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K-12 art teacher technology use and preparation

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ABSTRACT

Largely absent from educational/instructional technology journals, this study focused on how K-12 art teachers in a southern state used technology to support teaching and learning, uses they found to be the best, and what kinds of technology training they received as part of their initial teacher preparation. Findings indicated that presentation and resource access technologies had transformed the way art teachers in the study work with students and materials. They also had little use of technology to support students with special needs and had limited technology experiences in their own training. Elementary art teachers were found to have more examples of student higher-order thinking skills promoting technology use, while secondary art teachers had more student media creation and a desire to implement digital portfolios. Additional findings and interpretations are offered.

1. Introduction

It has long been suggested that research into art teacher education had enormous potential (e.g. Galbraith, 1997), but that call seems to have largely only been heard by scholars writing for art education journals. Art teacher education and kindergarten through twelth grade (K-12) art teacher technology use are subject areas that tend to get overlooked in educational/instructional technology journals, which otherwise give substantial coverage to the four core subject areas (language arts, mathematics, science, and social studies), suggesting a gap within the field of educational/instructional technology. When art teachers or art education are addressed in these journals, articles have focused on a specific application or approach. These instances have included examples such as the use of interactive whiteboards to support visual arts learning in early grades (Chou et al., 2017; Terreni, 2011), development of a tool to enhance student attitudes toward creation (Ho and Lin, 2015), the development of an app to enhance artistic expression and scaffold reflection (Ho et al., 2017), or considering how a specific tool such as blogs can support the collaborative activities of art education students (Çakiroğlu et al., 2017). Otherwise, you have to turn to a major reference work from the field of educational/instructional technology such as Lockee and Wang (2014) consideration of the evolution of visual arts education due to technology advancements and some of the research opportunities that have emerged as a result. Conversely, there are some educational/instructional technology faculty exploring the crossroads between technology and art education such as three-dimensional (3D) printing (see Smith, 2014), though this work appears in art education or art trend journals.

A broader reporting beyond the four core subject areas that receive the most attention will benefit teacher education programs responsible for designing and implementing the technology preparation experiences that are being included as part of their teacher education programs. While technology integration has been emphasized in general teacher preparation and professional development (Lawless and Pellegrino, 2007), understanding more about current art teacher technology use and preparation could help to better prepare future art teachers.

It should be noted that even though this paper focuses on the absence of reporting of art teacher technology use and preparation within educational/instructional technology journals, this does not suggest that research on technology in art education is absent from other journals and other scholars outside of the educational/instructional technology field. Some of the work being done in these other journals is addressed in the literature review below. It is hoped that a broader reporting of art teacher technology preparation and technology use will add to the larger

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conversation of teacher technology preparation and additional consideration for teachers outside of the four core subject areas.

2. Literature review

2.1. Teacher technology preparation

The majority of teacher education programs prepare pre-service teachers to integrate technology into their future classrooms and teaching by requiring them to complete a minimum of one technology integration course (Gronseth et al., 2010; Jia et al., 2017; Kleiner et al., 2007; Lambert and Gong, 2010). Even though a single technology integration course remains the practice for most teacher education programs, the composition of these courses can vary as they are often a place for curricular experimentation. Past experiments have included focusing on teaching integration strategies using a project-based approach (Marra, 2004) or having the course be more focused on technology skills and linked to specific field experiences (Brush et al., 2003). Other experiments have included focusing on the specific technologies being used in area schools (Donovan and Green, 2009) or redesigning the course around 21st Century Skills (e.g. collaboration, communication, critical thinking, media literacy) instead of focusing on technical skill development (Lambert and Gong, 2010).

While there is most often only a single technology integration course in a teacher education program, there can often be other technology experiences woven into other classes and requirements. As such, it has been previously determined that teacher education programs play an important role in determining a teacher's views on technology (Christensen et al., 2005). Despite having had these experiences, and after taking a technology integration course, pre-service teachers have still been found to have pedagogical concerns relating to how best to use technology in their teaching as well when it is the most appropriate to integrate (Hughes, 2005; Niess, 2005; U.S. Department of Education, 2017; Zhao, 2003). Some have previously suggested that these concerns may arise from placing too much attention on technical skills versus focusing on how technology can support pedagogy (e.g. Kariuki and Duran, 2004; Parette et al., 2010) or that teacher mindsets were not sufficiently changed as part of their preparation to view technology as being a part of effective instruction (Ertmer and Ottenbreit-Leftwich, 2010). Exploring more into each subject area's preparation could help us to better understand the different factors which may be at play.

2.2. Technology in art education

The National Art Education Association (NAEA) holds and continues to refine a variety of positions in technology and technology-related consideration. It supports the inclusions of new media forms of expression as part of visual arts education (National Art Education Association, 2015) and had also indicated support for 21st Century Skills, believing specifically that visual arts afford students opportunities to develop their skills and capacities in several areas, including the development of Information Literacy, Media Literacy, and ICT (Information, Communications, and Technology) Literacy (National Art Education Association, 2016a). With the continued focus on and development of Science, Technology, Engineering, Arts, and Mathematics (STEAM), the NAEA believes that strong visual arts educations will aid in the development of future STEAM professionals and that STEAM should not be viewed as a replacement for visual arts education and instruction (National Art Education Association, 2017). The NAEA has also stated that art educators in PreK-12 school settings should, "Have an ongoing understanding of and ability to integrate current and emerging technology into their teaching" (National Art Education Association, 2016b). In drafting its newest positions, the NAEA is including a heavy focus on digital citizenship and digital resources (National Art Education Association, 2018).

Pre-dating this national position statement, some universities had made efforts to substantially modify their teacher education programs including both fine arts voices and technology considerations. One such university, the University of Georgia, through a six-year grant from the U.S. Department of Education, developed the Georgia Systemic Teacher Education Program ([GSTEP]; Henry and Lazzari, 2007). As part of this process, a fine arts curriculum committee that included art educators and PreK-12 art teachers focused on revising art teacher standards and making sure that art teachers could meet those standards through their preparation and teaching (Henry and Lazzari, 2007). As a result, the arts had a place in theses efforts, ultimately leading to an inclusive Georgia Framework for Teaching, which was adopted by the Georgia Department of Education (Georgia Systemic Teacher Education Program, 2005). This framework, which "identifies knowledge, skills, dispositions, understandings, and other attributes of accomplished teaching," (Georgia Systemic Teacher Education Program, 2005, p.1), includes a technology principle and technology considerations woven throughout the different standards.

