Chapter 14

Teaching and Learning with Technology in Music and Art

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Learning Outcomes

After reading this chapter and completing the learning activities, you should be able to:

14.1 Identify implications of current issues that music teachers face for technology integration. (ISTE Standards for Educators: 1—Learner; 2—Leader; 3—Citizen)

14.2 Select technology integration strategies that can meet needs for instruction in music curricula. (ISTE Standards for Educators: 1—Learner; 2—Leader; 3—Citizen; 4—Collaborator; 5—Designer; 6—Facilitator; 7—Analyst)

14.3 Identify implications of current issues that art teachers face for technology integration. (ISTE Standards for Educators: 1—Learner; 2—Leader; 3—Citizen)

14.4 Select technology integration strategies that can meet needs for instruction in art curricula. (ISTE Standards for Educators: 1—Learner; 2—Leader; 3—Citizen; 4—Collaborator; 5—Designer; 6—Facilitator; 7—Analyst)

Technology Integration in Action: The Fine Art of Digital Portfolios

GRADE LEVELS: Middle to high school

CONTENT AREA/TOPIC: Music and art composition, technology

LENGTH OF TIME: Ongoing

(Continued)

PHASE 1 Analysis of Learning and Teaching Assets and Needs

Step 1: Analyze problems of practice (POPs)

The music, arts, and technology teachers at Eureka High School always had difficulty finding an audience for students' work; the teachers knew that having others listen to or view their work was motivating and provided helpful feedback to students at all levels. This was important because students in their classes always range from beginners in musical composition, artistic expressions, and technology creation to advanced musicians, artists, and designers. A new block scheduling plan in which music, art, and technology courses would share one of the four 90-minute units that students would attend each day posed an opportunity to tackle the authentic audience "problem of practice" at the same time as possibly working toward creating projects that linked the three disciplines.

Step 2: Assess technological resources of students, families, teachers, and the school

Eureka High School was a Bring Your Own Device (BYOD) school because the student population and their families tended to have newer and more updated technology than the school. However, the music, art, and technology programs had access to computer labs and specialty software and hardware, such as the Adobe Creative Cloud and music software including **Musical Instrument Digital Interface (MIDI)** keyboards and music editing software. The teachers had a history of using various technologies in their subject areas and pushing their school to purchase more updated tools to advance their teaching and students' learning.

Step 3: Identify technological possibilities

The teachers realized that a logical thread among these three curricula would be to have students develop a web-based portfolio of their musical and artistic work, which could serve as a valuable, ongoing assessment tool for students' art, music, and technology development. Portfolios would help students develop skills in using technology to present their work and to communicate and share information with others. The teachers explored the available web-based tools for constructing portfolios. They each examined several online platforms ranging from free or low cost to pay per use; they also tried using portfolio systems that ranged from prescriptive to extremely flexible. They eventually settled on a web-based tool that was flexible in that it allowed many types of media to be displayed and functioned on different computer/tablet/mobile platforms, but it was limited in that the overall design of each student portfolio would be the same. However, because the tool fit within their budget and would be easier to implement across classes, they decided it was the best choice.

PHASE 2 Design of the Integration Framework

Step 4: Decide on learning objectives and assessments

The teachers decided each would use a component of the portfolio as the basis of student assessment for each grading period. The art and music teachers would assign each student individual benchmarks to achieve in their composition and skill development, and the technology teacher would use the electronic portfolios that the students produced to assess their production skills. Students' grades would be a combination of the three assessments, with each content area scores weighted according to the one that was being emphasized during the respective grading period. They decided on the following outcomes, objectives, and assessment strategies:

Outcome: Progress in art.

- **Objective:** Students will meet their assigned benchmark for progress in art skills.
- **Assessment:** Rubric to assess this portfolio component.

Outcome: Progress in music.

- **Objective:** Students will meet their assigned benchmark for progress in music skills.
- **Assessment:** Rubric to assess this portfolio component.

Outcome: Progress in language expression.

- **Objective:** Students will meet their assigned benchmark for development in written and oral expression.
- **Assessment:** Rubric to assess this portfolio component.

Outcome: Technology skills.

- **Objective:** Students will demonstrate competence in each required web page development skill by completing assigned tasks.
- **Assessment:** Web production checklist.

Step 5: Design integration strategies and determine relative advantage

The teachers decided to follow the same sequence of activities for each grading period:

- **Review skill levels and set benchmarks:** The art and music teachers meet with each student, review accomplishments to date, and set benchmarks for individual skill development. Some students with lower skill levels are placed in small groups so that teachers can spend more time working with them.
- **Review portfolio requirements**: The technology teacher meets with each student, reviews the requirements for the portfolio, and sets tasks and expectations to assist students in developing more clear and aesthetically pleasing artifacts.
- **Decide on projects**: A different project is set for each grading period. For example, for the first project, the teachers decide to have students use their MIDI keyboards and notation software to write a musical composition based on the music of a period they have been studying in their history classes. Then the students use image manipulation software to create a collage of colors and images that come to mind as they listen to the music composition they or their fellow students have created. The technology teacher helps them add their sound and graphics creations to their portfolios.
- **Determine whole class instruction**: Each teacher identifies what whole group instruction to offer. For example, the music teacher needs to demonstrate techniques with the MIDI keyboard and music notation software. The art teacher designs a presentation on how to use layering techniques in Adobe Photoshop to create a graphic collage. The technology teacher develops demonstrations of video and audio editing techniques. After their class presentations, the teachers work with each student as needed to complete the required products.
- **Arrange reviews and final presentations**: In addition to ongoing parent access to the portfolio that the software provides, the teachers arrange for various experts in other locations to do online reviews of the students' creations and to give them feedback. Students will revise their products as time permits and as they feel appropriate. The teachers arrange for an "Evening at Eureka" to be given at the end of the grading period, during which computers would be set up in a lab to display each student's portfolio. Parents and friends are to be invited via the school website and via desktop-published invitations created by the art students.

Relative Advantage

This lesson aims to solve the challenges associated with music, art, and technology artifacts that go unseen by authentic audiences external to the school. Together, the teachers RATified the proposed integration of a web-based portfolio into these subject areas. Figure 14.1 shows the aspects of instruction, student learning, and curriculum that they felt would be impacted by the use of web-based portfolios. They were satisfied with the amplification and transformation of instruction, learning, and the curriculum in their plan. They believed that there was relative advantage to integrate the portfolios and submitted a request for the software purchase to their principal and director of instructional technology.

Figure 14.1 The RATified Digital Portfolio Project

	Instruction	Learning	Curriculum
Replacement Technology is a different means to same end.			
Amplification Technology increases or intensifies efficiency, productivity, access, capabilities, etc., but the tasks stay fundamentally the same.	• Portfolio streamlines teacher assessment with access to multiple types of evidence all in one easy to access website	• Portfolio allows for multiple digital ways for students to show evidence of music, art, and technology skills • Increase in parent participation and awareness	
Transformation Technology redefines, restructures, reorganizes, changes, and creates novel solutions.	• Portfolio & assessment features reveal students' learning process longitudinally in new ways • Simple viewing option controls allow non-school individuals w/ access (without coming to school)	• Students receive feedback from authentic audiences outside the school • Students engage in reflection and revision	• Music, art, and technology collaborate to create interdisciplinary projects • Increase in digital media in all curricular activities

(Continued)

Step 6: Prepare instructional environment and implement lesson

After the school purchased SeeSaw portfolio software, the technology teacher prepared short videos on how to use the software and shortcuts for performing each required operation, which would be useful for both teachers and their students. The technology teacher created a link from the school's main webpage to the portfolio system so students and parents could access it easily. The music teacher had a MIDI keyboard classroom, but there were not enough keyboards for each student to have one for a whole period. The teachers arranged the schedule so that half the class attended band, choir, or orchestra rehearsal, worked in the art studio, or worked on their individual portfolios in the computer lab, while the other half worked on composition.

PHASE 3 Post-Instruction Analysis and Revisions

Step 7: Analyze results and impact

At the end of each grading period, the teachers reviewed the students' portfolios, assessed progress, and discussed ways to make the work go more smoothly. They realized they could easily assess students at an individual level and saw that most individuals met the music, art, and technology benchmarks set for them and had engaged in written and oral reflection and revision. Students were actively engaged in project work during the class blocks, and the teachers observed much peer learning and sharing. The students reported that the SeeSaw portfolio had the range of digital file formats available for what they wanted to upload and share, so the system served their portfolio needs. By examining the software, the teachers also noticed that parents began viewing the portfolios more often after their first Evening at Eureka event at the school.

Step 8: Make revisions based on results

The teachers were gratified to see that most students seemed motivated by the idea of using a multimedia web format to display their work and were making good progress on their benchmarks. They agreed that the scheduling proved to be a challenge. They decided to request that additional MIDI keyboards and software be obtained to support this work.

