Promoting Technology-Based Collaboration Among Pre-Service Music Educators: An Inter-University Project

Wendy Matthews
Wayne State University

Daniel C. Johnson
University of North Carolina - Wilmington

The purpose of this inter-university project was to explore pre-service teachers' perceptions of collaboration and use of online technology. Twenty-two undergraduate music education majors from two separate universities participated in an eleven-week collaborative project to develop, teach, and self-assess general music lesson plans via a variety of student-selected online technologies. To determine the participants' perceptions, the researchers administered the quantitative Technology Integration Confidence Scale and periodic qualitative questionnaires consisting of open-ended questions. Participants showed positive quantitative gains in understanding technology operations and concepts, planning and designing learning environments, applying technology, assessment, and understanding ethical and legal issues in the classroom. From the qualitative data, the researchers found four emergent themes relating to communication and pedagogical knowledge: (1) versatility and potential of collaborating through technology, (2) barriers and challenges to effective communication, (3) importance of collaborative communication, and (4) increased personal effectiveness through reflective growth. Participants reported that working through collaborative assignments increased their self-confidence and reflective thinking skills, as well as helping them recognize the value of communication in terms of curriculum and instructional effectiveness. These findings highlight the importance of identifying strategies to instruct, motivate, and evaluate pre-service music teachers as they develop 21st century skills and music teaching competencies. To conclude, the co-authors discuss implications of technology-based collaborations beyond music education for the teaching profession in general.

In 2011, the Council of Chief State School Officers (CCSSO) released the Interstate Teacher Assessment and Support Consortium (InTASC) Model Core Teaching Standards that outlined the knowledge and skills K-12 teachers should have in contemporary learning contexts. These standards described the principles and teaching practices common to all subject areas and grade levels, including the skills of collaboration and using technology in the classroom (CCSSO, 2011). Accordingly, teacher education programs need to provide opportunities for their students to engage in collaborative projects in order to promote the development of these skills. In this article, we discuss one such collaborative, inter-university project for pre-service music education majors. The student-participants collaborated by designing, implementing, and self-assessing lesson plans for elementary general music classes. We enhanced participants' collaborative work through a variety of student-selected communication online technologies because it plays an ever-increasing and ever-changing role in teachers' professional lives (Kimmons, Miller, Amador, Desjardins, & Hall, 2015; Teo, 2015) and because it has the potential to facilitate effective collaboration (Dabbagh & Kitsantas, 2009; Funkhouser & Mouza, 2013; O'Donnell, Hmelo-Silver, & Erkens, 2013). Specifically, we investigated how collaborative assignments facilitated by online technology influenced undergraduate music education majors'

perception of collaboration and understanding of pedagogy.

Literature Review

Collaborative learning, an umbrella term indicating a range of cooperative educational strategies, began to draw educators' attention in the 1980s (Smith & MacGregor, 1992). It is broadly defined as a negotiated interpersonal process of two or more people focused on addressing a given learning problem (Ballantyne & Olm-Madden, 2013; Dillenbourg, 1999) and involves collective thinking, inquiry, and discourse. Teachers and teacher educators have used this approach to address passive learning and to generate more participatory and interactive methodologies (Barkley, Cross, & Major, 2014). It also promotes the ability to be open to other opinions in order to construct knowledge (Luce, 2001). In general, collaborative learning has the potential to transform instruction by altering the relationship between learners and teachers, who engage students as active participants and co-creators of knowledge (Goodsell, 1992).

Although employed in many disciplines, collaborative learning is particularly applicable to music and music education. Because music itself is a socially mediated phenomenon, experiencing and making music together allows participants to create shared meanings as a result of social interactions (Small, 1999). Consequently, collaborative learning can be an effective tool in the development of pre-service

music teachers' skills to manage classroom settings, engage in innovative thinking, and learn to understand cultural differences (Gaunt and Westerlund, 2013). For example, Feen-Calligan & Matthews' (2016) study of music educators found that students participating in a collaborative arts-based service-learning project developed more effective lesson plans, improved their teaching skills, and increased their capacity for deeper and more critical reflective practices.