Texas is another southern state that has taken prior action to bring more technology into its art classrooms. "Since 2011, the College of Fine Arts at The University of Texas at Austin has partnered with the Texas Cultural Trust (TCT) in promoting the Arts and Media Communication (AMC) curriculum" (Bain, 2014, p. 26). Through a series of professional development workshops, Texas K-12 art teachers are trained in how to develop project-based lessons such as digital storytelling to support the curriculum (Bain, 2014).

Methods classes can also be a source of innovative technology integrations. Baer and Daher (2014), brought online journaling into an Arts in the Elementary Curriculum class. This effort combined both an online journal and a traditional sketchbook to promote both artistic development and personal reflection, but also to challenge student perspectives on art and artists (Baer and Daher, 2014). The scholars indicate that while this is just one way in which technology supports ways to "mashup" practice and reflection, such undertakings are valuable for "pre-service educators' need to find thoughtful, creative, and efficient ways to express themselves and document their learning process and growth" (p. 33), which will support them in their future classrooms and with their future students.

Entire art education programs can be re-designed so that they have continual digital considerations through course updates and having sustained elements, such as the development and maintenance of a digital portfolio. In talking about these changes at Miami University, Baer and Danker (2017) indicate that "This structure has permeated every class in the art education program influencing curriculum content and delivery, encouraging scholarship, and empowering a paradigm shift for how students might see themselves as capable, reflective, tech-savvy art educators" (p. 2). Baer and Danker (2017) discuss how part of the portfolio is to have pre-service teachers document their growth as both process and product across the different identities of being artists, researchers, and teachers. These changes at the art education program at Miami University remain an ongoing evolutionary process.

While the NAEA can espouse aspirational positions, and different art education programs can make efforts to be heard in larger teacher education discussions, seek to train in-service teachers, and evolve to better prepare future teachers, there is still the matter of how art teachers are using technology to support their teaching and learning, as well as their views on technology. Disparities between the preparation of pre-service teachers and the actual practices of in-service teachers can vary and may take time to change.

2.3. Art teacher technology use in K-12

A previous survey of 225 K-12 art teachers (Roland, 2007) found that 96% of the surveyed teachers were frequently going online to collect images and information for use in their classrooms. Roland also reported that 70% of those teachers identified having their students go online to collect their own images and information as the most common activity. To aid in such online searches, art teachers may need the help of library

media specialists to help students better understand the quality of information sources and the potential biases in older sources (Zanin-Yost and Tapley, 2008). There have also been pushes for the inclusion of additional technologies in the art classroom, including Web 2.0 applications and social media (e.g. Buffington, 2008; Marshall, 2014; Roland, 2010). Such opportunities can include virtual field trips to art museums (Wetterlund, 2009) or using actual trips to museums and science centers as the basis for collaborative multimedia projects (Wishart and Triggs, 2010). While calls from art education can lead to changes in practice in K-12 classrooms, art teachers have not been idle in exploring technologies based on their own curiosity.

In observing the uses of Minecraft by students, Overby and Jones (2015), spoke with students between the ages of five and 18 about their experiences. Overby and Jones, while acknowledging the skepticism other art teachers may have in bringing Minecraft into their classrooms, articulated how it could be used to promote several different types of learning. These included teaching programming, leading to students wanting to learn how to use digital art software to further customize their virtual worlds, and as a gateway to have discussions and promote exploration regarding topics such as architecture, visual culture, and consumerism (Overyby and Jones, 2015).

Harkening back to earlier calls for the use of Web 2.0 applications such as social media, Jones (2015) reflected on his former students' discussions of the sharing of art via social media platforms. He explored the learning opportunities of the online platform known as Deviant Art (DA). DA is a social media platform where artists share examples of their art, document their processes, seek and offer feedback, and provide instruction for others to learn from. The social media aspects of DA include being able to like and follow different artists, tag different works for identification and location via search, as well as constructing different groups based on criteria like style, medium, or content. The activities on the DA platform, such as cultural development and diversity, collective intelligence, peer-to-peer learning, and fostering of experimentation and creativity, align with what has been designated both as participatory culture (Jenkins, 2006) and as a cyberspacial-postindustrial mindset (Knobel and Lankshear, 2007, as cited in Jones, 2015).

Innovative changes to practices in in-service art teachers' classrooms may come as a shock to some pre-service teachers who were not the product of art education programs such as those described earlier. It may also be a shock to those pre-service teachers who have beliefs about how art is done in the classroom or about the ability level of students. Lee (2015) recounts visiting an in-service classroom after pre-service preparation with print materials ready to share and use with teaching the children, only to find the students shifting to all digital practices once the opening of the class had completed. Unlike the art teachers from the Roland (2007) study noted earlier, it was the students in the classroom Lee was assisting in that were seeking out the resources from the web on their own. After recovering from the initial shock of students using so much digital technology on their own, Lee (2015) had questions about the safety of students using technology so freely, suggesting that teachers need to know more about internet safety and acceptable use practices. Lee (2015) further recommends that these areas where teachers may not be as comfortable could provide good opportunities for co-learning with the students teaching the teacher about digital applications and how they could be used, while the teacher is still teaching the students about the subject matter.

Not every school will have the technology available or allow students to use their own devices to support a classroom as the one Lee observed. Downing and Watson (2004) in examining art programs at 18 secondary schools found that students utilized ICT for producing art at only 10 of the schools, the same ones which were known to have contemporary art programs. ICT usage was however primarily focused on digital photography and image manipulation. These efforts were limited by the number of computers available and the lack of an ICT space in the traditional art spaces. Similar limited ICT access findings have previously been identified as limiting ICT use in art education (Callow, 2001; Long, 2001; Loveless, 2003).

Issues of access aside, there can also be uncertainty about how to best use ICT in art classes. Rodgers, Edwards, and Godfrey (2004) suggest that the majority of art and design teachers do not feel confident in implementing and incorporating technology into their curriculum despite increased technology use and availability in schools. In discussing the use of interactive whiteboards with teaching visual arts to kindergarteners, Terreni (2009) indicated that appropriate professional development was necessary to maximize the benefit of such a resource with early learners. Professional development options that could help teachers to bring more ICT practices into their curriculum may be limited (Downing and Watson, 2004), or there may be a lack of training of how to make the best use of additional resources, such as how to offer interpretations of different online art collections (Wetterlund, 2009). There can also be concerns over the qualifications of an art teacher, who may already be struggling with the basic pedagogical aspects of art education (Smilan and Miraglia, 2009), much less considering how to integrate technology into the art classroom. Some have called for a greater emphasis on preparing art teachers with "the best digital tools and practices available today in the professional training, so they will be better equipped to innovate for tomorrow" (Roland, 2010, p.23). Patton and Buffington (2016) suggest that being better equipped should include a focus on developing digital media art skills to both foster the 21st Century Skill of media making and also to be less likely to be seen as unessential when budget cuts are being discussed.

