work with others to listen or review. Teacher observed students being nervous while presenting/sharing music.