Step 9: Share lessons, revisions, and outcomes with other peer teachers

Other teachers began hearing about these students' portfolios and inquiring about them. The English and history teachers approached these three teachers about coordinating the portfolio work with students' writing and research projects. The teachers agreed to work together to merge these skill areas into students' portfolio assessments in the future. The district IT director also met with the teachers because she felt some other schools might be interested in implementing portfolio assessment.

SOURCE: Based on concepts from Duxbury's article "Make Sweet Music with Electronic Portfolios" in *Learning and Leading with Technology*.

Introduction

This chapter has four major sections. The first section reviews the major issues in music education that shape how technology can be integrated, and the second section describes integration strategies for this area. The third and fourth sections review the major issues in art education and describe integration strategies for this area. Notice that the second and fourth sections also provide a helpful rubric for self-assessment of growth in how well a teacher is able to integrate technology in music and art, respectively.

The arts are included in the federal Every Student Succeeds Act (ESSA) as a component of a well-rounded education (Jones, 2017). Technology has always played a part in the arts, providing tools, materials, and processes that aided artists' creative expression. In more recent times, electronic devices and digital capture have changed the ways people approach making art and music. Integration of computers and other forms of digital technology represents a logical evolution of the arts and arts education. Media arts should be included more extensively in school curriculum because messages are increasingly being displayed in visual, auditory, kinesthetic, and print formats (Gran, 2015). Thus, immersion in media arts represents a path to greater participation in the life of our society. Recognized standards in arts education also make it clear that technologies offer new and powerful means to accomplish artistic, scholarly, production, and performance goals. Think about these ideas as you continue your exploration of this exciting field.

Issues and Challenges in Music Instruction

Throughout the history of music, technological tools have been developed that afford musicians, teachers, and students the opportunity to experience music through creating, performing, and responding to it. However, there are several issues and challenges related to music education in general, including the use of technology in the classroom for teaching music.

A Changing Definition for Music Literacy

In music education, the term *music literacy* usually means the ability to read standard music notation. The computer enables—if not encourages—experimentation with alternative ways to represent music. The earliest **music sequencers**, even those with notation capability, have always included a "graphic" or "matrix" editor, a window in which the user could edit music by dragging, deleting, or expanding small rectangles on a grid. Touchscreen interfaces such as those found on tablets have also led to apps that use similar drawing metaphors for creating music.

Today, the desktop music production software industry is helping to accelerate a trend away from reliance on printed sheets and traditional notation toward audio artifacts. This means that many students who are discouraged by a requirement to learn notation-based theory can now participate in the school music program as both composers and performers without solely relying on standard notation to perform or compose music. Digitally-produced music is also playing an increasing role in music production. When the definition of *music literacy* is expanded to include nontraditional performance and composition, music education may be more accessible for the approximately 80% of American high school students who do not participate in band, orchestra, or chorus activities (Dammers, 2010, 2012).

Preparing Teachers to Meet Music Standards

In the broad context of teacher education, the Council for the Accreditation of Educator Preparation (CAEP) standards acknowledge the importance of providing a foundation for technology integration as a necessary component of all teacher preparation programs (CAEP Standards, 2016). Music teacher preparation is subject to these standards and thus rightfully includes technology. Researchers have recently shown that, although models of integration vary, most music teacher preparation programs do include coursework devoted to technology in music teaching (Bauer & Dammers, 2016; Dorfman, 2016).

The National Association of Schools of Music (NASM), which accredits schools of music, recommends that students have opportunities to explore independent interest areas, such as technology (National Association of Schools of Music, 2013). Professional organizations are working hard to develop standards to guide teacher preparation.

The 2014 music standards (National Association for Music Education [NAfME], 2014) developed by the National Coalition for Core Arts Standards include a strand specifically focused on music technology. Similar to the other strands of the music standards—which include general music, composition/theory, guitar/keyboard/harmonizing instruments, and ensemble documents—the components of the music technology standards contain ideas for students to participate in music through creating, performing, responding, and connecting. Proficient, accomplished, and advanced descriptors are provided for each of the areas within the standards. Music technology standards provide a framework for teachers who are developing curricula in this subject for use, particularly in high schools. The standards are also accompanied by model cornerstone

assessments, which include suggestions for the types of projects students might complete in technology-based music classes and how teachers can assess those projects.

The Areas of Pedagogical Skill and Understanding (Areas of pedagogical skill, 2016) developed by the **Technology Institute for Music Educators (TI:ME)**, a professional organization for music educators who use technology, are intended to address the types of technological knowledge and pedagogical skills that music teachers should develop in order to teach technology-based music classes. This document focuses entirely on the knowledge teachers should develop. As standards are evolving to more explicitly include digital technologies in music and art preparation, the rationale for including technology in the arts becomes stronger.

Downloading Music Illegally

Before 2010, software such as Napster, Pirate Bay, LimeWire, and Kazaa launched and allowed peer-to-peer sharing of files over the Internet. Thus, downloading music illegally has become a concern throughout the music industry. The sharing of files has led to numerous court cases surrounding this issue. According to a review of research (Smith & Telang, 2012), the majority of research indicates that **digital piracy** leads to statistically significant lower media sales, including lower sales of recently released music. The sharing of files is so readily available today that many students and adults do not view the downloading of music as illegal or copyright infringement.

Recent data (Nielsen Company, 2013) show some interesting trends. While overall music sales decreased by 6.3% and physical sales (of CDs, LPs, and cassettes) decreased by 13% between 2012 and 2013, music streaming increased by 32% during that same period. In essence, people are still consuming music but are showing a strong preference for online music streaming services such as Pandora, Spotify, Tidal, and Apple Music over physical purchases. It is possible that online musical engagement could make illegal capture and sharing of music even more prevalent. The topic of illegal use of copyrighted works such as music has become an essential part of the digital literacy that schools must address, as highlighted in Technology Integration Example 14.1.

Technology Integration

Example 14.1

TITLE: Why Is Downloading Music Illegal?

CONTENT AREA/TOPIC: Music

GRADE LEVELS: 9–12

ISTE STANDARDS•S: Standard 1—Empowered Learner; Standard 2—Digital Citizen; Creativity and Innovation; Standard 3—Knowledge Constructor; Standard 5—Computational Thinker; Standard 6—Creative Communicator;

CCSS: CCSS.ELA-LITERACY.SL.9-10.2, CCSS.ELA-LITERACY.SL.9-10.3, CCSS.ELA-LITERACY.SL.9-10.5, CCSS.ELA-LITERACY.RH.11-12.1, CCSS.ELA-LITERACY.SL.11-12.1

DESCRIPTION: In this lesson, students work in small groups and use websites to learn the history of copyright infringement as it relates to audio files and to review the applicable laws and issues that arise from violations of them. The students discuss their own practices and compare them to the legal standards. Finally, they use web resources to create a presentation in which they take a position on the controversy and use information they have found to make a persuasive argument to defend their position.

SOURCE: Based on an idea from the lesson plan Copyright Infringement or Not? The Debate over Downloading Music by Suzanne Taylor. http://www.readwritethink.org/classroom-resources/lesson-plans/copyright-infringement-debate-over-855.html.

The Intersection of Popular Music, Technology, and Music Instruction

The National Association for Music Education (NAfME) published a collection of landmark essays addressing the issue of popular music, but "Bridging the Gap: Popular Music and Music Education" made very little mention of popular music's heavy reliance on technology for both production (composition) and live performance (Rodriguez, 2004). Since its publication, we have seen closer connections between that broad popular music genre label and the use of technology for producing and recording the music. Some recent publications include descriptions of many alternative music programs including those that focus on popular music styles (Clements, 2010; Smith, 2013). Any music teacher seeking to start and sustain a program component dedicated to rock, hip hop, rap, or other pop genres must have extensive knowledge of desktop music production and live sound reinforcement—not to mention a credible familiarity with pop music's complex web of music, culture, and traditions.

The Music Director as Small Business Administrator

Typical secondary school music programs involve hundreds of students, rooms full of instruments and other equipment, wardrobes of uniforms and choral robes, libraries of sheet music, methods books and other print resources, and large budgets. The music director usually oversees the largest inventory of physical assets outside the athletic department. The music director is responsible for tracking students' academic progress and other duties common to all classroom teachers. In addition, the music director must be his or her own director of development, constantly on the lookout for continuing or increased funding. All of these issues make knowledge of information management software a high priority—if not a stated requirement—for the efficient operation of a successful music program.

Check Your Understanding 14.1

Technology Integration Strategies for Music Instruction

In a superb review of research related to technology and music learning, Webster (2002) identified several categories of music experience, including music listening, performance, and composition, that have been the focus of technology integration. They are still excellent guidelines today and have guided development of technology-based music curriculum materials such as those by Freedman (2013), Watson (2011), Dorfman (2013), and Bauer (2014). Webster also acknowledged the crucial role that technology plays in research and assessment within the educational environment. In addition to general-purpose software (e.g., word processing, spreadsheet, web authoring), two broad categories of computer-based tools play a primary role in serving the needs of music teachers: instructional software (programs developed primarily for teaching music skills) and music production software (programs that facilitate music composition, recording, and performance). Bauer, Harris, and Hofer (2012) explained the technological pedagogical content knowledge (TPACK) that teachers must develop to guide musical activities with particular technologies.