Educational or instructional technology including Internet tools, software applications, and mobile devices that integrate technological and pedagogical features offer a valuable complement to the teaching process (Dabbagh & Kitsantas, 2009; Funkhouser & Mouza, 2013). These tools can be used asynchronously when teachers and students interact in different times and places (e.g. web tools and software applications such as email, blogs, and Google Docs) or synchronously when students and teachers interact online together in real time (e.g., conferencing applications such as Google Hangouts or Zoom, instant messaging, etc.) (Dabbagh & Kitsantas, 2009). In-service teachers believe that using technology in the classroom benefits students' attention and perception skills, and that it improves students' ability to respond to, and to apply, knowledge in simulated environments. Yet, teachers tend to use technology mainly in low-level teaching and learning processes (Sangra & Gonzalex-Sanmaned, 2010). Teachers also find mobile technologies, such as tablets and smart phones, can be beneficial in enabling access to information, offering novel ways to learn, and fostering student interest (Domingo & Garagnté, 2006). Currently, students in higher education bring with them existing sociotechnical identities and practices and need opportunities to further develop these skills (Cronin, Cochrane, & Gordon, 2016).

Furthermore, current pre-service music teachers need opportunities to understand instructional technologies and improve their abilities to blend these innovations into their teaching practice (Moore et al., 2002). These abilities are essential in engaging students in music learning, creating, and sharing (Crawford, 2013). Through the use of student response technology, active collaborative learning promotes student engagement, enhances student learning (Blasco-Arcas, Buil, Hernández-Ortega, & Sese, 2013), and fosters a sense of interdependence and mutual respect (Cullen, Kullman, & Wild, 2013). There is, however, reluctance to favor technology-based instruction over traditional teaching methodologies (Digolo, Andang'o, & Katuli, 2011). In addition, teacher efficacy, or personal beliefs regarding one's capabilities to perform competently and effectively as a teacher or perceived confidence in one's ability to use technology, can vary greatly among pre-service teachers (Lemon & Garvis, 2016).

Although the use of online technology in a collaborative setting with pre-service music teachers has not been widely investigated, studies with pre-service teachers outside of music education have found that students valued multiple outcomes, including opportunities to work with the technology (Lautenbach, 2014), enhance their professional pedagogical knowledge and teaching facility (Arnold, Padilla, & Tunhikorn, 2009; Donnelly & Hume, 2015), and develop a sense of community (Kiliç and Gökdaş, 2014). More specifically, Lautenbach (2014) studied pre-service teachers participating in an online learning module centered around a variety of learning activities focusing on the use and integration of learning technologies to develop their technology skills. Student reflections demonstrated that they valued using the technology as tools for engaging in the modules, the opportunities for practical application, and the ability to share ideas with each other. In Donnelly and Hume's (2015) study, pre-service science teachers developed pedagogical content knowledge though developing wikis utilizing core representation design. This combination of collaboration and technology afforded the pre-service teachers with opportunities to develop subject matter knowledge, technological competencies, and instructional and assessment strategies. Similarly, Teo (2015) reported that pre-service teachers were open to new technologies and believed that developing technological skills are worthwhile and would benefit their future classrooms.

Collaboration between pre-service and in-service teachers through technology can also aid in developing teaching skills (Liu, Tsai, & Huang, 2015). Schmid and Hegelheimer (2014) found that when pre-service teachers and in-service teachers use computer-assisted language learning programs, pre-service teachers valued the opportunity to acquire specific technological skills and develop positive attitudes for using this technology in their future classrooms. Accordingly, the learners included teachers themselves as they engaged in collaborative professional development. Considering teaching scenarios as realistic music case studies, Ballantyne and Olm-Madden (2013) examined collaborative learning via an online learning resource. They found that participants were able to experience unfamiliar settings and contexts and to participate in discussions centering on sensitive topics in the relative shelter of an online environment. Additionally, the online environment allowed participants to build networks across wide geographical areas that, in turn, prevented the potential of professional isolation.

In these and related studies, researchers have investigated the importance and reported outcomes of collaborative learning for teachers. In particular, these teacher-education scholars have found multiple benefits in participant learning via online environments.

Consequently, we chose to further these ideas by examining undergraduate music education majors' perceptions regarding the development, implementation, and self-assessment of lesson plans via collaboration and instructional technology as part of their pre-professional curriculum at two separate universities.

