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SCHREYER HONORS COLLEGE

SCHOOL OF MUSIC

Student Perceptions of Digital Learning Technology: A Cross-Cultural Analysis of Music
Students

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ABSTRACT

Digital learning technology has increased in relevance as computers and software have become widespread in education settings globally. The COVID-19 pandemic and its impact on schools reiterated the need for a robust understanding of student perspectives on technological preferences and adaptations. Existing research highlights the technological preferences of teachers and does provide case studies on student use of technology. However, these studies do not account for the entire context of students' use of technology—particularly in relation to COVID-19 and its associated effects. This paper documents findings from student interviews at Penn State and the University of Oxford on their technology use in music coursework. Data were analyzed with GPT-4, mimicking latent Dirichlet allocation, a statistical probability model. Results show that students have an increased use and value associated with learning technology in music coursework, particularly post-COVID-19. Further, the importance of accessible user interfaces and institutional-procured software is highlighted.

TABLE OF CONTENTS

LIST OF FIGURES	iii
LIST OF TABLES	iv
ACKNOWLEDGEMENTS	v
Chapter 1 Introduction	1
Chapter 2 Review of Literature.....	6
Chapter 3 Methodology	10
Chapter 4 Results	14
Chapter 5 Discussion	17
Appendix A IRB Exemption Determination.....	22
Appendix B Participant Recruitment and Consent Letter.....	24
Appendix C Interview Protocol	25
BIBLIOGRAPHY	27

LIST OF FIGURES

Figure 1. Technological Pedagogical Content Knowledge.....	7
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LIST OF TABLES

Table 1. Learning Technologies from Student Interviews.....	15
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Chapter 1

Introduction

The importance of technology in educational settings has increased as the approaches educators use reflect the ways students are able to learn using technology: or, as Stevens, (2018) puts it, “new technology redefines the culture that creates it” (p. 66). For some, the COVID-19 pandemic accelerated trends like remote learning and the inclusion of technology in the curricula of educators around the world through remote learning. However, this trend was not felt equally, particularly in rural school districts with limited broadband internet access (Nicola et al., 2020). Music education is undeniably changing, evidenced by strengthened access to instrumental music programs for students, new learning experiences with digital technology, and the inclusion of diverse and historically marginalized perspectives in school music curricula (Parsad & Spiegelman, 2012). To better understand the backdrop to these sweeping changes, it remains important to discuss factors that intersect with digital learning technology use. Furthermore, it is vital to understand how American music education is distinct among its global peers, as well as identify areas where and how it can improve.

The Need for Technology in School Music

Often music as a discipline and American school music are conflated as the same thing. For many reasons, this is a positive, although it is important to consider how they are not the same. This distinction is of increasing importance due to the overlap of technology use in academic and personal settings. For example, a student who uses a tablet for notetaking in the classroom may use the same tablet for games and social networking outside of the brick-and-

mortar classroom. Furthermore, the same student may be able to use the tablet to complete academic tasks, such as homework in the home or a distinct third space (e.g., a coffee shop or public library). Similarly, music making occurs in many contexts beyond just the school. School music programs have been moving to include more genres of music through the introduction of courses in hip-hop production, rock, and similar (Kruse, 2016). Despite emerging diversity in school music courses, music will always be a synthesis of in-school teaching and out-of-school experience. Music in and out of schools can be broadly conceived as written, aural, professional, communal, individual, and above all, personal. As such, the goal of school music should be to equip students with the skills, strategies, and experiences necessary to be able to make, play, write, and enjoy music throughout the lifespan.

Music as an art form is associated with school music because it is through schools that music performance was able to proliferate to the masses. For instance, music performance was not always available for those who did not have access to the array of resources necessary to learn and teach music. Early on, the church provided much of this training, which is one explanation for the historical ties between Western music and the Catholic church. Today, American students are exposed to a wide net of musical genres, thanks in part to the prevalence of streaming services (e.g., Spotify, Apple Music) which might be beneficial to consider when developing curricula. At the same time, similar conversations on the value of including diverse perspectives in music courses have persisted in the United Kingdom (Kwami, 1993). Across cultures, music teachers are working to overcome dogma by iteratively reinventing their curricula with diverse practices to respond to the ever-changing music landscape. To provide the strategies and experiences necessary to be able to make, play, write, and enjoy music throughout

the lifespan, music educators can consider including diverse perspectives in their teaching.