Figure 14.2 Electronic Keyboards and Synthesizers
Reprinted by permission. TI:ME Technology in Music Education (www.ti-me.org)

Steps to integrate technology into the music classroom may depend on the environment of the school. While some schools prioritize purchasing and installing sophisticated keyboard-computer labs, as shown in Figure 14.2, others focus on BYOD models of technology integration using student-supplied smartphones, tablets, and laptops as in the opening Technology Integration in Action scenario.

In the traditional music performance area, many teachers use "intelligent" accompaniment systems such as SmartMusic or PracticeFirst. With expansive libraries of materials from standard repertoire and method books, students can select a piece from either the ensemble or solo literature and practice with an accompaniment system that follows their performance as tempo is varied for expressive purposes. Perhaps the greatest contribution that this technology offers to music education is that it helps teachers assess students' progress through automated means; it checks students' performances for correct pitches and rhythms and provides quantitative assessment data. In a school with little or no budget to provide accompanists, such technologies provide a significant opportunity. Strategies that make use of all these resources include support for music composition and production, music performance, self-paced learning and practice, teaching music history, and interdisciplinary strategies.

Support for Music Composition and Production

For the purposes of this chapter, music production and music composition mean the same thing. In the environment of the modern recording/production facility—whether at home, in a professional facility, or in a classroom—composing and producing cannot be divorced from one another. Music production software includes sequencing (MIDI and digital audio), digital audio editing (often a component of a sequencing program), and music notation. Although these programs offer teachers maximum flexibility in designing curriculum, they can require the teacher to have more specialized knowledge of the individual software package because each product operates with different functions. This section summarizes tools and integration strategies that support music production and composition.

TRADITIONAL DIGITAL AUDIO WORKSTATIONS (DAW) Also known as **sequencers, digital audio workstations (DAWs)** allow the user to record, edit, and play back digital audio and MIDI data. Important examples of these include Logic Pro, Garage Band, ProTools, and Cubase. Although hardware sequencers can still be found, often as components of sophisticated workstation keyboards, most sequencing platforms are

Video Example 14.1: Music Students Using MIDI Keyboards

This video shows how students are learning music composition with MIDI keyboards and music composition software.

computer applications. Computer-based sequencers require a complete MIDI workstation. Modern computers all contain the sound cards required to use a sequencer, and most external MIDI equipment can interface with the computer through common USB connections. Computer **music sequencer** software is very powerful, requiring increased processing speed, storage capacity, and a large screen on which to display data as compared to hardware workstations.

Most sequencing programs simulate the functions of the physical recording studio. Many applications even include graphics that are designed to look like physical studio gear. An interesting example is Reason from Propellerhead, which can also be used to teach students to correctly cable studio components with virtual cables. Music is recorded on tracks and assigned to channels for playback and editing. Software plug-ins are digital equivalents of outboard (hardware) signal modifiers such as echo chambers and compressors and, depending on the processing power of the computer being used, provide the composer with a desktop recording studio equipped with virtually unlimited mixing options. Many sequencers offer the ability to record sound directly onto the computer's hard drive with the use of a microphone. Live, simultaneous multichannel recording is possible with an external digital audio interface. After recording, digital audio data, as represented by a wave shape, can be manipulated (edited) with the ease and precision of text in a word processor.

With very few exceptions, sequencers support both step- and real-time recording of MIDI data. Once MIDI notes are entered, they can be edited like any other data on the computer: cut, copied, and pasted. The user can control all performance parameters of MIDI data independently of one another—including pitch, tempo, volume, and dynamics.

Some programs designed for young children have sequencing components that enable composition. The Doodle Pad component of Music Ace, for example, allows the user to drag different-shaped happy faces (representing notes of different rhythmic values) onto a staff. In addition, the user can assign each note to one of several different sounds (e.g., piano, violin) as represented by a different color. Similar functions are available in Hyperscore. With proper direction, however, elementary school students can be taught the basic operations of even the most sophisticated professional software (see Technology Integration Example 14.2).

Technology Integration

Example 14.2

TITLE: Organize and Create Music

CONTENT AREA/TOPIC: Music composition

GRADE LEVELS: 2–8

ISTE STANDARDS•S: Standard 1—Empowered Learner; Standard 4—Innovative Designer; Standard 6—Creative Communicator

NAfME Music Technology Standards Strand: Creating

TI:ME 3, 4, 6

DESCRIPTION: Hyperscore software, designed by developers at the Massachusetts Institute of Technology media lab, enables students of all ages to compose music. The software is entirely graphical—no standard music notation is used, so the complexity of notation is removed from the composition process. In the Hyperscore environment, students compose by drawing on the screen. Musical elements such as melody and timbre are represented on the "score" with objects of varying shapes, textures, and colors. Pieces can also take on sectional forms by grouping chunks of symbols together. A visual grid represents time, so there is a recognizable element of the visual elements flowing from left to right. Using this software, teachers can encourage students to be creative by composing their own music without the normal conventions of music notation.

NOTATION SOFTWARE Notation programs, such as Sibelius, Finale, Notion, and Noteflight, concentrate music production on the traditional realm of composition with standard notation. They focus on score and page setup, part extraction, text formatting, and other print-related issues. In other words, a sequencer facilitates music making in the aural domain, whereas notation facilitates music making in the visual domain.

GRID-BASED WORKSTATIONS Perhaps the most significant growth of any kind of music software in the last several years has been software specifically designed for live performance, embodied in products such as Propellorhead Reason and Ableton Live. This extension to the traditional digital audio workstation allows for recording and editing sound, and then performers can "trigger" playback of clips of recorded sound to produce a live performance. Performers often use hardware interfaces such as the Ableton Push or the Novation Launchpad as the physical connection to the software. These devices are also being used more frequently in school music labs.

COMPUTER SUPPORT FOR PERFORMANCE Projects that begin at a computer workstation in a lab can be used in other situations throughout the music program. Students can create notation files that are then used to facilitate performance in the rehearsal room or at a concert. Students who are especially proficient on an instrument (including voice) can create a sequenced instrumental "bed" to accompany a live performance and group or individual rehearsal. Although this may not be the goal of all composition activities, this technique can be used in circumstances in which students are proficient in traditional performance on instruments or voice.

SUPPORTING TRADITIONAL AND NONTRADITIONAL COMPOSITION BY ADVANCED AND NOVICE STUDENTS Desktop music systems (e.g., the MIDI sequencer) have prompted new definitions of musicianship that recognize alternative tracks to musical creativity, in addition to the traditional conservatory model of preparation. As suggested earlier, students with little or no "formal" musical training can create and edit compositions using a sequencing program with step-entry capability. Students can also perform analyses of music using pre-existing MIDI files and/or digital audio.

Once the pieces have been imported into a sequencer, students can explore all aspects of musical form, harmony, orchestration, and other parameters. Sequencers and audio editing software offer students the ability not only to listen to prerecorded music but also to manipulate it. Students can demonstrate their understanding of musical form by literally separating a piece of recorded music into its structural components. In this way, expositions, recapitulations, second choruses, guitar solos, and other sectional form elements all become discrete audio events, which in turn can be rearranged—resequenced—into new formal configurations.

Apple's GarageBand has become popular among young people for mixing and playing their own music, and its app counterpart has made these activities even more accessible. Many powerful apps for tablets and phones can help students make music in new and interesting ways and present fewer obstacles to music making than do traditional sequencers or notation programs. An excellent example of this type of software is Groove Pizza, which allows students to create and export beats with a simple, circular interface.

Students can record MIDI data over their favorite audio recordings using different kinds of MIDI controllers. More advanced analysis projects, such as those in an Advanced Placement music theory class, can now be undertaken using music software as a presentation tool. Consequently, the general music class can accomplish a great deal more than simply providing those students who are supposed to be unmusical or at least untrained with a passive listening experience.

THE ONE COMPUTER CLASSROOM While the preceding scenarios lend themselves best to a lab environment with multiple computers, even a single computer can provide valuable support for a general music curriculum. According to Smith (2010), creative pedagogy, free software tools, and a single computer classroom can be combined to effectively engage students in group composition and analysis of music as they learn collaboratively. Smith (2010) believed that when educational resources are limited, using a free **audio recording and editing program** such as Audacity can be a powerful educational tool for collaborative work in composing, performing, and recording music or manipulating elements such as pitch and tempo to deconstruct and analyze the dynamic elements of music as well. The integration of such technology also provides a medium for the formative and summative assessment of students' creative products and performances as well as their understanding of fundamental music concepts (Bauer, 2010). Numerous software options for music production make music production more and more viable in the K–12 classroom, as summarized in the Table 14.1, Top Ten Must-Have Technologies for Music.