For this mixed method study, our guiding question was: How do collaborative assignments facilitated by online technology influence music education majors' perception of educational technology, collaboration, and K-12 teaching pedagogies? We hypothesized that through this project participants would demonstrate gains in confidence integrating technology into their learning and into their future classrooms. Furthermore, the qualitative questionnaire allowed us to explore two research questions: (1) how did participants collaborate on the project assignments, and (2) what were their perceptions and experiences in working collaboratively through the use of online technology?

Methods

Participants

Twenty-two undergraduate music education majors ($n = 22$) from two separate universities participated in this eleven-week project. One university was a research institution ($n = 10$) located in the Midwest region of the United States, while the other was a Master's level comprehensive university located in the southeastern United States ($n = 12$). All participants were enrolled in a junior-level music education methods course in preparation for their student teaching. Over one-third of the participants, 39%, were male, and 56.5% were female; one participant (4.5%) did not indicate gender. The participants ranged in age from 20 to 42 years ($M = 23.32$, $SD = 5.74$). Ethnically, the participants identified themselves as 74% White American, 17% African American, 4.5% mixed race, and one participant, 4.5%, did not indicate ethnicity.

Measures

For data collection, we used separate quantitative and qualitative instruments. To provide quantitative data, participants completed the *Technology Integration Confidence Scale (TICS) version 1* (Browne, 2009) as both a pretest and posttest. This survey measures self-efficacy for using technology in educational setting and aligns with the International Society for Technology in Education's (ISTE) National Educational Technology Standards for Teachers (NETS-T). Comprised of 28 items, this instrument has seven subscales: Technology Operations and Concepts-Introductory, Technology Operations and Concepts-Continued Growth, Planning and Designing Learning Environments and Experiences, Teaching, Learning and the Curriculum, Assessment and Evaluation, Productivity and Professional Practice, and Social, Ethical, Legal, and Human Issues. For each item, respondents use a six-point continuum, with 0 indicating not confident at all, and 5 indicating completely confident.

To provide qualitative data, participants completed open-ended questions at the beginning, middle, and end of the project. These allowed participants to contribute as much detailed information about their experiences as they desired, and it also allowed for follow-up questions delivered via a learning management system (i. e., Blackboard) at the participants' home institutions. By responding to these quantitative and qualitative measures, participants reflected on collaboration, skill development, prior assumptions, lesson planning, and technology efficacy.

Project Description

One purpose of this project was to provide music education majors with realistic, collaborative learning experiences using enhanced online technology designed for teaching and learning purposes. Another purpose was to facilitate participants' practical experiences in teaching elementary-aged students. This project took the form of blended learning, a combination of face-to face instruction and collaboration via online technology (Digolo et al., 2011). After completing the IRB-approved consent forms from their home universities, participants engaged in collaborative assignments for eleven weeks.

As part of their regular class assignments, participants discussed common readings, compared professional music education standards, and investigated ways to incorporate measurement and evaluation in music instruction. Participant work products included written collaborative lesson plans, demonstration lesson presentations as peer-to-peer teaching, peer critiques of teaching videos and written work, and written reflections of both the educational process and pedagogical outcomes of this project. Because the instructors allowed the participants to decide when and how they would work together, the participants had ample liberty and autonomy in their approach to the tasks. For example, the participants frequently decided which online tools they would use and how they would complete the assignments. Participants chose to collaborate using synchronous and asynchronous platforms including blogs, Google tools, and Skype, as well as each university's Blackboard system. This approach provided the participants with an authentic context, as opposed to a controlled and artificial environment. This method also allowed for multiple data sources and contextual analysis of the interactions between the participants (Johnson & Christensen, 2014).

This project included four major activities: (1) introduction/reading assignment, (2) teaching video evaluation, (3) lesson plan writing, and (4) teaching. First, we asked participants to introduce themselves via Google Forum. This was the only time the researchers directed participants to use a particular technology. The introductions included sharing their musical, teaching, and technology backgrounds, as well as one non-musical fact about themselves. As an extension of the introductions, we assigned working groups of two or three participants (one or two from each university) to complete a reading assignment. Each participant independently completed a reflective reading assignment and answered questions drawn from *Music in Childhood* (Campbell & Scott-Kassner, 2014). They then shared their answers with their group members via Google Forum and wrote a one-paragraph response to each others' reflections. Their responses allowed them to reflect on the issues in the reading and to highlight points of concurrence and difference with their peers at the other university.