Importantly, the aim of this practice should be to keep students engaged and in class.

Effectively addressing students' needs amid the surge in digital learning technology is crucial for their optimal educational experience. An inherently broad topic, there are multifaceted considerations regarding learning technology, such as ethics—including student privacy concerns—student preferences for technology use, attitudes toward artificial intelligence in education, technical literacy, and the implications of learning technologies as capital projects, among others. At the same time, learning technologies increase the ceiling of student knowledge and achievement, primarily through increased access to information. Education technology, if implemented effectively, can help build skills for future careers, provide educators with more data points to inform their planning, increase student collaboration, and offer personalized learning experiences (Li, 2022; Nevgi et al., 2006; Schmid & Petko, 2019).

Education Technology Adoption in the COVID-19 Pandemic

There are several stakeholders that influence technological adoption in schools. For instance, Li (2007) identified the following:

Students' and teachers' beliefs about technology may affect their adoption of the tools which directly contributes to the establishment of a technology-enhanced environment. Further, administrators' understanding of technology-related issues may affect school policies. This, in turn, may influence the integration of technology in schools and reshape the environment. (p. 378)

Applied to a music education setting, conceptions of stakeholders might also include band booster associations, arts administrators, and third-party vendors. Geographical limitations might also impact education technology adoption. Southall et al. (2021) found that student absences in

England during and after the onset of the COVID-19 pandemic were clustered in urban areas in Greater London, the Midlands, and the North of England. Similar patterns of absenteeism in urban school districts occurred in the United States within the same timeframe, due to the COVID-19 pandemic. Dorn et al., (2021) identified a “sharp uptick in absenteeism rates nationwide, particularly in higher grades” (p. 8).

The technological response to the COVID-19 pandemic was felt in all sectors, including K-12 and higher education. Instead of struggling with student absenteeism, higher education institutions were tasked with continuing education remotely. Students continued to show up, but in remote and digital settings. Considering economic impacts, Turnbull et al. (2021) reflected that “a forced transition to online learning has been the only viable option for preventing a wholesale closure of many institutions.” (p. 6401). Music schools, college departments of music, conservatoires, and similar institutions faced enormous pressures in transitioning to remote learning.

Administrators and educators struggled with ontological questions related to their capacity to provide high-quality music studies virtually. Given the unique challenges each institution faced, how did different universities adapt and respond? What factors influenced students to use particular technologies? Primary and secondary school music education and university-level music education have inherent differences. From expenditure, research breadth, and administrative alignment, there are different incentives for universities as opposed to public schools. Despite these differences, students were impacted in similar ways across learning levels. Across the board, digital learning technologies were ubiquitous as teachers sought to continue providing learning experiences throughout the COVID-19 pandemic. As the pandemic recedes, questions regarding educational technology remain. For instance, what should teachers and

administrators do to best serve students with learning technology? Moreover, how can educators facilitate an environment that promotes the ethical use of emerging technologies like artificial intelligence? Researchers' understanding of habits and motivating factors behind student use of education technology will likely increase as cultures of innovation and technological adoption expand (Chuang, 2014). As with computing, the ability of new technology to serve administrations, teachers, and most importantly, students, in helpful ways may follow Moore's Law of exponential growth (Schaller, 1997).

Purpose

The purpose of this study was to investigate the similarities and differences American and British music students have with digital learning technologies, including devices, platforms, and websites. By interviewing current music education students, this study aimed to understand their preferences and goals when using various modes of learning technology, spanning from classroom tools, hardware, and software, including web and mobile applications. An additional purpose of this study was to identify the way students' use of technology has changed from before the onset of the COVID-19 pandemic to after COVID-19. The final aim of this study was to consider the practical implications of various modes of digital learning technology for music teachers based on an analysis of semi-structured student interviews. Subsequent analysis was performed via artificial intelligence models to generate an objective recommendation for teachers.

Chapter 2

Review of Literature

In a broad review of technologies used to enhance student creativity in the classroom, Lam (2023) identified eight technological tools for the music education classroom sourced from an analysis of 17 studies over 35 years. Studies were selected based on their relevance to the use of technology in K-12 music education. Additionally, Lam stated that qualifying studies “reported empirical evidence regarding technology’s impact on students’ creativity” (p. 3). Other considerations included: date of publication (January 1987 – November 2022), publication in peer-reviewed journals, and language of publication (English). Reviewed literature spanned from grades 3-12 to preservice teachers, as well as secondary music teachers, representing classrooms in North America, Europe, Asia, and Oceania. Lam reports that the most used loop-based software is GarageBand, while music notation software such as Sibelius and Finale are the second most useful technologies.