Support for Music Performance

The following three types of technology support the development of music performance:

1. Notation software (e.g., Sibelius, Finale, Notion)
2. Performance-oriented software (e.g., Ableton Live)
3. Notation display apps (e.g., ForScore, Scorch, NotateMe, Notion, Noteflight)

These technologies expedite preparation for performance, assist in developing instructional handouts and assessments, and support sectional or individual practice and experimentation.

EXPEDITE PREPARATION FOR PERFORMANCE Software such as Finale and Sibelius offers all of the power and flexibility of word processing applied to music notation. In a school music program, this category of software lets teachers rearrange music for alternate instrumentations, transpose parts into more accessible keys for performance, and simplify difficult passages. When printed, notation documents are legible and have a professional look, eliminating the lack of clarity and potential confusion that can result

Table 14.1 Top Ten Must-Have Technologies for Music

Technology Name	Description
GarageBand	Among the most popular apps for music teachers, Apple's® GarageBand product includes audio recording, song construction with loops, and "smart instruments" that allow performance without much traditional instrument knowledge. Recent updates include simulations of ethnic instruments and additional instrument interface types.
Notion for iPad®	Notion on the mobile platform is gaining popularity. It leads the way with its intuitive design and quality sounds. It also creates and reads files that can be exchanged with the desktop version of Notion. This app, along with similar ones, is capable of detecting handwriting and converting it into music notation.
Apple Music, Spotify, Pandora	Streaming music services are essential tools for music teachers. In addition to a school's local library of music, these services—which operate on paid subscription models—allow access to vast collections of music on demand. Their apps run on many devices, and the services can also be accessed from desktop computers.
forScore	Many music teachers are experimenting with digital notation for their ensembles. Apps such as forScore allow display of notation files (usually converted to PDFs) that can be distributed to students through Google Drive, Dropbox, or other online storage. Digital scores can be marked up, and users can even connect a Bluetooth pedal to devices to turn pages.
Virtuoso Piano	This is one of many keyboard apps available for mobile devices. Look for keyboard apps that have high-quality sounds and features such as velocity sensitivity, key labels, and split mode (two facing keyboards for playing duets).
SmartMusic	The mobile companion app to the enormously popular SmartMusic intelligent practice and accompaniment system allows access to the service on the go. Practically any device is now capable of running SmartMusic and using all of its features.
Amplitube, Tone Bridge, Mobile Pod	These are among several apps designed to apply effects to electronic instruments, usually intended to replace outboard effects processors for electric guitar players but are usable for any sound source that can be plugged into a device. To use these most effectively, consider purchasing a companion interface such as the Apogee Jam, the IK Multimedia iRig HD, and iRig Mic. Also, check to make sure that the effects app is compatible with the particular hardware interface; they do not all work together.
Novation Launchpad, Conductr, touchAble	These apps are virtual substitutes for hardware interfaces to interact with the enormously popular program Ableton Live. Although app purchases are often necessary to gain full function, virtual interfaces are far less expensive than their hardware counterparts.
Traktor DJ and djay 2	These apps are the "essential" tools for DJs who use iPads for mixing. They allow playback and mixing of songs stored in the iPad's music library. With apps such as these, the iPad has the potential to replace the laptop as the center of a DJ's toolbox.
Fingerlab DM1	There are many "beat-making" apps for mobile devices, but DM1 is among the most robust and mature. It simulates a hardware step sequencer for creating pattern-based beats. The app also includes high-quality drum and special effects sounds, randomization, and exporting tools. DM1 includes features that a short time ago were available only in desktop apps.

from handwritten parts. And, as is the case with all computer-generated data, existing documents can be corrected and/or revised without having to re-enter the music from scratch. Notation files are small in comparison to digital audio, video, and graphics files, so entire libraries (hundreds of scores, parts, and handouts) can be stored using an insignificant amount of disk space. Teachers must exercise caution when using notation software to rearrange music when copyright laws prohibit.

With notation software, teachers can create theory lessons, quizzes, and other handouts that combine notation with text and other graphics. These programs include templates or wizards to facilitate creating such informational documents and assessments. The capability of exporting sections of a musical score in a graphic format (GIF, JPG, or EPS) makes inserting images into word processing documents very easy to accomplish.

FACILITATE SECTIONAL OR INDIVIDUAL PRACTICE AND CREATIVE EXPERIMENTATION The distinction between the functions of modern notation and sequencing programs is easily blurred; this is because newer sequencing software often contains scoring functions, and notation software includes mixing and other playback functions generally associated with sequencers. To clarify the roles of the sequencer and the notation program in teaching music performance, analysis, and composition, it is helpful to consider the hypothetical scenario of an ensemble class. To support sectional or individual practice, the teacher could enter the score of a piece into a sequencer. Once the music had been entered, a student or teacher could choose which parts needed to be

ard, creating a "music-minus-one" type of accompaniment. In this way, for instance, e clarinet section could rehearse to a sequence consisting of the entire ensemble minus e clarinets. Or the second clarinet player could practice sectional passages by selecting ly the clarinet parts for playback but muting the second clarinet part. Meanwhile, e notation program could be used to edit any parts that need to be revised to better atch the student's performance level. Notation software is generally more flexible, werful, and appropriate when the end goal is a printed score; when audio files are e aim, sequencing software is the more suitable choice.

During the past decade, the piano lab has given way to the electronic keyboard lab, here students can develop much more than keyboard skills. Demski (2010) describes w electronic keyboard labs can be used to help students learn about music theory as ell as fundamental music elements such as melody, rhythm, and harmony. Keyboard bs can now be networked with devices such as the Korg GEC-III or the Yamaha LC+ at allow the teacher to communicate with individual students or groups of students by eans of a microphone and headphones. This allows instructional guidance as students re afforded the freedom to explore, experiment with, and compose music. Develop- g composition skills also provides an outlet for creative expression (Demski, 2010). outhcott and Crawford (2011) advocate for pedagogical strategies that encourage using usic technology as more than just a technical tool. Also see how to help all students ave access to this tool in the Adapting for Special Needs feature.

Teachers should also consider technology for performance beyond traditional nstruments. Electronic devices and computers can offer students creative outlets. Intui- ve surface interfaces, such as the Novation Launch Pad and the Ableton Push, allow or control of complex software without knowledge of a keyboard or other traditional usical instruments. Students with access to these kinds of instruments can take part n new and different musical experiences unique to the world of technology. Dorfman 2013) provides profiles of students and teachers taking part in nontraditional ensem- les and shows their benefit to students' musical learning.

Support for Self-Paced Learning and Practice

nstructional software is available to help students learn or practice new skills, ear train- g, and music theory with tutorial software or through teacher introductions with drill nd practice software. Practica Musica, for example, can be used as a tutorial in music

Box 14.1 Adapting for Special Needs

Adapting for Special Needs in Music and the Arts

Students with disabilities need to participate in music and art just as other students do. In some cases, some accommodations are necessary to ensure opportunities for access and engagement. The following resources can be useful.

For Music

- *Assistive Technology in Education/Music* (at the Wikibooks website)—An overview of strategies and tools for using assistive technology to provide access to music for students with disabilities.
- Meet Adam Goldberg and His Students (at the Center on Technology and Disability website)—Watch a video titled "Hands on Music: An iPad Band for Students with Disabilities" from District 75 in New York City to see how Adam Goldberg teaches music concepts to his students who have a range of disabilities.

For Art

- Art for Children and Adults with Disabilities (search at the Kinder Art website)—Resources and art activity ideas for children and adults.
- Very Special Arts (at the Kennedy Center website)—An international organization devoted to promoting participation in the arts by individuals with disabilities. They offer professional development, lessons, resources, and free webinars about adapting arts curriculum for students with disabilities.

—Contributed by Dave Edyburn and Joan E. Hughes

fundamentals with little or no input from the teacher. It can also serve as a drill program when a student needs help with a particular topic related to ear training or music theory. Some of these software packages, such as Auralia, are cloud-based, allowing students to access the software from any location and any devices. Almost all music instructional software packages either have a designated drill component, and many have the capability to maintain assessment information and other important data for multiple students on the same computer, accessible only to the instructor through use of a password-protected account. This capability helps teachers track students' progress on music skills.

Support for Teaching Music History

Music teachers have long sought to foster a deep understanding of musical works by situating them in their social and historical context. This is an excellent way to introduce young students to the practice of research while offering more mature students unlimited opportunities for independent projects.