For the teaching video evaluation, we combined working groups from the previous activity, arranging participants into groups of between four and six members. Individually, participants viewed a video of a general music demonstration class and evaluated it using a published observation template (Conway & Hodgman, 2006). Next, they compared answers with their assigned groups, discussing and summarizing the different responses. Their instructions were to consider each other's perspectives carefully by examining four elements: similarities, differences, what they learned from others in their group, and how their group collaborated to complete the assignment. Each participant group independently decided which collaborative technology tools they would use to complete this assignment.

Then participants collaborated with their assigned groups from the previous activity to write one fifteen-minute lesson plan to accomplish the following objective for third-grade students: students will be able to expressively sing and/or expressively play an age-appropriate musical selection using a variety of dynamics and interpretation. Just as before, we allowed participants to choose their own online collaboration tools. In a virtual setting, they discussed the assigned objective and decided on corresponding instructional activities.

Finally, group members taught the lesson to their collegiate methods class at their home university. They shared a video of the lesson with their instructor and the rest of their group. After they viewed the other group members teaching the same lesson at their home university, participants wrote a critique celebrating strengths and making suggestions to address areas for improvement. After reviewing their critique, participants reviewed their video and wrote a two-page self-reflection to address four components of their teaching and learning experiences: teaching practices, giving and accepting feedback, writing their lesson plan collaboratively, and sharing feedback. Finally, each participant group taught their lesson in the field under the supervision of a university professor or licensed professional music educator.

Data Analysis

For this mixed method study, we used a convergent parallel design, keeping the qualitative and quantitative data results independent and then comparing them when the project was complete (Creswell & Plano Clark, 2010). We analyzed the quantitative data statistically using *IBM SPSS Statistics* software (IBM, 2013). For the qualitative analysis, each author independently coded the written answers, recording in-vivo responses that described participant perceptions of their teaching and learning experiences. Then we jointly discussed the relationships among our respective in-vivo codes in order to identify themes. We analyzed these codes by using a constructivist approach to yield the final themes (Charmaz, 2006). When no substantive changes occurred during the coding process, we reached data saturation (Glaser & Strauss, 1967). Finally, to aid in organizing and understanding the data, we reviewed the data multiple times via memoing to further understand the participant responses (Maxwell, 2013).

Findings

For the quantitative portion of this study, we performed a paired t-test to investigate the changes from pretest to posttest scores on the TICS measure. Because the usual minimum for a sample size using this statistical procedure is 30 pairs of scores, these results of the paired t-tests should be interpreted with caution (Green & Salkind, 2014). Even so, the t-test results revealed trends from the two intact classes in this data set of 22 participants with a significant increase in the total technology integration confidence scores. More specifically, five of the seven subtests in this measure displayed growth: Technology Operations and Concepts-Continued Growth, Planning and Designing Learning Environments and Experiences, Teaching, Learning and the Curriculum, Assessment and Evaluation, and Social, Ethical, Legal, and Human Issues. The subscales of Technology Operations and Concepts-Introductory and Productivity and Professional Practice did not show changes in confidence. See Table 1 for a display of these results.

From the qualitative data we found four emergent themes: (1) versatility and potential of collaborating through technology, (2) barriers and challenges to effective communication, (3) importance of

Table 1
Technology Integration Confidence Scale (TICS) Scores

		Pre Project		Post Project			
		M	SD	M	SD	*t*	*p*
1.	Total Score	4.02	.52	4.40	.45	-4.13	.001
2.	Technology Operations and Concepts- Introductory knowledge	4.64	.64	4.84	.34	-1.67	.11
3.	Technology Operations and Concepts- Continued Growth	3.77	.95	4.25	.78	-2.87	.009
4.	Planning and Designing Learning Environments and Experiences	3.63	.82	4.18	0.58	-3.32	.003
5.	Teaching, Learning, and the Curriculum	3.60	.76	4.18	.69	-3.85	.001
6.	Assessment and Evaluation	3.43	.95	4.14	.60	-3.58	.002
7.	Productivity and Professional Practice	4.74	.35	4.63	.47	1.39	.18
8.	Social, Ethical, Legal, and Human Issues	3.78	.68	4.22	.66	-3.84	.001

collaborative communication, and (4) increased personal effectiveness through reflective growth. Below, we present the thematic categories along with representative quotations. We also identify common themes and underlying constructs across interviews.