Types of Technology in Classrooms

Graduate student researchers use a variety of technological tools just as all other music students are apt to in their day-to-day activities. In a survey of graduate student researchers in six significant music education over a five-year period, Bauer (2016) highlighted valuable technologies for young research students. The TPACK (Technological, Pedagogical, and Content Knowledge) model illustrates the importance of both student and teacher literacy with emerging technologies – probably even more acutely today, given the date of publication of Bauer’s study.

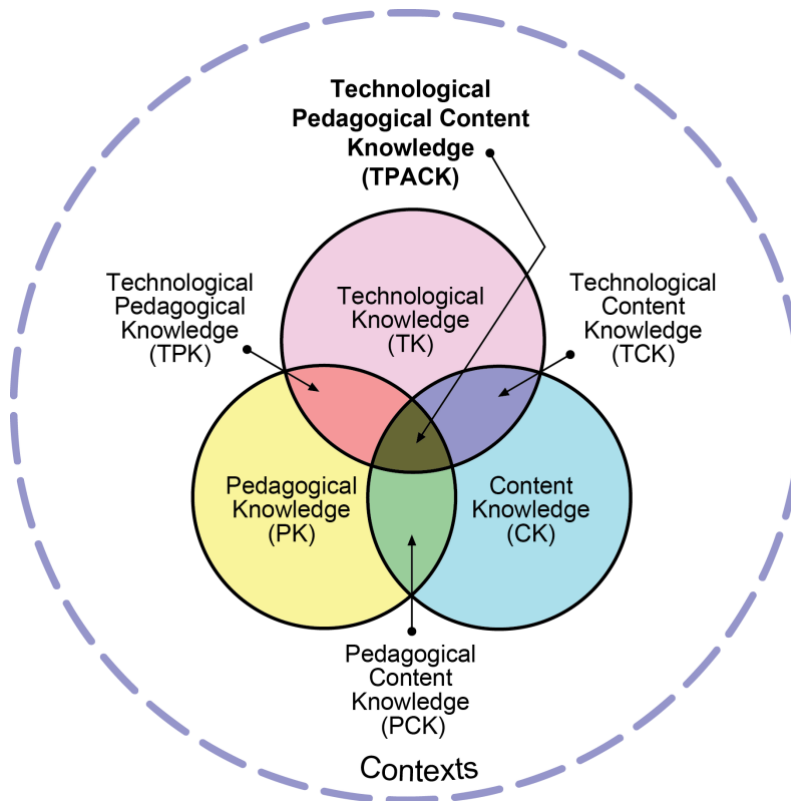
In an adaptation of the TPACK model, Bauer considers the notion of methodological knowledge to be swapped for pedagogy, from which researchers (students) can better think about the research (learning) process. He later notes from a participant:

Technology is merely a tool and with any tool, understanding that it exists and utilizing it in an appropriate manner are two different issues. We need to teach our students about the myriad resources available and help them to devise a protocol that will suit their needs as scholars in the future. (p. 12)

In sum, graduate researchers and students can benefit from the use of hardware, software, web applications, and similar tools if paired effectively with content knowledge, technical literacy, and efficacious pedagogical practices (The TPACK model).

Figure 1.

Technological Pedagogical Content Knowledge (TPACK, 2012)



Pedagogical practices utilize various modes of technology depending on the content of a lesson, something common in other disciplines but less customary in music education. Kim (2013) discussed ways that teachers can take ownership of music software and technology to provide students with multiple unique learning experiences with technology. In a case study, South Korean elementary school students followed a music technology curriculum across eight lessons. Kim found that implementing a music technology-based curriculum “could enhance students’ self-motivated engagement in the music class and their perception of music in general” (p. 424). The results also indicated that technology-based curricula give students the willingness and ability to “make creative decisions” and direct their own learning.

It is widely understood that the COVID-19 pandemic had expansive effects on many sectors, notably education. In response, many educators became reliant on digital technologies like computers and tablets to conduct classes. For instance, Merrick and Joseph (2023) reported that in Australia, “teachers adapted their practice...reporting increased confidence, application, and ICT [Information and Communication Technologies] usage” (p. 189). From a student perspective, the pandemic similarly availed pupils to technologies while developing literacy with new technologies.