ACCESSING INFORMATION ON COMPOSERS AND MUSICAL PERIODS OR COMPOSITIONS The web has become the most powerful research tool available to students and teachers at all levels of education. Students and teachers can access online databases, electronic books, online journals, archived and current newspaper articles, audio and MIDI files, video clips, thousands of out-of-print books, and discussion groups on almost any music topic imaginable. Online music archives such as the Naxos Music Library, the National Jukebox of the Library of Congress, and the Internet Archive can be especially useful for teachers who cannot afford to buy recordings of historical music examples. Public Broadcasting Studios (PBS) offers archives of radio interviews and stories about musicians and music, such as an interview with music producer Tommy LiPuma to a history of music in Lubbock, Texas. Focus on Sound is cloud-based software that develops students' listening skills and music knowledge. Productive educational use of these web resources is limited only by the user and, to some extent, the connection speed and processing power of the computer used. The effective use of such powerful tools requires clear instruction, guidance, and supervision by the teacher.

Video Example 14.2: Using Online Videos for Music History

In this video, a principal describes how a fine arts music teacher uses online video resources to support music instruction.

SHARING STUDENT RESEARCH Building a website can be a perfect culminating activity for a general music class. Students can do much of the planning in groups—even offline if computer access is limited. Within each group, students can assign themselves areas of the site according to individual strengths and literacies. A student who can't read music may be proficient with a web page authoring tool; some students can search the web for relevant graphics while others look for text or sound.

Videos and DVDs continue to be a source of valuable historical reference material, many in the form of informative documentaries. Excerpts from these media can be captured on a computer's hard drive or embedded using provided code from many media-sharing sites and then incorporated into a student- or teacher-authored web page or software presentation as long as care is taken to clearly understand and follow existing copyright laws. With the advent of digital music files, the understanding of the copyright law as it relates to digital media is a very important aspect of a student's education. Finished projects can be viewed locally on a single computer, burned to a disc for distribution, posted on a school network, or uploaded to a website so that parents or other students around the world can see them, link to them, and perhaps even contribute their own material. Because distribution methods rely more on cloud and streaming technologies, the use of **storage media** on CDs and DVDs, for example, is decreasing, yet still allows access for individuals and communities with low Internet access or bandwidth.

ATTRACTING STUDENTS TO MUSIC CLASSES Finally, compelling music classes have the potential to be highly effective recruiting tools. Students who initially feel out of place in their school's traditional music program dominated by instrumental and/or choral ensembles may find an exciting and challenging alternative role for themselves by enrolling in a technology-enhanced general music class or a new music class focusing on digital music creation and audio engineering. Often, access to music technology attracts these students, who typically constitute 80–85% of the secondary school population, and provokes a new interest in music in them. In addition to gaining the attention of nontraditional music students, Olson (2010) maintains that technology holds particular promise for music education in the areas of collaborative and interdisciplinary learning.

Support for Interdisciplinary Strategies

The opportunities in a general music class for interdisciplinary study abound. These include exploring relationships of music to other subject areas and facilitating the integration of music projects to support broader school activities.

BUILDING ON NATURAL RELATIONSHIPS BETWEEN MUSIC AND OTHER SUBJECTS The close relationship between music and physics calls for projects that examine the science of sound by exploring elements such as vibration, pitch, and amplification. Identifying the existence of shared fundamental concepts across disciplines (e.g., ratios represented in math as fractions and in music as note durations) opens the door to a new world of learning potential within which multiple representations of these basic concepts and their connections are used to deepen student understanding (An, Ma, & Capraro, 2011). The Math Samplings section of the American Mathematical Society website explores connections between mathematics and music through a range of resources. In music—as in other disciplines such as science and mathematics—creativity, innovation, and knowledge production are inextricably linked (Ghassib, 2010). For example, Benton (2015) investigated whether and how musical expertise influenced novice computer programming. He found that musicians used their knowledge of numeracy, musical concepts, and musical techniques to solve programming challenges. Composers, in particular, were engaged in computer programming for the longest work duration, added the most objects into the project,

and tested their programs the most often, as compared with other musicians and non-musicians. Benton concluded that knowledge of composition can be leveraged for design-based computer programming activities.

HELPING PROMOTE MUSICAL LITERACY IN OTHER SCHOOL ACTIVITIES Student-produced music and research can enhance a variety of aspects of school life. Multimedia-based research projects in the humanities can easily include music that underscores a presentation or that is itself the object of study. A sequencer can facilitate the work of student composers who want to supply music for dance projects or video footage of athletic events. Recent research established that musical elements such as sound effects and music were crucial to players' engagement while playing educational games (Rosenblum, 2014). The sounds provided clues to game playing strategy, communicated the game's narrative story, and developed characters. More schools are teaching game design and development, and musical elements are crucial to effective games.

Application Exercise 14.1 Technology Integration Strategies for Music

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Teacher Growth in Technology Integration Strategies for Music

These sections have introduced the issues, challenges, and strategies for integrating technology effectively into music instruction and learning. In the future, teachers can begin developing expanded and strengthened capabilities to understand emerging issues, generate possible solutions, and address technology integration in music in teaching. Review the rubric in Table 14.2, which measures a teacher's progress in integrating technology in music instruction.

Educators should continue learning how the music and the arts are positioned within broader curricular standards and state and/or federal policy legislation. For states that use CCSS, the College Board (2012) released a report entitled *The Arts and the Common Core: A Review of Connections Between the Common Core State Standards and the National Core Arts Standards Conceptual Framework*. Also, the National Coalition for Core Arts Standards (NCCAS) is a group of educators and organizations that document the connection between Common Core State Standards (CCSS) and arts standards. For teachers, the challenge is to explore the intersection between CCSS, arts standards, and technology and prepare to teach in ways that combine them most effectively.

In addition to resources from this chapter, teachers can become involved in the music professional organizations, such as the National Association for Music Education (NAfME) and the Technology in Music Education (TI:ME), both of which offer teaching resources, advocacy ideas, professional development, and collaboration opportunities. The American Mathematical Society is another organization that offers specific resources for connecting mathematics and music. Finally, teachers can participate in professional learning by following art-specific Twitter hashtags:

- #musedchat
- #musiced
- #musictech
- #elmused
- #musiceducation

Table 14.2 Rubric to Measure Teacher Growth in Technology Integration for Music

	Part I: Teachers' Knowledge of Music Issues and Challenges		
	Basic Knowledge (1–2 points)	**Intermediate Knowledge (3–4 points)**	**Advanced Knowledge (5–6 points)**
	I can articulate the nature of the issue/challenge.	I can both articulate the nature of the issue/challenge and identify some of the possible ways to address it.	I can articulate and implement my own plan for addressing the issues/ challenges in my own teaching.
A changing definition of music literacy	❑	❑	❑
Preparation of teachers to meet music standards	❑	❑	❑
Illegal downloading of music	❑	❑	❑
The intersection of popular music, technology, and music instruction	❑	❑	❑
The music director as small business administrator	❑	❑	❑
	Part II: Teachers' Technology Integration Strategies for Music		
	Basic Knowledge (1–2 points)	**Intermediate Knowledge (3–4 points)**	**Advanced Knowledge (5–6 points)**
	I can describe the strategies and identify technologies to carry them out.	I have designed at least two activities based on these strategies to enhance my teaching and my students' learning.	I have designed and implemented my own plan for integrating these strategies throughout my curriculum to enhance my teaching and my students' learning.
Support for music composition and production	❑	❑	❑
Support for music performance	❑	❑	❑
Support for self-paced learning and practice	❑	❑	❑
Support for teaching music history	❑	❑	❑
Support for interdisciplinary strategies	❑	❑	❑
Support for teacher growth in integration strategies	❑	❑	❑
Total Points	_____ **of 66 possible points**		

Check Your Understanding 14.2

Shared Writing 14.1 Can a Digital Music Ensemble Supplant a Traditional One?

Issues and Challenges in Art Instruction

Like music instruction, art instruction faces many classroom challenges that intersect with technology integration. Some teachers are not adequately prepared to produce digital art, much less to teach their students to do so. Technology appropriate for the art classroom changes rapidly, and staying up-to-date with the latest software and hardware can be challenging. This section addresses some of these important issues.

Funding for Art Instruction

As a result of the ever-increasing emphasis on accountability as reflected in standardized testing, funding for arts education is at an all-time low (Ellerson, 2010). Public funding of the arts from local, state, and federal governments decreased during 2012 by 3–5% (Stubbs, 2012), and public funding has not maintained levels when adjusted for inflation. When viewed in this light, funding has decreased by 15% over the last twenty years (Stubbs & Clapp, 2015). Teachers and school administrators must increasingly find ways to stretch funds available for arts education. In light of this reality, funding for technology in art is especially difficult; updating technology resources and buying computer supplies present continuing problems. For example, production of graphics is a popular art activity, but the cost of expensive ink for printers and specialized paper supplies quickly depletes an annual budget. Teachers are forced to take measures such as password-protecting printers and putting software print controls in place to limit the number of pages a student can print for free. Some teachers turn to fund-raising for resource-intensive curricular projects through crowd-sourcing, such as GoFundMe or DonorsChoose (Iasevoli, 2017).