Theme 1: Versatility and Potential for Collaborating through Technology

Throughout this project, participants were able to use any type of technology to communicate with their group members at the other university and as part of their lesson design. Participants reported communicating and sharing ideas through a variety of applications and programs including Google Docs, Google Hangouts, YouTube, iMovie, email, group texting, and telephone, as well as synchronous and asynchronous communication via Facebook tools.

It was important for participants to consider when and in what virtual space they could collaborate. Therefore, this theme also incorporates how participants prepared to collaborate with each other. For example, one participant described using email for more professional settings and Facebook for other purposes because she knew everyone would be using it. Many participants valued the ability to interact with each other asynchronously, via shared documents for convenience. Two participants explained how they used a variety of technologies while working on their project. One participant wrote:

[I used] strategies for contacting others in different ways; using a place where all members can see things that are posted, such as Google drive, is important so that no one is left out on updates, and contacting members individually with emails, phone calls, texts, and other methods is necessary.

Another participant emphasized the accessibility of content using online technology:

We used mostly Google docs in order to create [and] edit most of our ideas in one spot. We know it had to be a program that we could all access at any time without trying to rely on Skype or email in which not everyone is on or checks.

Participants also commented on ways they would and should incorporate technology in their lesson plans such as using YouTube or iMovie to demonstrate a concept to their students. One participant highlighted the importance of preparation and choice of technology to match assignments:

Be sure that the technology you incorporate is appropriate and functions correctly for each lesson. Be prepared to answer questions about the software or program being used. There are various ways to incorporate technology, and students love to participate in interactive activities.

The participants valued collaborating with technology as a way to connect with others to get information and ideas to use in their project and their future classrooms. One participant expressed how working together on the project helped shape her lesson plans: "Seeing how project team members approach this has given me new ideas for how to select goals for students."

Similarly, three participants expressed the value of collaboration with other teachers in their future teaching positions. One participant wrote, "Networking is a good tool for all educators. We all know so much. We have to be constantly willing to learn and absorb information and techniques from people that have a better grasp of something than we do." Another participant commented, "[Communication is] important in networking. Networking (so I've been told) can help in the long run when it comes to getting tips on how to plan lessons, assess or just in general for advice." A third participant wrote, "I would not mind collaborating [on] ideas on how to connect music to other subjects with teachers within my school. I may also brainstorm or collaborate with music teachers from surrounding schools." In that sense, learners include in-service as well as pre-service music teachers. Although the focus of the current study was on pre-service music teachers as learners, in-service teachers engage in collaborative learning as professional development.

Theme 2: Barriers and Challenges to Effective Communication

Barriers for effective communication centered around two ideas: the difficulty in communicating and unbalanced contributions from group members. Although participants did not report any barriers in accessing or using their chosen technologies, they did explain that some group members had differing views about which objectives or goals should be included in the lesson plan, as well as about the structure of the lesson plan itself. During this process, participants learned about the differences in state standards for teaching music education, and that different instructors have different ways of teaching the same concepts. As one participant explained, "I assumed that everyone would have similar ideas while lesson planning. This changed. Everyone has their own way of lesson planning." Similarly, another participant wrote:

> I thought that since the class setting and idea about projects we'd be doing were the same, that the other students would step up to the plate and put forth the effort in collaborating in the projects. I was a little disappointed because they would collaborate at the last minute and they also had some confusing ideas on how lesson planning should progress and what would go into the teaching.

Additional barriers to communication included contacting group members and balancing other participants' schedules. The inability to gather for synchronous, virtual meetings led to confusion about what role each participant was to play in the project. Participants commented on the importance of finding time for collaboration. They reported that because they lacked face-to-face collaboration with each other, they did not have a sufficient interpersonal or emotional connection. Some participants also thought that, at four to six members, the groups were too large. Several commented that too many ideas clouded the process, and they were frustrated with some group members not doing their share of the work.