Cross-cultural Research in Music Education

Portowitz et al. (2014), composed of academics from Bar-Ilan University, Israel, Indiana University, USA, and Saint John’s University, USA, evaluated *In Harmony*, a music education model designed to scaffold student thinking and facilitate human-computer interaction. Students were able to successfully compose music in groups via tasks delivered over computer software. Critically, students in Bloomington, Indiana, and Jaffa, Israel both improved “working memory, self-regulation, and cognitive flexibility” using the computer program. The authors later

discussed the oversaturation of technologies available to today's learners, something with potential effects on educators' and administrators' hesitations implementing new technology in classrooms. To this end, the researchers proposed the *In Harmony* model to synthesize various technologies into a single platform for elementary school music students. The two components of *In Harmony* included: 1) *Teach, Learn, Evaluate! (TLE)*: online exercises that scaffold early musical ideas for elementary students, and 2) *Impromptu*: music composition and remixing over computer software, designed to provide an understanding of basic melody, form, rhythm, meter, pitch, and harmony.

From a cross-cultural standpoint, this study illustrated the value of comparing two distinctly different educational settings that share the same technology. The watershed potential of music education technology, specifically comprehensive learning platforms, such as *In Harmony*, suggest that students from a greater diversity of locales can increase student scholastic achievement through the development of fundamental skills at an early age. Moreover, technology-based curricula can provide valuable experiences for students to hone fundamental skills and work in group settings.

Chapter 3

Methodology

The present study examined the ways university students use technology in their music courses at the Pennsylvania State University and the University of Oxford. Participants were recruited from a population of students enrolled in a university-level music course of study at the Penn State School of Music or the University of Oxford Faculty of Music. No individual students or factors (e.g. year in school, instrument family, etc.) were given preference in the study; all potential participants were given equal consideration throughout the recruitment process.

Undergraduate, graduate, and doctoral students indicated their willingness to participate via a Qualtrics survey. The Penn State School of Music Undergraduate and Graduate Program Coordinators were contacted to distribute the invitation survey via email LISTSERV to students. The same action was performed by the Events Office at the University of Oxford, Faculty of Music. First, students read the study invitation, which detailed the purpose, procedures, and pertinent information such as confidentiality of data and consent. Students then indicated their name, email, and availability to schedule a remote interview via Zoom. Eight students scheduled an interview slot through the Qualtrics survey. Seven total interviews were completed, with one no-show. The full recruitment and participant consent letter is in Appendix B.

The interview protocol was grouped into three sections. The purpose of the first section was to collect demographic information on the participants. In this section the investigator prompted participants for their 1) name, 2) degree program, and 3) primary instrument or voice type. Data were anonymized for subsequent analysis. The second section documented students' use of technology in their coursework, including the value they associate with specific modes of

technology. I grouped this in two sub-sections: hardware (e.g., laptops, personal computers, iPads, and similar), and software (web browsers, websites, word processing software, and similar). Semi-structured interview questions were designed to gather specific details about why certain hardware and software were more useful than potential alternatives. The students had space to reflect on factors that influenced their decisions, such as utility and cost. An additional aim of this section was to gather information on the quantity of class time in which certain technologies were utilized in coursework. The final aim of this section was to compare how much time was spent with technology in academic versus non-academic contexts.

The third section of the interview protocol included a more open discussion on technology use before, during, and after the outbreak of COVID-19. Specifically, students were prompted to describe changes around March 2020, when academic institutions first began to lockdown and transition to remote instruction. In this section students were asked to describe how they transitioned and speak to their preparedness with new platforms, such as Zoom. Finally, participants answered questions that made them reflect on their own academic journey and how technology had assisted them, as well as if they are looking to use technology more, less, or about the same in the future. The full interview protocol is in Appendix C.