2.4. Importance of the study

As noted in the literature review, there are innovative art teacher education programs making strides to make sure the voices of art educators are included in the development of new teaching standards. Innovative programs are also pushing the professional development of in-service art teachers, as well as completely revamping their curriculum to be as digitally relevant as possible. K-12 art teachers are also demonstrating innovative technology-enhanced practices or looking to technology platforms for inspiration to change their practices. These are examples of mindset change that has been adopted by some educators and practitioners in the field, but not all.

Adoption of such thinking and resources may prove challenging for others in the field due to deeply entrenched beliefs such as art education being, "largely connected to the tools and materials used in the subject, such as pencils, paintbrushes, paper and paint. The tools and materials are accompanied by a powerful tradition and history" (Marner and Örtegren, 2013, p. 674). Another set of beliefs has to do with whether art is taught with a studio-based approach or an academic/critical approach (Smilan and Miraglia, 2009). While there are examples of technology use in art education well before the position statements of the NAEA (e.g. Galbraith, 1996), the magnitude of the changes advocated may require a paradigm shift for some to consider such usage (Marner and Örtegren, 2013). To help foster such change, it is important to continue to document how K-12 art teachers are being prepared and what current K-12 art teachers' practices include, especially to a broader audience within the larger field of education.

To help inform this broader discussion, this study sought to address the following three research questions of (1) How do K-12 art teachers use technology in their classrooms to support teaching and learning? (2) What technology experiences were included as part of their teacher preparation programs?, and (3) What differences exist in how elementary art teachers used technology versus their secondary counterparts?

3. Method

This study utilized a mixed-methods research approach and was carried out across two phases. In the first phase, a survey research design was utilized to develop a general understanding of the larger population.

In the second phase, a multiple case study design utilizing interviews was used to develop a more complete understanding of the findings from the survey. Participants, data sources, and collection procedures are described below. This study was approved by the Ohio University Institutional Review Board.

3.1. Participants and context

The participants were 67 K-12 art teachers from different regions in the same southern state. They consisted of 33 elementary and 34 secondary teachers. The gender of participants is not reported due to the participants being able to remain anonymous if they did not wish to self-identify for potential inclusion in the interview phase of this study. Because of variations in grade levels served between different types of schools in the state, divisions were based on the naming self-designations by the schools (i.e. elementary school versus middle or high schools). Middle and high school teachers were combined into a secondary teacher category for analysis. Participants were almost equal in the highest education level, with the secondary teachers having one more bachelor's degree ($n = 19$ versus $n = 18$) and one more advanced degree of master's or higher ($n = 15$ versus $n = 14$). One elementary teacher did not report their level. Participants were also skewed towards being more experienced teachers, with both groups having equal numbers of teachers with either six to ten years (both $n = 8$) or more than ten years (both $n = 21$). With the exception of one secondary teacher who did not respond, all of the participants indicated some level of comfort using technology (i.e. Somewhat Comfortable, Comfortable, Comfortable Teaching Others to use Technology in Their Classrooms; coded 1 to 3). Secondary teachers had slightly higher levels of confidence (mean = 2.15, standard deviation [SD] = 0.76) versus the elementary teachers (mean = 2.09, SD = 0.84), but both means were closer to the rating of comfortable. Of the 67 teachers who completed surveys, 36 opted into the interview phase, but only eight completed in-depth follow-up phone interviews.

3.2. Data sources

Two data sources were collected as part of this study. These consisted of responses to an online questionnaire and semi-structured interviews conducted via telephone.

3.2.1. Online questionnaire

The online questionnaire consisted of 23 items divided into three sections: demographic information, technology use during an average week and technology experiences that were included in their initial teacher education programs, and comfort level/preparation level with technology. Participants also had the opportunity to opt into the interview phase of the study. This survey instrument, used with permission, was previously used in a national study of teacher technology use and the technology preparation included as part of teacher education programs (see Ottenbreit-Leftwich et al., 2012) and the items were designed and validated by a group of university faculty, K-12 teachers, and educational evaluation experts selected by the USDOE based on their expertise in technology integration.

3.2.2. Interviews

Eight teachers, split evenly between elementary and secondary, completed the interview process. The interview protocol, again used with permission, was also the same instrument as had been designed and validated as part of the previously mentioned national study (see Ottenbreit-Leftwich et al., 2012).

3.3. Data collection procedure

Survey recruitment messages were first sent to a listserv for K-12 administrators that were part of a clinical schools' network (clinical schools are the designation used by several organizations within the state to designate schools where students teachers are regularly placed) for dissemination to their teachers, then to a statewide listserv of K-12 teachers assembled by the study author based on information provided by the state department of education. Participants could opt into the interview phase of the study by providing contact information at the end of the online questionnaire. Additional participants were recruited via snowball sampling. This occurred when interview participants would indicate there was another art teacher in the same state who would be beneficial to contact as part of the study. In those instances, the identified art teachers were contacted via e-mail to indicate how they had been identified and asked to first complete the online questionnaire. For the sake of data integrity, art teachers were only interviewed if they had completed the questionnaire. Interviews lasted approximately 40–60 min and were recorded and transcribed. Participants were given the opportunity to review transcripts to verify accuracy and asked to clarify any points of confusion that may have been identified during the transcription process.

3.4. Data analysis

Phase one of the analysis focused on the online questionnaire, which contained both open and closed-ended responses. Questions dealing with demographics and other closed-ended responses were analyzed using descriptive statistics. Part of the closed-ended questions included participants selecting what types of technology use they employed in their professional classrooms during a typical week (see Table 1 for the listing of technology topics from which participants selected) and what types of technology topics were present in their teacher education programs (see Table 2 for teacher education program selection options from which participants selected).

Open-ended questionnaire responses were first read through without any note-taking or coding to develop a holistic understanding and then a constant comparative coding approach (Merriam, 2009) was utilized during subsequent reviews. Participants were asked to describe the best ways to use technology to support teaching and learning as well as to provide an example of how they used technology to support student learning. These responses were analyzed using a deductive code list from the technology use topics described in Table 1. The author used the code list and descriptions to code responses independently. An outside reviewer reviewed the code list and made their own notes and coding assignments. Coding was then compared and differences were discussed one at a time until a consensus was reached.

Phase two analysis focused on phone interviews. A multiple case study analysis procedure (Merriam, 2009) was utilized to analyze interview data and margin notes taken during each interview. Using the same codes from phase one, each teacher was treated as a single case. The study author reviewed each case to identify emerging themes. The emerging themes, both within and across cases, were then discussed with the outside reviewer, and differences were discussed until a consensus was reached.