Ethical Issues Associated with the Use of Images and Other Materials

Because it is easy to use images from the Internet and other sources, it is increasingly important to teach students that they must request permission to use information, images, and other sourced materials and to cite sources for materials they use. When students are carrying out research or creating artwork on computers for websites or graphic design or other art projects, they must also learn issues of appropriation and repurposing of images and how this use can intersect with plagiarism, copyright law, and copyright infringement. Perhaps a short assignment early in the term could require students to identify the specific issues and how they feel about copying someone else's work, whether text, image, or sound. Consider using digital resources such as information at the Library of Congress (2015; n.d.) website or the lessons and resources compiled by Borovoy (2015) in Edutopia to help students understand the rules and implications of copyright in fun, interactive ways.

Accessing Images Used in Art Instruction

If schools use filtering software on computers to protect students from unsavory materials (e.g., pornography), many great works of art are also likely to be filtered out unless the filter is carefully constructed. Educators must take care to allow these important artworks to be visible and accessible to students. The works of lesser-known contemporary artists can sometimes blur the line between what is generally considered to be art and what is not. In photography, the nude figure has been a common subject. Great artists throughout history have used the nude as metaphor for beauty, nature, and life. Limiting access by allowing only the names of the most famous artists to pass through a filter will not solve the problem. Strategies must be designed for allowing complete access to images of artworks for students to use. If all else fails, teachers must make sure the school library has a good collection of art and art history books.

The Challenge of Meeting Standards in Arts Instruction

The National Visual Arts Standards are a component of the 2014 National Core Arts Standards. Similar to the National Music Standards, the art standards are expressed in terms of teaching students to create art, present art, respond to art, and connect to art. The National Visual Arts Standards (National Coalition for Core Arts Standards, 2015)

is an extensive document that should be reviewed when arts instruction intersects with a teacher's curricular responsibilities. Six anchor standards for visual arts focus on the creation and presentation of artistic ideas and work. The standards emphasize students creating, organizing, revising and completing artistic ideas and work; and selecting, analyzing, interpreting, and making meaning through presentations of artistic work (National Coalition for Core Arts Standards, 2015).

Schools are challenged to find ways of meeting these standards in an educational climate in which the role of the arts is often not a priority. The limited time and resources available for arts instruction often result in these standards being interpreted as *ideals* that might never actually be reached in most schooling scenarios. New technologies can both help and exacerbate this challenge for arts educators. They help by providing access to examples and free resources not available locally. But access to the technologies themselves may be beyond the reach of already underserved schools, thus further widening the gap between those who are and are not likely to meet the standards.

Check Your Understanding 14.3

Technology Integration Strategies for Art Instruction

As with music instruction, technology resources in art instruction support a variety of classroom strategies—from simple demonstrations of materials to student production techniques. See Table 14.3 for a list of the Top Ten Must-Have Technologies for Art.

Table 14.3 Top Ten Must-Have Technologies for Art

Technology	Description
MoMA Art Lab	This much-heralded app allows group and individual art creation and exploration of artists' techniques including the uses of shape and color. The app makes excellent use of the tablet's touchscreen interface.
Paper by FiftyThree	Paper is a standout among many drawing apps available for mobile devices because of its flexible and simple design. In-app purchases allow for additional types of drawing tools. Other notable drawing apps include ArtStudio, iDoodle2, iDraw, Brushes, and Adobe Ideas.
Photos	Apple's Photos allows for editing existing photographs either taken with or imported into the mobile device. Alternatives include the full-featured mobile version of Photoshop Instagram.
iMovie	Mobile video editing is becoming increasingly popular because of the video capture capabilities of mobile devices. Mobile video editing apps include features, such as transitions, slow motion, and effects, that would be expected from desktop programs.
Let's Create! Pottery HD (App)	This app is a virtual simulation of a pottery wheel experience. It also includes a game that allows social interactions with others playing it. Also check out the PotteryWheel app.
Love Art: National Gallery, London	As suggested elsewhere in this chapter, many websites offer virtual museum tours. Mobile apps are also available for this, and the Love Art tour of the National Gallery in London is among the best. Also check out iMuseum Musée du Louvre HD and collections from individual artists such as Da Vinci HD, Renoir HD, and Vincent van Gogh Virtual Art Gallery (all iOS apps).
Bamboo Paper	Bamboo Paper is designed for all kinds of drawing from precision technical work to simple sketching. The app is made by Wacom—a brand long known for its hardware drawing interfaces—and offers many familiar tools to help with digital drawing.
Comic Life	Comic Life is for making comic strips, which can then be shared with friends through social media. Like some other apps mentioned here, it can be used seamlessly as a companion to the desktop application of the same name.
ArtRage	ArtRage is an app that simulates the experience of painting. It is a single-layer canvas that mimics the behaviors of real paints and brushes.
Eye Paint Animals	Some of the painting apps mentioned here are very open ended and might be intimidating for younger students. Eye Paint Animals is like a coloring book; it lets students select illustrations and use the device's camera to capture colors that they can then apply to line drawings.

Accessing Art Examples for Classroom Use

Websites now offer vast and rich collections of artwork that students can use as illustrations of artists' work and as models for their own work. Teachers can generate a set of sites to bookmark for regular use in classes such as:

- Metropolitan Museum of Art (MET): Image and Data Resources
- Library of Congress: Prints and Photographs Online and Digital Collections
- Digital Public Library of America (DPLA)
- ArtCyclopedia
- Kinder Art's multicultural art resources

Teachers can also involve students in these searches. For example, they might give students an assignment that asks them to find sources for paintings that use still life as subject matter, that use the technique of chiaroscuro, or that are 15th-century Florentine. Learning can result from the act of collaboratively searching for these types of artifacts. Note that the MET recently implemented an Open Access policy, which released 375,000 public-domain artworks for free and unrestricted use under the Creative Commons Zero (CC0) license. When searching, look for the CC0 license label or the "Public Domain" designation.

Other activities include:

- Having students use the school library to find specific works of art and then challenging them to use the web to locate other examples of the artist's work or work from the same period.
- Teaching students about the work of contemporary artists and having them look at galleries and exhibitions online to see the new work.
- Using web-based collections on art techniques for instructional reinforcement.
- Creating a digital library to use for slide shows and presentations. Assign students who are traveling during the school year or during the summer to visit galleries and museums and bring back pamphlets, postcards, examples, and photographs (if allowed by museums) of artwork they see. Scan the examples to create images for the classroom digital library.

Using Teaching Examples and Materials

Teachers can use presentation software such as PowerPoint, Keynote, and Google Slides to create lecture slides. Slides are especially helpful when they contain example images for quick access to illustrate ideas. Teachers should collect materials that are in the public domain, require Creative Commons attribution, or can be used for educational purposes. Also, teachers can create interactive websites to help students learn color theory, design theory, and photography techniques. Websites that use copyrighted materials are problematic because the teacher is in essence redistributing the material, which is illegal. Teachers should keep instructional examples on websites that offer only internal use within the school or are password protected unless the redistribution of the examples is permissible.

Producing and Manipulating Digital Images

Teachers can use a range of hardware and software to easily produce and manipulate digital images. These resources support novice artists in creating high-quality products and scanning found objects for use in artistic compositions.

IMAGE HARDWARE RESOURCES The most common type of hardware resource in art instruction is **image digitizing equipment**. **Graphic scanners** are computer peripherals that create digital versions of images in a variety of formats (e.g., GIF, JPEG, BMP, TIFF). Artists can also capture an image from a video source using digitizing software such as iMovie, Final Cut, and Premiere. This equipment and the software provide

Technology Integration

Example 14.3

TITLE: Visual Biography

CONTENT AREA/TOPIC: Art

GRADE LEVELS: 6–12

ISTE STANDARDS•S: Standard 1—Empowered Learner; Standard 3—Knowledge Constructor; Standard 4—Innovative Designer; Standard 5—Computational Thinker; Standard 6—Creative Communicator

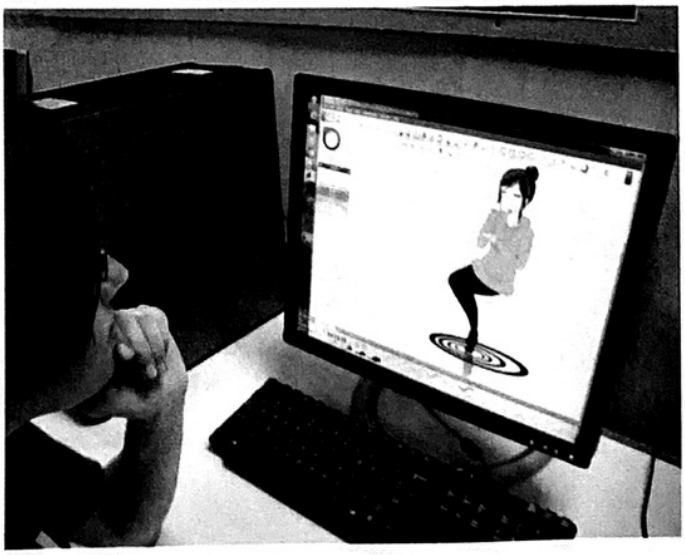
NATIONAL VISUAL ARTS STANDARDS: Creating, Presenting, Connecting

DESCRIPTION: Students can use digital art tools to explore and express a sense of their own identities. Using digital cameras, students search for found objects that represent important parts of their lives. They can also search online and print media, and capture or scan those media. Depending on the students' ages and levels of sophistication, they can make a digital collage of these images using PhotoShop (or similar software), or use movie-making software (such as iMovie) to make a short film. Adding music to the film is a great way to cross content area lines, especially if the students compose original music for their films.

users flexible systems to capture and manipulate digital images, which can then be edited using software such as Photoshop. The ability to digitize still images and video has opened up a whole new genre of art, and personal technologies such as tablet computers and Wacom tablets have made extensive image creation and editing available to many more people. The Technology Integration Example 14.3 introduces a lesson in which students can create a visual biography exploring their identity.