Interview Transcription and Corpora Construction

Interview transcription was performed with assistance from AI program Otter.ai. Otter uses deep learning algorithms to automatically transcribe speech in Zoom meetings. At the conclusion of each interview Otter automatically creates a transcription of all speech from both participant and investigator. The investigator verified the accuracy of each transcript before exporting and organizing interview data in .txt files. Qualitative interview contents were organized to reflect the two corpora of data used to perform an analysis. The first corpus

represented qualitative responses regarding general technology use in music courses, including specific technologies, as well as the value associated with each one. These data were analyzed through a topic model representing the most pertinent technologies used in music courses. The second corpus contained qualitative responses regarding students' reaction to COVID-19 and associated technological adaptations. These data were analyzed through the creation of a narrative via generative AI program GPT-4. I attempted to mitigate the impact of social-desirability bias by maintaining candid dialogue and fostering an environment where students feel comfortable sharing their insights and opinions.

Data Analysis

I utilized a Generative Pre-Trained Transformer, more specifically OpenAI's GPT-4, a multimodal large language model (LLM) (OpenAI, 2023). I prompted GPT-4 to create a topic modeling algorithm that mimicked latent Dirichlet allocation (LDA), a probability model which organizes semantic data (Blei et al., 2003). This data analysis process was applied to the first corpus, which discussed students' general use of technology in music courses. The aim of this procedure was to highlight specific learning technologies that students found to be valuable to their learning. The second corpus was again analyzed by GPT-4 which was prompted to perform narrative procedures which represented students' experiences with learning technologies before, during, and after the COVID-19 pandemic, as well as adaptations they had with new technologies. GPT-4 is able to create more adaptable and refined outputs via prompt engineering. In a development environment, LDA is a more direct and objective analysis, but is limited in refinement and responsiveness to the particular needs of the researcher. In contrast, GPT-4 is able to summarize concepts in the interview transcription and successfully assign meanings with

definitions. However, the technology is still experimental and limited to pattern making and recognition, lacking the depth of knowledge a human researcher.

Chapter 4

Results

This study's purpose was to understand the ways students use technology in music courses and present a digestible set of best practices for music educators. The data reflects the lived experiences, opinions, and preferences of music students in the United States and the United Kingdom. Further, it charts the ways they have changed their preferences and habits with educational technology.

Topic Model Categorization

Classroom Tech refers to technological tools and applications that are integral to the classroom setting. These can include learning management systems like Canvas, as well as specific apps used for music education, such as tuner and metronome apps. *Supplementary Tech* encompasses technologies that are not central but significantly enhance the learning experience. These could be additional music apps, digital libraries, and score analysis tools that students use alongside their primary learning resources. *Digital Tools* represents the primary digital devices such as laptops, smartphones, projectors, and tablets that students use in their academic activities. This topic covers the general use of these devices rather than specific applications. *Organizational Apps* focuses on applications used for organizing and managing academic work. This includes note-taking apps like Microsoft OneNote, email applications, and tools within the Google Suite, which help in structuring academic tasks and communications. *Tech vs Traditional* highlights the balance or tension between the use of technology and traditional methods in education. This includes preferences for digital note-taking software versus traditional paper and

pencil, indicating the diverse approaches to learning and studying among students. *Tech Accessibility/Ease of Use* emphasizes the importance of user-friendliness and accessibility in educational technology. This topic reflects students' preferences for intuitive, easy-to-navigate tools and the challenges they face with complex systems.

Table 1.

Learning Technologies from Student Interviews

Topic	Keywords	Representative Sentences	Rationale
Classroom Tech	Canvas, Smart Music, Tuner Apps, Metronomes	“Canvas is kind of like the home base for almost all assignments.”	Students are increasingly relying on technology for essential academic functions like organization and learning tools.
Supplementary Tech	Music Apps, Digital Libraries, Score Analysis	“Fourscore is a very... easy to learn thing, like it's very bare bones in what you need to do to make it work.”	Technology is supplementing traditional learning methods with innovative, digital solutions in education.
Digital Tools	Laptops, Smartphones, Projectors, Tablets	“My computer is like, solid about the time for like, tuning or metronome, which is very minor.”	There's a growing dependence on digital devices for both academic and personal tasks, enhancing efficiency and access.
Organizational Apps	Microsoft OneNote, Google Suite, Email	“I use like the Penn State Library's website a lot like especially if I'm looking for database to like look for articles and things.”	Digital tools are increasingly used for organizing and managing academic tasks, indicating a shift towards digitization.
Tech vs Traditional	Note-taking Software, Physical Books	“Learning I'm much better with paper and pencil stuff for that particular subject.”	Students balance technology with traditional methods, indicating a preference for hybrid learning environments.
User-Friendliness	App Usability, Accessibility, Learning Curve	“User friendliness is a big thing. I don't feel like having to figure out some complex system.”	The importance placed on user-friendliness suggests a desire for accessible and easy-to-use technology in education.