3.5. Trustworthiness

As noted earlier in sections 3.2.1 and 3.2.2, the instruments utilized in this study were the same as those used in a previous study. The original instruments were developed through consultation with an expert team of researchers and teachers assembled by the USDOE. Multiple triangulation efforts were undertaken by using more than one data type, more than one researcher, more than one method, and member checking. Longer, richer quotes are also utilized in the results section versus decontextualized snippets.

3.5.1. Limitations

One of the limitations of this study is that it focused on art teachers from a single state, which limits the generalizability of the findings to other states. Additionally, those art teachers who participated may have

Table 1. Technology use topics.

List Items	Examples
Personal Productivity	Use of technology for personal use. (Word processing, computer literacy)
Information Presentation	Use of technology for the presentation of information or visualization for content
Administration/Classroom Management	Use of technology to help manage classes (Course delivery system, grading)
Communication	Use of technology for one-way communication. (E-mail, website)
Electronic Resources	Use of technology to access, evaluate, or use electronic resources (Web sites, online databases, class resources)
Analyze Student Data	Uses of technology for data-driven decision making (Formative/summative assessment)
Document Growth	Uses of technology for recording professional growth and development (ePortfolio/digital portfolio, reflection, artifacts)
Higher Order Thinking Skills (HOTS)	Use of technology to foster higher-order thinking skills (Collaborative tasks, analysis or evaluation activities)
Special Needs	Use of technology to support students with special needs (Specific hardware or software solutions)
Classroom Preparation	Use of technology for lesson planning (Preparing materials, researching concepts)

been those who were more interested in technology, which could have created some biases in responses. The sample of this study also skewed toward more experienced teachers, which meant that their teacher preparation courses would have been prior to recent technology advancements in the classroom and technology integration courses becoming less about tool proficiency.

3.5.2. Researcher positionality

In research that involves qualitative data and analysis, it is important for authors to establish their positionality. As a former teacher education student, a former K-12 teacher, former K-12 district technology coordinator, a teacher educator, and educational/instructional technology faculty member, the author has considered teaching, learning, and technology through a variety of lenses for over two decades. As one of the researchers on a national study of teacher technology preparation and K-12 teacher technology use (see Ottenbreit-Leftwich et al., 2012), he believed the methods and instruments utilized were effective. While the findings were interesting to him, there was limited representation for any given state. To address this, the author decided to use the same methods and instruments to explore a single state more thoroughly than the national study had allowed. In reviewing the literature, the author was struck by how little attention his field of educational/instructional technology gave to K-12 teachers outside of the four core subject areas. The author decided to first focus on the art teachers who had participated in his statewide study, as they were one of the groups he had observed as being least represented in his own field's literature.

4. Results

Results are presented in order based on the data source from which they originated.

4.1. Questionnaire

4.1.1. Typical weekly technology use

Other than two elementary teachers who indicated that they did not use technology in a typical week, the remaining elementary and secondary art teachers indicated frequent technology use. The most frequent types of technology use included Personal Productivity, Information Presentation, Communication, Accessing and Using Electronic Resources, and Classroom Preparation (see Figure 1).

Table 2. Technology experiences from the teacher education program and attributed value.

		Elementary (n = 16)	Secondary (n = 13)
An educational technology course	Did Not Complete	n = 4	n = 2
	Not Valuable at All	n = 2	n = 1
	Valuable	n = 10	n = 10
		Mean = 3.5, SD = 1.4	Mean = 3.1, SD = 1.2
Technology projects/activities in teaching methods courses	Did Not Complete	n = 3	n = 1
	Not Valuable at All	n = 2	n = 0
	Valuable	n = 11	n = 12
		Mean = 3.2, SD = 1.3	Mean = 3.3, SD = 0.9
Technology projects/activities in other education courses (other than educational technology courses or teaching methods courses)	Did Not Complete	n = 3	n = 1
	Not Valuable at All	n = 1	n = 0
	Valuable	n = 11	n = 12
		Mean = 3.4, SD = 1.2	Mean = 3.3, SD = 0.8
Classroom observations of technology use by teachers and/or students	Did Not Complete	n = 5	n = 2
	Not Valuable at All	n = 3	n = 0
	Valuable	n = 8	n = 11
		Mean = 3.0, SD = 1.6	Mean = 3.5, SD = 1.0
Development/implementation of technology lessons/activities during field experiences	Did Not Complete	n = 4	n = 3
	Not Valuable at All	n = 2	n = 1
	Valuable	n = 10	n = 9
		Mean = 3.4, SD = 1.4	Mean = 3.6, SD = 1.3
Development/implementation of technology lessons/activities during student teaching	Did Not Complete	n = 5	n = 2
	Not Valuable at All	n = 2	n = 1
	Valuable	n = 9	n = 10
		Mean = 3.6, SD = 1.4	Mean = 3.6, SD = 1.3

Several of these categories of use appear to have significant differences upon visual inspection and basic comparison of percentages. To test this a series of chi-squares could have been run for each comparison, but due to the smaller size of the samples, Fisher's Exact Tests were run instead. Only Administration and Classroom Use were found to be significantly different between elementary and secondary art teachers ($P = 0.0002$).

4.1.2. Best use and example uses of technology

An open-ended response item asked art teachers to identify what they felt was the best way to use technology to support teaching and learning. The previous technology use codes were used to code the responses and results are reported based on those art teachers who responded (see Figure 2). Based on the coded responses, both elementary and secondary art teachers identified the three best uses as Accessing and Using Electronic Resources (36% and 29%), Information Presentation (33% and 24%), and Personal Productivity (21% and 9%). Higher-order thinking skills tied for third (also 21%) amongst elementary respondents. Another open-ended response item asked for a specific example of technology use in their classes. Using the same codes and based on those that responded, both elementary and secondary art teachers provided examples that were identified as Information Presentation (58% and 53%), Accessing and Using Electronic Resources (24% and 41%), and Personal Productivity (21% and 18%).

While the best use item requested best uses of technology to support teaching and learning, a trend was observed amongst some elementary (12%) and secondary (12%) teachers where they instead responded with statements regarding the appropriateness of technology use or disparities in access to technology in their particular schools or districts. This resulted in the identification of the emergent themes of equity and appropriateness. An example of an equity response included, "Flipping the classroom would be awesome, but we have neither the planning time to produce it or the hardware to access it!" (Elementary Teacher 1190). An example of an appropriateness response included:

> Like in many things I believe there is a middle ground rather than an all-or-nothing attitude. I believe technology is wonderful when it enhances and facilitates learning, but I do not believe that teachers should be required to use it every day just so a county can claim to be cutting edge or implementing a technology initiative. (Secondary Teacher 1128)

A similar occurrence was noted in the responses to the example of technology use items. While no responses that fit into the appropriateness theme were identified, responses that fit into the equity theme were again identified for both elementary (6%) and secondary (12%) art teachers.