Both the inability to make time for collaboration and the lack of personal investment led to time management issues in two of the four groups. When encountering such difficulties, many participants reported that they developed new strategies to work together and to come to consensus. In particular, they commented on the importance of patience when working with others. Below, three participants discussed how they had to develop personal strategies for time management skills in order to communicate effectively with their group. One participant wrote:

> I realized I needed to be confident with statements and assertive with my ideas for the group since it was already difficult to communicate. I had to be very clear when we did have the chance to. At first I was passive and that didn't work out. Once I got more assertive things worked out better for my participation in the group. At first it was very difficult for both parties to share ideas because we did not use enough methods of communication quickly enough. This improved over time, but I need to continue improving on this skill… to be confident and a leader… to listen and have open minded thoughts about ways I wouldn't necessarily do things.

Another participant reported learning:

> … it is very key to make sure the method of communication is a good one in order to properly convey the right message and purpose about a lesson plan. Communication is key! It was hard at first to find a way to plan lessons online between six people.

A third participant commented on practical techniques for time management:

> I realized that it is important to set up a strong timeline for getting activities done. In the future I will set clearer goals and checkpoints for myself

and for my students in order to achieve tasks in a more timely, organized fashion.

Theme 3: Importance of Collaborative Communication

During this project, participants experienced new ways to use a variety of communication tools. After completing the project, they commented on the value of communication and technology in working with colleagues and in teaching students. Generally, they reported on the importance of using collaborative tools in the classroom and working with other teachers. As their ability and confidence with technology grew, their online communication skills improved, and they became more open to using technology. They saw technology as a resource to use both in this project and in future endeavors. For example, one participant wrote about the increasing importance of technology for collaboration and use in the classroom: "Technology is becoming more essential every year, and technology is helpful with collaborating, especially when you can't meet face to face to produce a lesson."

Many participants commented on how they saw collaboration as a benefit to working with different types of people. Collaborating fostered an appreciation of their peers' backgrounds and teaching styles. For example, one participant articulated the variety of things learned from other participants by writing, "I have come to value what a great resource my peers are for their ideas, experiences, and philosophies. I learned that organization and communication are imperative to a successful collaboration." Another participant wrote:

> [My perspective] has evolved because I got to see ways of teaching that I wouldn't choose, but yet that were effective and still ways to successfully teach, and it opened my eyes to maybe making a few changes in my own approach.

A third participant wrote, "I've learned that people follow directions and become creative in their own ways. None of us in our group had the same exact thought process for our tasks but we all compromised together to get them done efficiently."

Theme 4: Increased Personal Effectiveness through Reflective Growth

Overall, the participants developed strategies to become more reflective practitioners. During this process, they considered their teaching performance and speculated on ways to improve their teaching in the future. Noticeably different from the responses at the beginning of this study, participant comments about the importance of reflection during the posttest phase showed the value of reflection in the educational process. Participants also commented on the relevance of recording themselves as they teach for later reflection. One participant wrote:

> When reflecting on my lessons after presenting them, the first thing I think about is if the learning goals were achieved. Did my students actually learn something? This project has given me a better understanding of the lesson planning process.

This project aided participants' understanding of, and confidence in, writing lesson plans. Participants commented that lesson plans needed to be easily understood, very detailed, and adapted to their particular students and educational setting. One participant wrote, "I've found that it is important to share ideas and lesson plans and build upon your own experiences by relating what you bring to your classroom to others experiences." Comments from three other participants illustrate similar points. One participant wrote:

> I have learned many new ways to go about lesson planning from observing my group and all the different ideas and ways of teaching. It helped me think more creative and come up with new ideas. I would have never thought of.

After reflection, another participant reported:

> I put more thought into the outcomes of the lesson. Also, I try to focus more on the elements of music that are being focused on through activities rather than trying to simply find enjoyable activities to do with the students. Collaborating made me focus more on the outcomes than the actual activity.