COVID-19 Reaction Narrative

In the course of the interviews, students from Penn State shared a variety of devices they rely on for their academic endeavors. For AW, her primary device is the computer, which she uses extensively for applications like Canvas and Smart Music, stating they are “like solid about

the time for like, tuning or metronome.” SF highlighted his frequent use of cellphones, specifically mentioning “I would say my cell phone.” The device for him is a central hub for academic tasks and a gateway to the Canvas app, which is a crucial platform for his studies. BH takes a diverse approach to technology, integrating a “Laptop, iPad, iPhone” into his daily usage. He speaks highly of the iPad's capabilities, particularly praising the app forScore for its utility in displaying music. “It very well displays the music... it has a lot of organizational features that are really helpful,” he noted, emphasizing its indispensable role in organizing and executing his performances and practice sessions. TD emphasized the importance of his iPad, not just as a tool for engagement during lessons, but as an essential device for note-taking and music reading, stating “I use it 100% of the time in my lesson.” He spotlighted the applications OneNote and forScore as integral to his learning process, with forScore being lauded for its user-friendly interface and ease of use. Lastly, AA expressed reliance on the camera and microphone features of his phone and computer, defining them as “significant” for his vocal studies. These devices provide a vital feedback mechanism, allowing him to review and refine his performances meticulously. Each student’s testimony illustrated the integral role of these varied devices—computers, cellphones, and tablets—in their academic and musical pursuits at Penn State. Through different applications, these devices offer essential support, facilitating a richer, more engaging educational and musical experience at the institution.

Chapter 5

Discussion

This study approached learning technology from the angle of the importance and value students enrolled at a higher education institution in a music course of study placed with it. These findings had many similarities across demographic profiles, seeming to indicate the increasing interconnectedness the internet has brought to people and learning. Chiefly, the democratization of knowledge is revealed through the similar attitudes and value all participants placed with various aspects of learning technology during interviews. This chapter will explain the findings of this study, connect it to ongoing and future research in the emerging field of learning science and technology, and relate it to the broader context of music education. Each participant in this study had prior experience with technology. The primary motivation for their use of technology was academics, including courses such as music history, aural skills, and general education credits in addition to performance-based coursework such as instrumental and/or vocal lessons, studio classes, and music ensembles. Students in this study were enrolled in some or all of those courses as a part of their degree program.

British students used software for performance-based courses such as forScore, a digital score reading application. They also used this application for courses in conducting. Their American counterparts also indicated heavy use of forScore in addition to other sorts of classroom management software such as Canvas. Another thread that connected both British and American students was the influence institutional software played on their technological experience in day-to-day life. For instance, the University of Oxford provides students with the

Microsoft Office suite of products, including Word, Excel, and PowerPoint. Similarly, Penn State provides students with access to the Microsoft Office suite of products as well as the Google suite of products. This gives students a default set of software to use for tasks such as cloud storage, word processing, and slide decks. As such, all students indicated heavy use of Microsoft products, most commonly OneDrive and Word. Further, Penn State students mentioned that they used Google products in addition to Microsoft products, often swapping one out for the other (e.g. Google Docs for Microsoft Word).

All students indicated the importance of remote learning technologies to their learning experience. The second corpus of data, the students' response to COVID-19, revealed that the most valuable technology for students was a synthesis of videoconferencing technology (most commonly Zoom) classroom management software (e.g. Canvas, Schoology, etc.), and cloud file storage (e.g. Google Drive, Microsoft OneDrive). Their learning experience in response to school closures associated with COVID-19 was varied, yet consistently involved rapid adaptations to new technology.

The accessibility of a software or web app's user interface (UI) was highlighted as a very important by students. One student mentioned "I don't feel like having to figure out some complex system." Having a clean, simple UI allowed students to learn how to use the program faster and more effectively. The GPT-4 topic model analysis stated, "There's a growing dependence on digital devices for both academic and personal tasks, enhancing efficiency and access." Accessibility goes beyond software to include the hardware students use in coursework. Above all, iPads were cited by participants for their ease-of-use, portability, and note-taking ability. iPads were given clear preference by British and American students of various instrumental backgrounds and years in school. Students also mentioned the heavy use of laptops

and cell phones in their academic work for a wide spectrum of different use cases. Many students utilized their phone as a recording tool, either via the camera or audio recorder app, for use in lessons, studio classes, and personal practice. Laptops also provided access to word processing tools and recourses like the university library, which are better suited to a keyboard and large screen.