4.1.3. Technology preparation from the teacher education program

When identifying the technology experiences they had in their teacher education program, participants indicated that requirements varied. Elementary art teachers were split almost evenly on whether ($n = 16$) or not ($n = 17$) they had technology requirements as part of their program. The difference was more pronounced in secondary art teachers, with more ($n = 21$) indicating they did not have a requirement versus those that did have a requirement ($n = 13$). Participants that indicated they had technology requirements as part of their preparation program were given the opportunity to identify what kind of experiences they had and if they found them to be valuable (see Table 2). Regardless of elementary or secondary level, almost all participants indicated that if they had a technology experience, they had found some degree of value (e.g. somewhat valuable, valuable, or very valuable; coded as 1 for no value up to 4 for very valuable) in the experience. The average mean for both groups across all experiences rounded to 3.4 or slightly closer to being valuable versus very valuable. Those that did not find value from the requirements shared thoughts like:

> They were not helpful in preparing me. The use of technology was very limited and either obsolete by the time I used it or unnecessary. The computer programs used in the school system are vastly different from what is being used in the real teaching environment. I use a wide variety of technology in my teaching methods, none were taught or even mentioned 10 years ago, though the technology was available. (Elementary Teacher 1997)

Participants were also asked how well prepared their program had made them be able to support teaching and learning with technology. All participants provided a response. Only a portion of the elementary teachers ($n = 5$) indicated that they did not feel that they were prepared by their programs. Otherwise, the remaining participants indicated that they had felt some level of preparedness (e.g. somewhat prepared, well prepared, or extremely well prepared; coded as 1 to 3). Secondary teachers indicated slightly higher levels of preparedness (Mean = 2.00, SD = 0.78) versus the elementary teachers (Mean = 1.93, SD = 0.77), but both means were closer to the rating of well prepared.

4.2. Multiple case records

Analysis of the interview data revealed several emerging themes that highlighted similarities and differences between elementary and

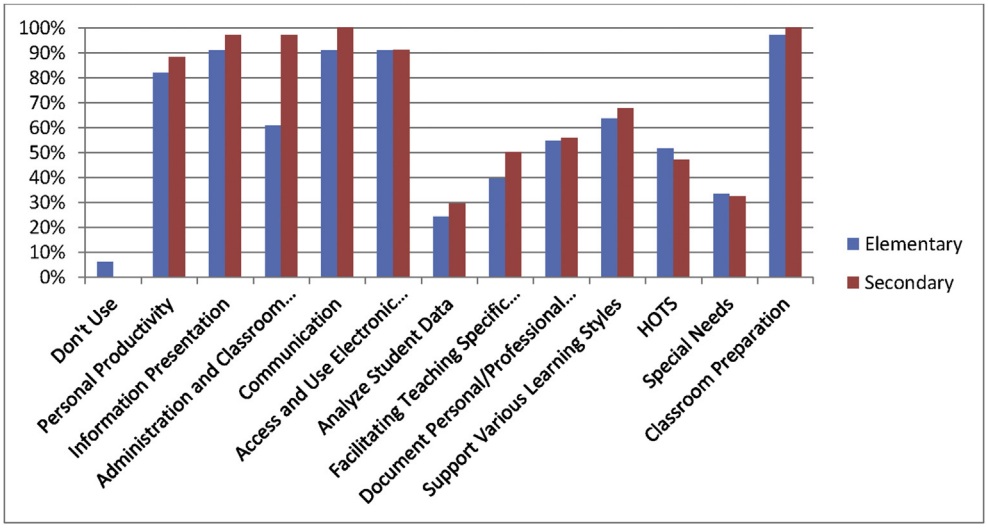

Figure 1. Technology use during a typical week: Elementary versus secondary art teachers.

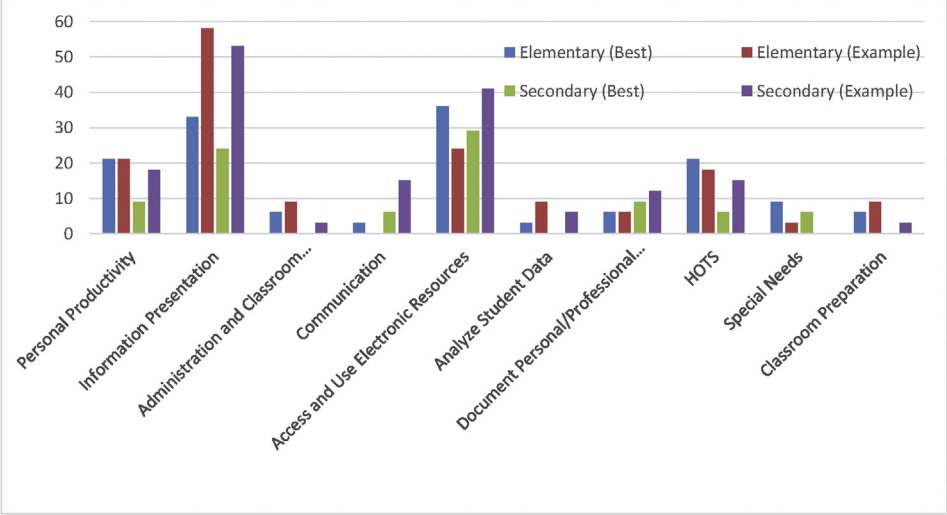

Figure 2. Comparison of perspectives regarding the best uses of technology and example uses of technology: Percentages of elementary versus secondary art teachers.

secondary art teachers. Four themes relating to Information Presentation, Students with Special Needs, Technology in their Teacher Education Program, and Future Technology Integration were identified as spanning both groups. Two themes relating to Personal Productivity and Electronic Resources were found to span only the secondary art teachers. These themes are presented below with common themes first.