A third participant described the growth of his planning process:

> I begin with the goals/outcomes which students should learn from the lesson plan, and I try to vary these goals so that over time students learn a wide set of skills. Seeing how project team members approach this has given me new ideas for how to select goals for students. I did not know how much more helpful a lesson plan is when it is as detailed as possible. I used to think a more vague outline was good enough, but now I know better.

Participants also commented on how their self-confidence grew. For many, their future goal to become a music educator became stronger. For example, one participant wrote: "My perspective has matured more than anything, especially in understanding all of the

detailed work, time, and effort truly put into music education." Another participant noted the importance of networking and peer mentors:

> It is a good idea to collaborate with other pre-service and in-service teachers. As a future educator, I know that it is impossible to learn everything on your own or all at once. It is important to build a network of peers and mentors that can help you, because let's face it, we all need help at one point or another.

Discussion

The purpose of this inter-university study was to investigate undergraduate music education majors' perceptions of collaboration processes facilitated by educational technology. We designed group lesson-planning tasks to facilitate participant collaboration via instructional technology. Our intended learning outcomes were to enhance participants' application of theoretical and procedural knowledge in realistic, technology-based, and collaborative settings in order to promote elementary-aged student learning.

As demonstrated by the quantitative results from the TICS measure, participants' overall self-efficacy to use collaborative technology significantly improved. They gained confidence in planning and designing opportunities to collaborate and to create learning environments. More specifically, they learned how to align their lesson plans, teaching, and assessments with standards and curriculum. Consistent with Strobel and Tillberg-Webb (2009), we found that when participants reflected on their own perceptions of instructional technology, they reconsidered the benefits, uses, and disadvantages of these virtual tools as a result of their collaborative experiences. Their scores, however, did not demonstrate a meaningful change in the TICS subscale for Understanding Technological Operations-Introductory. Perhaps the reason for this lack of growth is because the majority of participants were Millennials, for whom technology has been present since birth. Although not statistically significant, there was also a downward trend for the subscale Productivity and Professional Practice from pretest to posttest. The questions in this subscale addressed their ability to work with other teachers in their future school environments. This decline is congruent with the struggles that many participants reported in the qualitative data.

The qualitative portion of this study yielded insights into how the participants viewed the collaborative lesson-planning project. Participants were comfortable deciding on the types of technology they would use through the project, gravitating towards asynchronous methods where participants could engage online during times of their own choosing. Asynchronous tools, however, were not always successful for the collaborative process as some participants felt other group members did not contribute equally or in a timely manner. Similar to the findings reported by Lee, Tsai, Chai, and Koh (2014), participants in the current study reported that their collaboration was difficult and challenging because they did not meet each other face-to-face. Similarly, Donnelly and Hume's (2015) study reported that pre-service teachers preferred face-to-face interactions when collaboratively developing teaching practices.

Regarding other challenges, participants commented on the high level of communication required, which was not readily addressed by online technology. Participant comments revealed frustration with establishing a consensus on the content and developing the lessons plans. They also reported discomfort with the process of discourse, and they struggled with openness to others' opinions. A few participants also expressed concerns regarding how instructors evaluated group work and if others' lack of contribution would affect their course grades. On a positive note, participants began to develop more productive strategies such as patience, self-confidence, time management, and communication skills through the process of working with others in group settings.

Overall, participants reported that this project helped them develop skills that they could use in their future classrooms. Many became more open to using technology for communicating and for supporting learning in their future classrooms. They saw the value of collaborating online to improve their lesson planning and recognized the value of communication in terms of curriculum and instructional effectiveness. They also recognized the importance of collaborative online learning as it helped them solidify their understanding, engage with new ideas, and value others' contributions to the learning process. In addition, participants reported enhanced interpersonal skills related to teaching, such as listening and being open minded to constructive criticism. During the group work, they commented that they valued sharing knowledge and clarifying their thinking. Specifically, participants characterized how important clarity and flexibility were to achieving a common goal. From a metacognitive perspective, these processes helped participants become more successful music educators by reflecting on their own learning and building confidence in their own teaching.