Recommendations for Educators

American and British music educators have the fortunate position to be the inheritors of a large and innovative education technology industry which is constantly iterating and evolving to fit the needs of their users. Unfortunately, for teachers and students, this does not always translate into effective software and hardware for learning. In many cases, while students and teachers are the end user, the primary ‘users’ are school district technology departments. Teachers, whenever possible, should carefully examine software and see if it is aligned with their learning objectives. At the same time, teachers should connect the content of the resource with its accessibility and user interface. *How would the students interact with this?* Consider how and where students will interact with the specific learning technology. What does their sign-in process look like? How do they check for assignments, or in other cases, how do they report progress to the teacher? Most importantly, how easy is it for students to learn how to use the technology? Focus on simplicity and value; in other words, how simply can students understand what they are doing in a way which maximizes the value they are getting out of the technology?

Another point to consider is the efficacy of technology in various settings. Participants used technology less in large ensemble settings such as band and orchestra. In these cases, students reported using a cell phone or pocket tuner, if they used one at all. In higher education, students may use a cell phone tuner, if they choose to use one, but it is not a piece of technology

that is administered or easily monitored by a teacher or conductor. The general music classroom is where technology use comes to life. Participants use a greater variety of devices, software, and apps in university-level classroom music coursework. The same is true in K-12 education; students have more opportunities to implement technology, primarily in the form of district-provided tablets, laptops, PCs, or similar, in a general music class.

Recommendations For Future Research

A considerable limiting factor in this study is its sample size. Simply put, a larger sample is needed to truly assess the state of technology use for music students across higher education. Similarly, more populations from more geographic areas need representation. This study focused on two large research universities with the institutional power to be able to quickly pivot to a new technology. New research in learning technology, specifically in music education, should carefully consider the demographics of a particular school and seek to include more perspectives whenever possible. This limiting factor did not permit this study to fully encompass all potential attitudes and perceptions of learning technology.

Another equally important missing component of this study was the influence of students' upbringing on their technological experiences and perceptions. Participants were not asked interview questions regarding their technology use outside of its academic role prior to the COVID-19 pandemic, and as a result, may have had varied exposure to technology that is unaccounted for in this study. Future research on this topic should aim to be more holistic and include students of a younger demographic whenever possible.

Future research that uses novel methods such as LLMs, particularly as instruments for data analysis, should seek to corroborate findings with participants with triangulation and validation methods. Ethical considerations must be weighed heavily when choosing to use an

LLM in a research study owing to the recency of the technology. Future research that chooses to use LLMs should be informed by best practices and recommendations from review boards, publishers, and policymakers. Above all, LLMs should be reflective of what the investigator would have achieved through traditional methods in a purpose-built, objective way via the LLM.

Conclusion

Students, schools, and teachers faced enormous challenges when tasked with adjusting to remote learning through the COVID-19 pandemic. This study connected the lived experiences of music students through the COVID-19 pandemic with the technology they adapted to and came to rely on for remote instruction to take place. Students shared mixed perspectives that underscored the use of a particular technology with its instructional value. Students used a wide array of devices, platforms, apps, and websites, and often those that were provided at reduced or no cost through a school license. In certain cases, students paid to use apps or services if they proved to be valuable for learning and instruction. Participants in this study shared their feelings and attitudes on the state of education technology in their music coursework today and if they were content with their technology use. Many were content with the amount of technology they used and were not looking to incorporate more technology in their music coursework. Finally, and perhaps most importantly, participants repeated the value of good design in learning technologies. The thoughtful and intentional design of media, games, and content for learning is paramount to the success of the student. In a world with ever-increasing technological access, it is critical to consider the design of learning and/or instructional content as tantamount to the success of the student.