4.2.1. Common themes

4.2.1.1. Information presentation. The emerging theme from the information presentation code was whole class dissemination. When asked about how they used technology in their art classrooms all eight teachers indicated that they used some form of interactive whiteboard, document camera, and/or digital projector to share examples of art, highlight differences, or demonstrate either techniques or procedures. One of the teachers represented most of the opinions the best by sharing:

> I think the thing that has changed them being able to understand what I'm doing the most is the document camera and projecting onto a screen or a smartboard. The document camera has made it so I can teach a small group or a large group and they can actually see it. It's not so good for color because it doesn't pick up the color really well, but drawing skills or even something as simple as going over a test or drawing something out that they didn't quite understand has been the most effective thing. The smartboard is really cool, but that document camera has really made a difference. (Secondary Teacher 1531)

These capabilities were of such interest that one of the elementary teachers went so far as to build their own solution to achieve this technology use. She shared that, "I have an overhead projector in my classroom that I use to project presentations as well as different artists and different artwork that students learn from. I also use a self-made document camera to present different techniques and skills" (Elementary Teacher 2306). An observed contrast within this theme was that in the high school art classrooms, the information presented was also likely to come from students either in the form of a presentation or sharing of recorded materials. One teacher felt this was empowering to her students, "for them to be able to project it up there for everyone to really see big, and bright, and colorful. I know they like to be able to use it themselves to show off with" (Secondary Teacher 2353).

4.2.1.2. Special needs. The emerging theme from the special needs code was that of a general approach. Students with special needs, either developmental or language-related, and low achieving students were generally treated the same way in art classes. Most teachers in this study indicated that they used the same general approach, or as one teacher indicated, "I teach like they all need help. I try to do it in terms of they see, they experience, they have examples" (Elementary Teacher 238). Technology would not always be involved, as one secondary teacher clarified that she, "Adjusts things, and differentiates things obviously, and uses differentiation strategies and things like that, but not from a technology standpoint" (Secondary Teacher 1267). Special needs students generally were paired with other students in the class, but often did not have specialized technology to aid them in being successful in the art classroom. With art being a visual medium, the teachers did not find that specific technology was necessary to assist them. Some employed more basic accommodations such as, "Giving them half as much to do and not marking down for spelling" (Secondary Teacher 1531) or really targeting specific technology use such as one teacher who worked with a larger emotionally handicapped population:

> I found if I use the technology in small chunks that I encourage partner work more than if I don't use technology with certain projects. I've also found that I can use drawing applications for them to brainstorm ideas on and get their brainstorm completely hashed out before putting it on the paper because they get very angry when they put something on paper because they feel it's permanent, whereas if it's something they've drawn or sketched out on the iPad and it's not permanent and you can just erase it, there's no trace that you've even made a mistake. It reduces the frustration level. (Elementary Teacher 470)

4.2.1.3. Technology in the teacher preparation program. All of the teachers spoke about there being little or no technology preparation in their teacher education programs, at least not specialized technology training for art teachers. In almost every interview, teachers joked about how they predated most modern technology; referencing mimeographs, manual overheard preparation, and slides. Instead, some of the teachers sought out additional experiences on their own. As one secondary teacher who sought out extra opportunities mentioned, "I sought out the technology. We did have to learn, and this is like the early nineties, we did have a mac lab, we had a pc lab. We had to learn the basics" (Secondary Teacher 1305). While one teacher did indicate having a class, it was a separate skills class. She shared that, "I had one class in computers in art that was about graphic design and Photoshop kinds of things, it was an introduction to that" (Elementary Teacher 238).

4.2.1.4. Future technology integration. Almost all (n = 7) of the teachers indicated a desire for a future technology integration opportunity via

some form of one-to-one computing (i.e. One computer or device available for each student to use). This was because of either having limited access to labs due to competition amongst teachers or because they wanted to be able to do more with digital art. One elementary teacher summed up some of the scheduling issues as to why she would like to have her own set of iPads as, "It's a big school so you have to get on the list far in advance, there's no spur of the moment idea where you can just do that" (Elementary Teacher 2147). The other thing that having a set of her own iPads would limit would be the setup time involved, she added, "It is just hard during the day with such short classes to get it in and set up and go. It takes a little more planning" (Elementary Teacher 2147). Another elementary teacher echoed the same logistical issues, "I really feel like with art they just need a computer lab to let us use, period, and not have to fight over getting a cart and that sort of thing" (Elementary Teacher 238)

> One of the secondary teachers indicated that he would like better laptops to open up different software opportunities:
>
> I don't want to say a Mac Book, but that type of computer, that is focused on having the ability to create and basically be able to be interchangeable with everything because then you could get the licenses for any software program you want. (Secondary Teacher 1267)

The one teacher who had not expressed this same desire indicated that "We made a very conscious effort to not use devices one-to-one with children whether they were laptops or iPads. So we have it so that it's one to three laptops or iPads" (Elementary Teacher 470). This teacher did subsequently offer that she did have a class set of iPads though that she made frequent use of for her classes. This suggests that many students will still experience using a device in her school, but not necessarily in every class.

4.2.2. Secondary only themes

The following themes only emerged from the interviews of secondary art teachers.

4.2.2.1. Personal productivity. The emerging theme from the personal productivity code was students as creators. Student creation might take the form of producing supplemental materials to help with the art process or as a way to replace more traditional assessments. Students producing supplemental materials were best addressed by examples of students being allowed to use cell phones in class. One such example addressed producing materials related to specific art projects:

> I try to make the most use of their smartphones I can. Having them use them not only for references and things like that, but it also allows them to do studies, self-portraits, and get angles that were previously only possible while holding a mirror. (Secondary Teacher 1267)

Another example spoke to the broader use of producing materials to help with general success in class:

> I give them a choice of recording information. Since they can use their own devices, they can use whatever works best for them. They can record the whole class, can record demonstrations, can take photographs of notes instead of handwriting them, or they can link to the presentations. I use Google Docs and if they have their Google we can share and that way they can access it and see it. (Secondary Teacher 1305)

An example of modifying assessments was moving away from the use of paper-based writing assignments and exams. One teacher shared that:

> What we have done for our exam is the kids have to put together a video of all their artwork and then they have to put music to it and they have to do a little presentation. It's pretty time intensive for them to get in there and put all of that together, but I really think they enjoy doing that a lot because instead of just writing about their art they get to talk about it. (Secondary Teacher 2353)

4.2.2.2. Electronic resources. The emerging theme from the electronic resources code was digital portfolios. Two other categories that were considered were documenting professional growth or analyze student data. The code for document professional growth was not applied here because teachers did not speak to documenting professional growth, so much so making the student work more accessible, and the analyze student data code was not applied because the focus was not on data-driven decision making. Fundamentally, students were digitizing their work and making it accessible to the teacher, their classmates, and others. The secondary teachers talked about the use of portfolios and had interests in digital portfolios. Part of the necessity was to ease the review of the materials process and limit how many materials were being transported and handled. One secondary teacher indicated how they were approaching digital portfolios to address logistical concerns:

> We've been using Edmodo. We have kids upload photos of their artwork and do essays and critiques, that way so that there is a lot less paper to carry around, a lot less trying to store artwork with that many students since we have such a large department and classroom space is limited. (Secondary Teacher 2353)

If this study was to revisit the same teachers in the future, it could be that this same theme of digital portfolios might shift to become analyze student data or documenting professional growth, as the same secondary teacher indicated that:

> We're working as a department to have digital portfolios with the students so that we can track them. So when the students start beginning art with me or someone else, when they go into advanced or intermediate art, we have a digital portfolio for the new teacher to see what level they were at when they come to them. (Secondary Teacher 2353)

One secondary teacher came from a department that had discussed digital portfolios, but there were some concerns that held her, and potentially others back, indicating "We've had the option of that, but because it's hard to get any of the labs or to access the apps we didn't follow that option for portfolios" (Secondary Teacher 1531).