IMAGE SOFTWARE RESOURCES A wide variety of software is available to teachers and students who are interested in producing computer art. Simple paint programs (Paintbrush, KidPix) are available for very young students; in fact, teachers often use these types of programs when first introducing students to the computer. Integrated software and multimedia authoring programs (Flash or Director) always include fairly sophisticated drawing and painting tools; these might be good intermediate tools for the developing computer artist. High-level programs (Photoshop) suitable for the advanced artist would be used primarily at the high school level. The photograph in Figure 14.3 shows a students' digital art produced in a drawing program.

Figure 14.3 Student Using Drawing Software
(Photos by W. Wiencke)



Teachers should also explore the wide variety of mobile apps available for editing images. These include the mobile version of iPhoto, Photo Editor by Aviary, PhotoShop Express, and the artistic filters available in application services such as Instagram.

Supporting Graphic Design and 3-D Modeling

Art educators can choose from among a number of software options to let students explore graphic design. A range of animation programs is available, from simple cell-type animation to more advanced programs that offer features such as **tweening** or **morphing**, graphic techniques that can be done only with computer software. Other programs are specifically geared toward cartoon production and allow artists to add music and sound.

An art studio would not be complete without an image manipulation program such as Adobe Photoshop, which enables students to edit clip art or digital photos, as shown in Figure 14.4. High-end programs provide hundreds of options and special effects for altering images. Morphing software, such as Morpheus, enables the user to transform images smoothly from one shape or image to another. This technique by which images can be altered easily offers tremendous potential for artistic expression and helps to foster the development of visual literacy skills.

Finally, as Davenport and Gunn (2009) and Bryant (2010) contend, students can use 3-D modeling and animation software, such as Ulead COOL 31, Blender, or Google SketchUp, to communicate ideas visually through computer-generated models, animation, and imagery use. Davenport and Gunn (2009) describe a powerful example of the use of these tools in a high school media literacy program they developed to serve indigenous youth from underrepresented populations throughout remote areas of rural Mexico. Students used digital images and video cameras and 3-D and animation software to visually communicate images and stories about their cultures and traditions. The integration of technology as a medium to design and create not only

Video Example 14.3: Using Drawing Programs with Young Students

In this video, the teacher uses a simple drawing program to show her young students how to draw a face.

Figure 14.4 Student Using Image Editing Software on Tablet
(Photo by W. Wiencke)

provided these students with the opportunity to explore their own identities, but also aided in their empowerment by giving them a voice to share their unique backgrounds and experiences through artistic and cultural expression. Bryant (2010) confirmed that such transformative learning experiences can also occur in traditional art classrooms as students' creativity, engagement, and collaborative problem-solving skills are fostered by the use of 3-D animation and visual imagery to create captivating artwork that holds personal meaning. 3-D modeling tools also can enhance students' abilities to recognize the characteristics of objects in space and apply advanced mathematical concepts to them (Panorkou & Pratt, 2016).

Art education teachers can integrate 3-D printing into their classrooms with relatively little training (Schelly, Anazalone, Winjen & Pearces, 2015). 3-D printing shows promise for blending artistic work with design thinking and providing students and teachers with a way to rapidly prototype ideas about three-dimensional objects (Loy, 2014). Economic analysts expect the 3-D printing market to continue to grow, and several major companies have entered the hardware market, which will reduce consumer-level 3-D printing costs.

Supporting Student Publication

Many schools look to their own graphic arts programs to create brochures and newsletters as part of student learning activities. Because students gain valuable experience through creating and producing these publications, the activities can be considered a type of internship to prepare for actual jobs as graphic artists for newspapers or other companies. This strategy requires schools to provide both desktop publishing software and access to image manipulation program such as Adobe PhotoShop.

Virtual Field Trips to Art Museums

Many museums around the world have sites offer **virtual tours** such as the following:

- Louvre Museum
- Art Institute of Chicago

- Museum of Modern Art
- Metropolitan Museum of Art
- Smithsonian museums
- National Gallery of Art

Although virtual tours are clearly not the same as viewing the works in person, they offer a way for students to explore and experience masterworks. With the development of 3-D imagery and virtual reality software and hardware, researchers have shown that visitors to virtual museums can experience an increased sense of presence, customization, and personal navigation than when visiting the museum in person, but online interfaces still lag in development (Sundar, Go, Kim & Zhang, 2015). To support classroom learning, some museum sites even make their server available for students to post their own creations and to learn to create art using a certain medium, such as papier mâché, batik, or origami. These sites also can be the basis for multicultural "field trips" to gather examples of art and music from around the world (Risinger, 2010). When using the web for arts instruction, it is important to remember that the images are reproductions; students will need to be made aware of the idea of scale and be reminded that they need to keep in mind the limitations of digital imagery.

Creating Films as an Art Form

Students can make short or full-length digital films with the software that often comes installed on a computer or smartphone. For example, Macintosh iMovie and Windows Movie Maker both allow students to produce their own creative works using images, digital video, and sound for the purpose of reports, assignments, and entertainment. Smartphone-based filmmaking is legitimized by iPhone films at the Sundance Film Festival and has opened opportunities for inclusion in art education (Gran, 2015). These films can be shared across platforms by saving them in universal formats. When combined with technologies for capturing images, such as digital cameras and scanners, and when students accompany visuals with sound, this relatively easy-to-use type of software can assist in producing powerful demonstrations of students' work.

Gran (2015) emphasizes storyboarding as the key visual script and notes that films can incorporate traditional art forms, such as the inclusion of hand-drawn, clay, or mixed materials, especially in animated films. For example, Savran (2016), as a first-year teacher, created an after-school Animation Art Club in collaboration with a fifth grade writing teacher. Students wrote scripts, used stop-motion animation software, such as FramebyFrame, and digital cameras to capture their story with cut-out, paper backgrounds and characters, and animated the story with voice-over and sounds using iMovie software. Meager (2017) describes how children as young as 10 years old can engage in observational filmmaking to draw them to build new understandings about their own lives, a type of participatory video pedagogy.

Sharing Students' Creative Art and Research Works

With the use of digital publishing, videos, and presentation software, students can share their art creations with others. Portfolios have long been a way for art students to demonstrate their achievements and abilities, and web-based portfolios are a natural extension of this strategy. Students can create presentations, videos, e-books, blogs, and websites to show their research and creative work. Artists' books can be created and printed using desktop publishing and color inkjet printers. For high-quality output, students might use paid services, such as Shutterfly, Picasa, or CreateSpace, to create photo books and projects.

Application Exercise 14.2 Technology Integration Strategies for Art

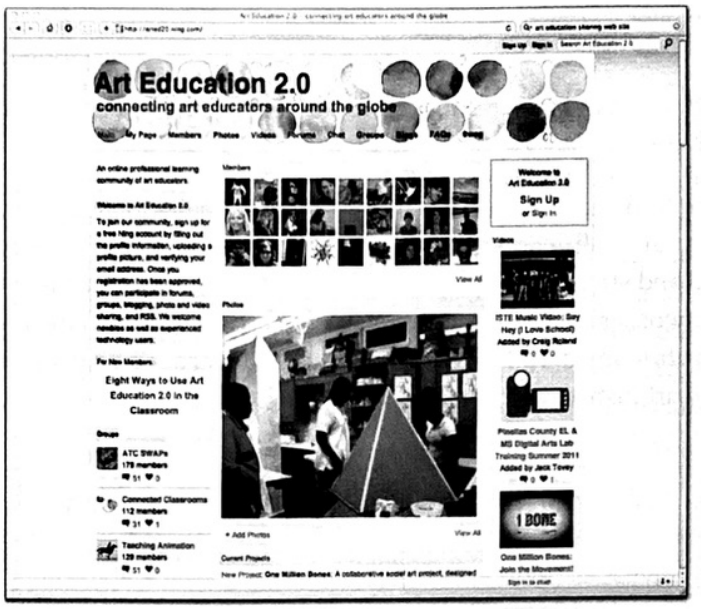
Teacher Growth in Technology Integration Strategies for Art

This chapter introduces the issues, challenges, and strategies for integrating technology effectively into art instruction and learning. In the future, teachers can begin developing expanded and strengthened capabilities to understand emerging issues, generating possible solutions, and addressing technology integration in art in their own teaching. Review the rubric in Table 14.4, which measures a teacher's progress in integrating technology in art instruction.