Conclusion

Outcomes of this study highlight the importance of developing collaborative skills in pre-service music teachers. These are consistent with the requirements for teachers to work in collegial teams and to apply principles

and practices of group work competently in the classroom (de Jong et al., 2011). Other results of this study relevant to teacher education and online collaboration include identifying broadly-applicable strategies to instruct, motivate, and evaluate pre-service music teachers as they develop 21st century skills and music teaching competencies. Beyond music, the implications of this study apply to teacher education in other fields. For example, the results support the use of collaborative learning to promote teachers' lifelong professional development. Potential outcomes of collaborative learning facilitated by technology reflect the growing importance of being professionally flexible, of engaging in new situations imaginatively, of interacting empathetically in unfamiliar social contexts, and of cooperating beyond familiar geographical boundaries.

The pre-service teachers chose to use predominantly information management tools to aid in designing the lesson plan and communicating with each other. They rarely used applications specifically designed for music such as music notation, and/or composition software in this project. With the exception of YouTube and iMovie, they rarely used technologies for content delivery to engage K-12 learners in lessons. The pre-service teachers preferred to use more traditional techniques such as modeling and directed response activities. Participants may have favored these because their lesson plans required the K-12 students (third graders) to demonstrate performance skills in music. Future projects and pedagogical instruction could focus on effective ways pre-service teachers incorporate discipline specific software in their future music classroom instruction.

Although participants completed multiple tasks, the scope of this study was limited to one project. Our findings were also based on participants' self-reports. As both authors were the professors of record and we chose to incorporate collaborative learning into our courses, we may have a bias towards our results. Additionally, the quantitative trends should be carefully interpreted in view of the relatively small sample size. Despite these limitations, our findings strongly support collaborative online learning as a valuable component of pre-professional pedagogy. To further our understanding of collaborative processes utilizing educational technology, future research in Instructional Learning Technology (ILT) and web-based pedagogical tools (WBPT) might include the following: investigating how the technology-based communication habits of millennial participants impacts their use of instructional technology, understanding how technology shapes participant interactions inside and outside the classroom, gauging the level of support needed to facilitate effective web-based pedagogy, and developing pedagogical tasks that promote self-regulated learning (Dabbagh & Kitsantas, 2013; Resta & Laferrière, 2007).

Many of our findings apply to the development of collaboration and technology skills of in-service teachers and in other academic domains. Additionally, the results of this study highlight the importance of extending successful pedagogical approaches from the K-12 level to college education. By extending effective, collaborative strategies in the primary and secondary grades, tertiary instructors can continue to engage and involve their students using similar interactive techniques while taking advantage of technological enhancements (Schmid & Hegelheimer, 2014). Findings of our study also apply to teacher-educators and professional development leaders in general. These results provide guidance to identify instructional and motivational strategies for teachers as they develop pedagogical proficiencies.

Even though joint-authored research in higher education has been more common in scientific disciplines than in the humanities (Schoenfeld & Magnan, 1994), this co-authored, multi-campus study also demonstrates the value of a collaborative approach to research. By combining our pedagogical perspectives and contrasting university contexts, the resulting research yielded a richer and more informative analysis of our students' experiences with the project. As Austin and Baldwin (1991) wrote, this approach may also enrich intellectual curiosity, promote publications, and further specialized knowledge.

In particular, our findings suggest that pre-service teachers need more opportunities to participate in collaborative work. Courses that utilize online collaborations should incorporate an introduction to on-line collaborative tools, as well as scaffolded assignments to develop students' collaboration skills (e.g., determining roles within groups and practicing habits such as open-mindedness). Similarly, orientation assignments should include opportunities for group discussion to strategize for optimal contributions to the group (e.g., goal setting, time management, and communication/listening skills). Furthermore, we recommend incorporating dedicated, synchronous time with an instructor's guidance to help students develop working relationships with each other. In conclusion, future investigations may aid in understanding how teachers utilize instructional technology to promote collaboration and other 21st century skills.

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WENDY K. MATTHEWS is an Assistant Professor of Music Education at Wayne State University in the College of Fine, Performing and Communication Arts. Her research interests focus on self-regulation, motivation, and performance in music and academic related domains.

DANIEL C. JOHNSON is Professor of Music and Music Education at the University of North Carolina Wilmington. His research focuses on critical thinking in music instruction, teachers' professional development including arts integration, and cross-cultural comparisons of musical experiences.