5. Discussion

The purpose of this study was to examine K-12 art teachers, a group that is often overlooked in educational/instructional technology journals. This study examined topics of technology use, technology preparation provided by their teacher education programs, and differences in use between elementary and secondary art teachers. A discussion of the findings is presented below.

5.1. Uses

This study found that the dominant uses of technology by participant K-12 art teachers included personal productivity, information presentation, communication, access and use of electronic resources, and classroom preparation. This does not vary substantially from past findings of teacher technology use (see Lawless and Pellegrino, 2007; Maddux and Johnson, 2006; Ottenbreit-Leftwich et al., 2012; Project Tomorrow, 2008, 2009, 2011; Roland, 2007) or lower-level/passive technology uses despite the benefits of higher-level uses (Hsu, 2016). These typical weekly uses contrasted with the coding of what the art teachers identified as best uses for technologies and specific examples of their use, which included accessing and using electronic resources, information presentation, and personal productivity. The findings of this study suggest that art teachers do not use technology all that differently than their

counterparts in other subject areas. However, with K-12 art being a visual medium, it is not surprising how many of the art teachers indicated their use of information presentation and accessing and using electronic resources.

The biggest change that technology has allowed for art teachers in this study was the locating of, preparation, and sharing of art examples and techniques with all of their students instead of with small groups one at a time. Limited technology uses included analyzing student data, promoting higher-order thinking skills, and addressing special needs. The interviews indicated that limited support was needed for students with special needs, which teachers in this study referenced as either minor developmental differences or language barriers, as all of the interviewed art teachers had no students with major developmental differences.

The limited use category of analyzing student data seemed to conflict with some identifications by teachers in the survey and interviews that portfolios were utilized with students. Portfolios suggest documentation of growth and progress that is reviewed by the teacher, which could lead to some data-driven decisions. It is possible that the art teachers in this study took this category of use as relating to standardized testing data as opposed to utilizing any available student data such as those works that may appear in their portfolio. Higher-order thinking skills were largely unaddressed by the art teachers in this study. The lower use of technology for this seems at odds with National Art Education Association (2016a) view on promoting 21st Century Skills such as higher-order thinking skills and critical thinking. It could be that teachers facilitated such efforts through lecture and class discussion, viewing technology primarily as a way to show content to students or connect them with it.

Based on how similar other technology uses were to other subject area teachers, there should be more exploration here in case there are potential misunderstandings as with the analyzing student data example above. Possible ways to promote 21st Century Skills via technology may be helped by a greater emphasis on apps to help promote creation and reflection (Ho and Lin, 2015; Ho et al., 2017), supporting greater media creation (Patton and Buffington, 2016), or helping art teachers to better understand how their presentation and access technologies are helping to promote higher-order thinking skills, versus continuing to perpetuate passive consumption via technology (U.S. Department of Education, 2017). It was encouraging that a number of teachers in the study indicated a desire for more one-to-one computing options and a desire for some additional software options. This could suggest a desire to move to more student creation via technology if there are sufficient resources available.

5.2. Differences

Based on the identification of weekly use, few differences were present between elementary and secondary art teachers. The greatest discrepancy that appeared was in the use of technology to support administration and classroom management. This difference could, however, be something of an error. The state from which this study drew participants requires that all schools use a particular student management system for attendance and grades, as a result of this mandate the findings would have been expected to be 100% for both groups. The lower number could be due to either the ubiquity of the technology uses for that function being subconsciously dismissed as "real" technology use, or it could be a result of teachers separating the attendance or grade recording functions as being outside of the course content itself and actual teaching or learning that is supported by other technologies.

Based on the interview phase, secondary teachers had two different uses that were not identified with elementary teachers, including having students producing media in different forms and digital portfolios. Having students use their cellphones and other devices to record, share, and connect with each other and the teacher speaks toward engaging in Participatory Culture (Jenkins, 2006), with "low barriers to artistic expression and civic engagement, strong support for creating and sharing one's creations, and some type of informal mentorship" (p. 3). The encouragement of recording seems to promote different opportunities for 21st Century Skills development such as creativity, collaboration, and communication (Patton and Buffington, 2016; U.S. Department of Education, 2017). These kinds of uses also address where the NAEA is going with its positions on digital citizenship (National Art Education Association, 2018) and new forms of media (National Art Education Association, 2015).

The development and use of digital portfolios were mentioned as ways to address logistical concerns of storage and transportation, a way to access resources for critique, and a way to track student progress. Art teachers who want to use digital portfolios solely as containers should be cautious, as past studies have found such limited uses are not well-received (Borko et al., 1997; Meyer and Tusin, 1999). Concerns over their use can be addressed by discussing how they will be focused and what they will contain (Ritzhaupt et al., 2008). Beyond simple critiques, the inclusion of some type of social networking functionality with them can help to create a sustained learning community (Crichton and Kopp, 2008) and provide ways to support digital citizenship education (National Art Education Association, 2018) as students learn to better engage with each other online and respect other's materials. Beyond just students, the use of digital portfolios can also provide a reflective opportunity for teachers as well (Rickards and Guilbault, 2009), adding further utility to teachers considering their use.

5.3. Preparation

Most of the teachers in this study, at least those in the survey phase that had technology requirements as part of their teacher preparation, found the requirements to be valuable. This contrasted with the interview data where teachers indicated how they had little technology training due to having been in their programs before the internet was widely accessible, and instead having learned more about basic software skills or older technologies like mimeographs and slide production, suggesting that they may not have had integration strategies to work with (Niess, 2011; Wetzel and Marshall, 2011). In considering how well prepared they were by their programs to teach with technology, only some elementary teachers indicated they were not prepared.