Appendix A

IRB Exemption Determination



PennState

Office for Research Protections

Human Research Protection Program
Office of The Senior Vice President for Research
The Pennsylvania State University
101 Technology Center
University Park, PA 16802

814-865-1775

irb-orp@psu.edu
research.psu.edu/irb

EXEMPTION DETERMINATION

Date: April 19, 2023

From: Shannon Strohmeyer, IRB Analyst

To: David Hutchinson

Type of Submission:	Initial Study
Title of Study:	Student Perceptions of Digital Learning Technology: A Cross-Cultural Analysis of Music Students
Principal Investigator:	David Hutchinson
Study ID:	STUDY00022542
Submission ID:	STUDY00022542
Funding:	Not Applicable
Documents Approved:	• HRP-591 - Protocol for Human Subject Research [Hutchinson].pdf (2.0), Category: IRB Protocol • Interview Protocol Questions.docx (1.0), Category: Data Collection Instrument

The Office for Research Protections determined that the proposed activity, as described in the above-referenced submission, does not require formal IRB review because the research met the criteria for exempt research according to the policies of this institution and the provisions of applicable federal regulations.

Continuing Progress Reports are **not** required for exempt research. You must notify the IRB when the exempt research study is closed/completed by completing a continuing review in CATS IRB.

Changes to exempt research only need to be submitted to the Office for Research Protections in limited circumstances described in the below-referenced Investigator Manual. If changes are being considered and there are questions about whether IRB review is needed, please contact the Office for Research Protections.

Investigators are required to follow the requirements listed in the [HRP-103](#) – Investigator Manual, which can be found by navigating to the IRB Library within CATS IRB (<http://irb.psu.edu>).

**PennState****Office for Research Protections**

Human Research Protection Program

Office of The Senior Vice President for Research

The Pennsylvania State University

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Investigators are also responsible for reviewing the History tab of their STUDY in CATS to ensure that any administrative HRPP requests are addressed in a timely manner.

This correspondence should be maintained with your records.

Appendix B

Participant Recruitment and Consent Letter

Student Perceptions of Digital Learning Technology: A Cross-Cultural Analysis of Music Students

David M. Hutchinson, *Principal Investigator*

Jacob Holster, Ph.D, *Thesis Supervisor*

Linda Thornton, Ph.D, *Honors Advisor*

Dear students of the faculty,

We invite you to participate in this study, which seeks to understand the way students value particular mediums of technology over others and the ways that technology is used in music courses.

The findings of this study are important the field of music education and educational technology writ large as there is a scarcity literature focused on student perspectives of learning technology; rather, much existing research focuses on teachers' reported usefulness of modes of learning technology. Although there is no direct benefit or compensation for individual participants in the study, your contribution will significantly impact our understanding of students' technological experiences and preferences in music education.

The study will take around 20 minutes to complete via in-person or virtual interview, scheduled at your convenience. Undergraduate and graduate students enrolled in a music course of study are eligible to complete this study.

You are invited to indicate your participation via Qualtrics survey:

https://pennstate.qualtrics.com/jfe/form/SV_1Ojr6MzzCy22clM

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Appendix C

Interview Protocol

Student Perceptions of Digital Learning Technology: A Cross-Cultural Analysis of Music Students

David M. Hutchinson, *Principal Investigator*

Jacob Holster, Ph.D, *Thesis Supervisor*

Linda Thornton, Ph.D, *Honors Advisor*

Participant Background

Name:

University:

G/UG:

Degree:

Instrument:

1. What sorts of things do you associate as technology in your classes at [institution name]?
2. What percent of class time do you use technology in your courses at [institution name]? For example, I use a tuner app in symphonic band 40% of the time.
3. How much time do you spend on technology for academic purposes vs. non-academic purposes?
4. Which devices do you use most often for academic purposes?
5. Which apps or websites do you use most often for academic purposes?
6. Tell me a little bit more about the app/website that you use the most. How useful is it?
7. What does that app/website do that is more useful than potential alternatives?
8. How important is that app/website to your learning experience as a student at [institution name]?
9. Do you pay to use that app/website? If not, how much would you be willing to pay to continue to use that app/website?
10. Briefly explain how your use of technology has changed before and after the outbreak of COVID-19 in March 2020. Do you find yourself using technology more, less, or about the same?
11. Were you prepared to use new technologies, such videoconferencing platforms, in March 2020? Do you feel prepared to use them now?
12. What pain points do you have with videoconferencing technology?
13. How were you able to adapt to use new technologies in your classes? Describe your process.
14. Are you looking to use technology more, less, or about the same amount in your future course work?

15. How much of your academic achievement do you contribute to assistance from technology?
16. Is there anything we haven't discussed that you'd like to add?

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