Table 14.4 Rubric to Measure Teacher Growth in Technology Integration for Art

Part I: Teachers' Knowledge of Art Issues and Challenges			
	Basic Knowledge (1–2 points)	**Intermediate Knowledge (3–4 points)**	**Advanced Knowledge (5–6 points)**
	I can articulate the nature of the issue/challenge.	I can both articulate the nature of the issue/challenge and identify some of the possible ways to address it.	I can articulate and implement my own plan for addressing the issues/challenges in my own teaching.
Funding for art instruction	❑	❑	❑
Ethical issues associated with the use of images and other materials	❑	❑	❑
Access to images used in art instruction	❑	❑	❑
Challenges of meeting standards in art instruction	❑	❑	❑
Part II: Teachers' Technology Integration Strategies for Art			
	Basic Knowledge (1–2 points)	**Intermediate Knowledge (3–4 points)**	**Advanced Knowledge (5–6 points)**
	I can describe the strategies and identify technologies to carry them out.	I have designed at least two activities based on these strategies to enhance my teaching and my students' learning.	I have designed and implemented my own plan for integrating these strategies throughout my curriculum to enhance my teaching and my students' learning.
Accessing art examples for classroom use	❑	❑	❑
Using teaching examples and materials	❑	❑	❑
Producing and manipulating digital images	❑	❑	❑
Supporting graphic design and 3-D modeling	❑	❑	❑
Supporting student development of publications	❑	❑	❑
Taking virtual field trips to art museums	❑	❑	❑
Creating films as an art form	❑	❑	❑
Sharing students' creative and research works	❑	❑	❑
Supporting teacher growth in integration strategies	❑	❑	❑
Total Points	_____ **of 78 possible points**		

Figure 14.5 Collaboration Opportunities for Arts Educators



Educators should continue learning how the arts are positioned within broader curricular standards and state or federal policy legislation. For example, after the passage of the ESSA, the government released a guidance document outlining components of its "well-rounded education" concept that allows U.S. states to broaden beyond competency in math and English (Jones & Workman, 2016). Another report (Jones, 2017) outlines the opportunities for the arts within ESSA. For teachers, the challenge is to explore the intersection between the ESSA, arts standards, and technology and prepare to teach in ways that combine them most effectively.

We suggest involvement in professional organizations, such as the National Arts Education Association (NAEC), a leading organization for visual arts educators, which offer teaching resources, events, recent research, advocacy opportunities, professional development, and collaboration. ArtsEdge, a section of the Kennedy Center, is devoted to sharing free resources for learning with and about the arts. For an arts-focused professional learning community, visit the Art Education 2.0 site (see Figure 14.5). Craig Roland created this resource more than a decade ago to serve as a collaborator space for teachers to share ideas and to collaborate on collective art projects together. Finally, teachers can participate on Twitter by using the following art-specific hashtags:

- #arted
- #artsed
- #arted
- #teachart
- #artednow
- #artteacher

Check Your Understanding 14.4

Chapter 14 Summary

The following is a summary of the main points covered in this chapter.

1. **Issues and Challenges in Music Instruction**—These include the changing definition of music literacy; the need to train teachers to meet music standards; problems with illegal downloading of music; the intersection of popular music, technology, and music instruction; and the music director as a small business administrator.
2. **Technology Integration Strategies for Music Education**—Strategies include:
   - Supporting music composition and production by using digital audio and grid-based workstations, sequencers, and notation software.
   - Supporting music performance with notation software, sequencers, and performance software.
   - Supporting self-paced learning and practice with instructional software to help students learn new skills (tutorials) and practice skills introduced by a teacher (drill and practice).
   - Supporting the teaching of music history with online archives, e-books, online journals, archived and current newspaper articles, audio and MIDI files, video clips, out-of-print books, and online discussion groups.
   - Supporting interdisciplinary strategies by assigning multimedia-based research projects, creating music or video footage of school events, and studying the science of music.
   - Continuing teacher growth in understanding issues and integration strategies for music by following opportunities set by state and federal governments and joining professional communities.
3. **Issues and Challenges in Art Instruction**—These include obtaining funding for art instruction, understanding ethical issues associated with the use of images and other materials, accessing images used in art instruction, and meeting standards in arts instruction.
4. **Technology Integration Strategies for Art Instruction**—Strategies include:
   - Accessing online art examples for classroom use.
   - Using teaching examples and materials in presentations.
   - Producing and manipulating digitized images with software.
   - Supporting graphic design and 3-D modeling with animation and image manipulation software.
   - Supporting student publication.
   - Taking virtual field trips to art museums.
   - Creating films as an art form with digital cameras and movie-editing software.
   - Sharing students' creative and research works in various online formats.
   - Continuing teacher growth in understanding issues and integration strategies for art by following opportunities set by state and federal governments and joining professional communities.

Technology Integration Workshop

1. Apply What You Learned

In this chapter, you learned about teaching and learning with technology for music and art education. Now apply your understanding of these concepts by completing the following activities:

- Reread the Technology Integration in Action scenario *The Fine Art of Digital Portfolios* at the beginning of this chapter. Pay close attention to Step 3 of the TTIPP when the teachers identify the technological possibilities for the problem of practice: providing students with an authentic audience for their music, art, and technology creations. Using your knowledge about technology integration strategies for music and art introduced in this chapter, generate at least one new technological possibility for targeting the problem of practice.
- Review how the music, art, and technology teachers RATified the lesson in Step 5 of the TTIPP, as represented in Figure 14.1. Use the RAT Matrix to analyze the role(s) and relative advantage that your new technological possibilities (identified in the last step) would play in the lesson. You must reflect on the roles that the identified technological possibilities play as replacement, amplification, and/or transformation of instruction, student learning, and/or curriculum. Do you feel your proposed technology would provide relative advantage?

2. Technology Integration Lesson Planning: Evaluating Lesson Plans

Complete the following exercise using the Technology Integration Examples 14.1–14.3, any lesson plan you find on the web, or one provided by your instructor.

a. Locate lesson ideas—Identify three lesson plans that focus on any of the music or art technologies you learned about in this chapter, for example:
- Using sequencers and software for music composition and production, music performance, self-paced learning and practice, teaching music history, and interdisciplinary strategies.
- Accessing art examples for classroom use, using teaching examples and materials, producing and manipulating digitized images, supporting graphic design and 3-D modeling, supporting desktop publishing with graphics, taking virtual field trips to art museums, creating film as an art form, and sharing students' creative and research works.

b. Evaluate the lessons—Use the Technology Lesson Plan Evaluation Checklist and the RAT Matrix to evaluate each of the lessons you found. Based on the evaluation and your RATification of the lessons, would you adopt these lessons in the future? Why or why not?

3. Technology Integration Lesson Planning: Creating Lesson Plans With The TTIPP Model

Review how to implement the TTIPP Model (see Figure 2.6) for technology integration planning and use the Technology Integration in Action scenario *The Fine Art of Digital Portfolios* in this chapter as a model. Create your own technology-supported lesson that uses technologies to support instruction or learning in music or art by completing the following activities:

a. Describe Phase 1—Analysis of Learning and Teaching Assets and Needs:
- What is the problem of practice or main content topic in your lesson?
- What are the technology resources your students, their families, you, and your school could bring as assets to the lesson?
- What are the technological possibilities for helping to solve the identified problem of practice? Identify the technology(ies) you will integrate into the lesson and ensure that you have the skills and resources you need to carry it out.

b. Describe Phase 2—Design of the Integration Framework:
- What are the objectives of the lesson plan?
- How will you assess your students' accomplishment of the objectives?
- What integration strategies are used in this lesson plan?
- What is the relative advantage of using the technology(ies) in this lesson?
- How would you prepare the learning environment?

c. Describe Phase 3—Post-Instruction Analysis and Revisions:
- What strategies and/or instruments would you use to evaluate the success of this lesson in your classroom, in order to determine revision needs?
- Create descriptors for your new lesson (e.g., grade level, content and topic areas, technologies used, ISTE standards, 21st-century learning standards).
- Save your lesson plan with all its descriptors and TTIPP Model notes and share with your peers, teacher, and others.

When you use your new lesson with students, be sure to assess it using the Technology Impact Checklist.