Since some of the teachers went through their programs more recently, newer technologies and more readily accessible internet resources would be available, which could mean other factors are at play. This could suggest that technology integration courses need to either model more examples of technology integration for future art teachers, bring in specific examples of how local art teachers are using technology in their classrooms (Donovan and Green, 2009), a specific technology integration course solely for art teachers could be implemented to allow for greater focus on art classroom applications, provide service-learning opportunities (Jia et al., 2017), and/or more modeling may be necessary within art and art education courses to help future art teachers to see more examples and have their entrenched beliefs about the use of technology in the art classroom challenged (Ertmer and Ottenbreit-Leftwich, 2010; Marner and Örtegren, 2013).

5.4. Equity and appropriateness

When participant art teachers were asked to share their thoughts on how to best use technology to support teaching and learning or for examples of how they used technology in their classrooms, some of them instead talked about the appropriateness of using technology or a lack of equity in who could access technology and at what times. Similar thoughts appeared in the interviews as most of the teachers indicated a desire for one-to-one computing since they could not always get into computer labs or borrow mobile lab carts. This may speak to previous claims of a near one-to-one computer ratio in schools (Gray et al., 2010) being incorrect or further indications that barriers to technology use and

integration (Ertmer, 1999; Park and Ertmer, 2008) are still prevalent in the schools in the southern state in which this study took place.

While the interest in accessing more technology is encouraging, there may still be a number of art teachers who hold somewhat traditional views on what art and art education consist of (Marner and Örtegren, 2013) and to past findings that some teachers do not use as much technology because they do not recognize its relevance to them, their subject area, or their classroom (Ottenbreit-Leftwich et al., 2010). The appropriateness concerns would seem to run counter to the technology skills and use the NAEA is expecting from licensed art teachers (National Art Education Association, 2016b) and considering for the future (National Art Education Association, 2018). With the majority of teachers in this study having taught for more than 10 years, it should also be remembered that these kinds of changes and implementations can take time for teachers to make (Ertmer and Ottenbreit-Leftwich, 2010).

5.5. Implications for practice

As noted in the introduction, only a few articles regarding art teacher technology use or technology preparation appear in educational/instructional technology journals. It is not clear why this field has largely overlooked or disregarded K-12 art teachers and art teacher education as viable research foci in favor of their four core subject area colleagues, but it could lead to technology integration faculty and instructors teaching future art teachers the same general types of technology use as other future educators, regardless of the intended subject area, and not provide any unique modeling or examples more relevant to the art classroom. The findings of this study that participant art teachers' technology use didn't vary much from other subject area teachers could suggest that general teacher technology preparation is sufficient as it is within the state. Maintaining this status quo is troubling when other states have made particular efforts to include the voices of art educators and teachers in larger teacher education programs (Georgia Systemic Teacher Education Program, 2005) or have regularly supported in-service K-12 art teachers with specific training relevant to their subject area and practice via projects such as digital storytelling (Bain, 2014).

In the event that technology courses are taught within art education programs, there could be pockets of faculty who may have limited views on how technology can be integrated into art education or have a more traditional view of what tools should be used within art, excluding digital or more modern technologies in the process. With the sample of art teachers in this study skewing older and having more than 10 years of experience, the notion of limited thoughts by art education faculty may be outdated, as practices will likely have changed since these participants went through their training programs. However, with some newer art teachers in this study also reporting limited technology preparation, there could still be some programs that have not changed. Regardless of where the future art teachers are receiving their technology experiences, general or specialized, teacher educators may need to think about additional examples of how technology can be specifically integrated into the art classroom to help better prepare art teachers for the variety of options that they could be drawing from in the future. Beyond specific examples of modeling, more meaningful integrations and modeling could best lead to growth. Examples of integrating reflective digital journaling and sketchbooks (Baer and Daher, 2014) or the integration of a digital portfolio throughout an education program (Baer and Danker, 2017), provide examples of how students might engage more frequently and more critically as they develop their identities as artists and teachers, as well as their practices as both.

In K-12 schools the administrators or faculty members responsible for developing, carrying out, and/or arranging professional development will need to consider more areas than the four core subject areas for both topics and examples. Sessions that include at least one art example or better linkages across the broader curriculum could help to foster additional technology use by art teachers. One potential bridging topic could be about creative or artistic thinking as a way to help students with STEAM activities (National Art Education Association, 2017). Art teachers, especially those experimenting with technology use in their classrooms, are uniquely positioned to provide insight to others in fostering creativity and encouraging students to look at problems in new ways. As Black and Browning (2011) suggest, "When learning to create and express their ideas with new software, they can improve their patience and appreciate the subtle and larger changes that they learn with graphic effects tools" (p. 21). Other linkages within the curriculum could include other broad-reaching efforts such as teaching reading across the curriculum or how to promote problem-solving or computational thinking skill development in all subject areas.

6. Conclusion

Educational/instructional technology journals often feature research on the technology preparation or technology use of teachers, exploring the uses of certain applications and pedagogies, as well as considering factors such as self-efficacy, comfort, and stress. Seldom do any of the considered populations include teachers from the arts, instead favoring the four core subject areas. Using the same instruments as a past study that considered teacher technology use and preparation at the national level (see Ottenbreit-Leftwich et al., 2012), this study focused on a single state and specifically examined K-12 art teachers.

This study found that art teachers in a southern state used technology much like other teachers in past studies, though with their greatest emphasis being on presenting information and accessing and using electronic resources. Secondary art teachers were found to have their students produce more of their own media and had a greater interest in utilizing digital portfolios. K-12 art teachers viewed their teacher education programs as being generally beneficial, but the technologies utilized were limited. Concerns were raised by some over the equity and appropriateness of technology used to both teach art and to produce art, suggesting that there are still entrenched beliefs that may lead to disparities in use amongst art teachers (Marner and Örtegren, 2013). Such differences are at odds with what the National Art Education Association (2016a, 2016b, 2017, 2018) has stated and could contribute to a continued digital use divide (U.S. Department of Education, 2017) related to the use of technology to support learning.

Additional considerations for preparing future art teachers to support teaching and learning should be undertaken and these different efforts examined for their impacts and effectiveness. These discussions and examples of innovation continue to take place within the art education field, but should also be given greater consideration by applied fields such as educational/instructional technology, which has largely overlooked K-12 art teachers and art education to date. With educational/instructional technology faculty teaching many of the technology integration courses required of pre-service teachers, it is important that they consider perspectives and examples from more subject areas than just the core subject areas. Beyond just the pedagogical considerations of such classes, educational/instructional technology scholars should also strive to be more inclusive with the subject areas they examine and report on via their research. There are many more types of teachers and their technology integration practices we can all learn from; we just need to widen our view.

Declarations

Author contribution statement

Jesse Strycker: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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