PREDICTORS OF SUCCESSFUL INTEGRATION
OF TECHNOLOGY INTO MUSIC TEACHING

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The purpose of this study was to examine factors that might lead to the successful integration of technology in music classrooms. From a random sample of 665 music American schools, 116 teachers responded to a researcher-designed, online questionnaire that examined potential factors including educational priorities, demographics, attitudes, and training experiences. Results indicated that standards-based educational priorities are not likely a strong predictor of successful technology integration. Analysis revealed no significant differences in successful integration based on the included demographics. Pearson correlations revealed statistically significant relationships between many of the examined attitudinal measures.

Introduction

Despite several decades of research in the field of general education regarding the integration of technology into classroom practices, integration of technology into music education remains a challenging idea for researchers, teachers, and teacher educators. A general perception persists that prominent obstacles stand in the way of integrating technology into music instruction in the deep, effective, all-encompassing ways that other academic areas have been able to accomplish. Still, despite these obstacles, many music teachers demonstrate successful uses of technology in their teaching, which, we may assume, translates into their student’s learning.

Given the emphasis in recent years on pre-service and in-service training in technology integration, the music education profession stands at a critical juncture. Technology integration can either take a path toward helping students develop meaningful musical experiences, or it can be restricted to a surface-level tool for administrative work. Successful technology integration, it is hypothesized, involves engaging students with technology that advances their music education in ways that traditional music teaching might not.

The purpose of this study was to examine factors that might be related to music teachers’ integrating technology successfully into their teaching. Inherently problematic in the purpose of this study are the definitions of two elements: (a) integration is a variable term that may refer to a broad spectrum of technology uses and (b) success with technology integration...
can be interpreted in a variety of ways and measured in still more. In addition, the variability of these terms is based on such factors as teachers’ pedagogical beliefs and attitudes. While no definition of these terms is perfect, we have appealed to the abundant literature from the field of general education to settle on useful, limited definitions for these ideas.

For the purposes of this study, we defined integration as any use of digital technology in the music classroom. It was beyond the scope of the study to determine the extent of that integration for our respondents. Success is perhaps less straightforward; a definition of this variable was constructed from our findings and will be discussed in the conclusions section of this article. The items in the questionnaire (to be described in the “Procedures” section) are reflective of synthesized understandings of these terms. The following research questions guided this study:

1. To what extent do individual educational priorities, as indicated through self-reported importance of the National Standards\(^1\) predict successful technology integration?
2. To what extent do demographic variables such as geographic region, school socioeconomic level, age, gender, teaching area, and teaching experience predict technology usage in the music classroom?
3. What is the impact of music teachers’ attitudes toward technology and technology proficiency on successful integration of technology into their music classrooms?
4. What types of music technology training experiences do music teachers view as most valuable and least valuable?

The variables examined in this study can be delineated along two levels, as established in previous research (Ertmer, 1999; Sang, Valcke, van Braak, & Tondeur, 2010). External or first order variables include influences that have potential impact on technology integration but are largely imposed on teachers from structures outside of themselves. These may include forces such as access to technology, training in the use of technology, and support from the school and district organization. Internal or second order variables include influences found within teachers’ own disposition and are ultimately within their own control. They may include beliefs, philosophies, efficacy, and attitudes.

\(^{1}\)Data for this study were collected prior to the release of the National Core Arts Standards in 2014. Questions were based on the 1994 MENC National Standards for Music Education, which are available at http://www.nafme.org/my-classroom/standards/national-standards-archives/
Because several studies have been conducted regarding the impact of external or first order variables on the integration of technology into music classrooms (Dammers, 2012; Dorfman, 2009), we chose to focus this investigation on internal or second order variables. These personal obstacles, which may stand in the way of deep integration in music classrooms, mirror the type of restructuring that has occurred in other academic subjects. We consider the external variables to be important, and have, therefore included them as an additional part of our investigation. Given the frequency of their investigation in previous literature, however, they were not the primary focus of the present study.

Literature Review

First-order Barriers and Successful Integration

Perhaps the most prominent type of research investigating technology integration deals with first-order barriers, or those that are imposed on teachers from external sources of power. The barriers under consideration in these studies include technology availability and access (Corwin & Marcinkiewicz, 1998; Redmann & Kortlil, 2008). Brinkerhoff (2006) suggested that, among other first-order barriers, institutional imposition of time limitations and lack of training were difficult obstacles for teachers to surmount. Previous researchers have examined both the barriers that exist, and teachers' perceptions of those barriers (Al-Senaidi, Lin, & Poirot, 2009; Brush, Glazewski, & Hew, 2008). Findings from these studies are fairly predictable, usually indicating that teachers with fewer restrictions on availability of and access to technology are more likely to attempt integration.

Integration is measured typically in terms of quantity, whereas quality or success of integration is rarely investigated. Most previous authors who have addressed quality or success of integration have done so from a pedagogical or philosophical stance rather than an empirical one. Coffman (2009) suggested that the massive investment into teacher support in Virginia has resulted in "improved student learning and test scores" (p. 21), but, like many similar articles, little or no data were offered to substantiate this claim. Several researchers have profiled instances of technology integration in situations that present particular obstacles to technological acceptance, and many claim changes in teacher's attitudes and student achievement, usually measured according to standardized test scores, as positive outcomes of these integrative attempts (e.g., Baker, 2003; Bayraktar, 2001-2002). We located no previous research on the
application of the first- and second-order barriers model to music teachers.

Pedagogical Beliefs and Technology Integration

Previous researchers have examined the influence of teachers' general beliefs about pedagogy on their successful integration of technology into their classrooms. Non-specific pedagogical ideas such as openness to change have been shown to have substantial impact on developing teachers' dispositions about technology integration (Vannatta & Fordham, 2004). Several researchers have posited that adherence to - or at least knowledge of - constructivist ideals of teaching may promote technology use in the classroom (Hancock, Knezek, & Christensen, 2003; Sang et al., 2010).

Beyond the fact that teachers hold pedagogical beliefs, researchers have recognized the idea that beliefs must be compatible with technology and its uses to teach the content of a discipline (Zhao, Pugh, Sheldon, & Byers, 2002). This idea raises issues of software and hardware design, software content, and large-scale curriculum design that are beyond the scope of this study. However, it is important to recognize that technology that is designed in recognition of teachers' beliefs about what and how their students should learn is more likely to be used in the classroom, and that those qualities of technology may influence the level of success teachers and students attain with it.

Impact of Demographics

Previous researchers have provided evidence that few demographic variables demonstrate significant correlations with the ways in which teachers use technology in their classrooms (Redmann & Kotrlik, 2008; Sammons & Strickland, 2000). This trend in research that downplays the significant findings related to external variables further supports the decision we made to focus on internal variables in the present study. Miller and Olsen (1994) suggested that, while external variables are important, their greatest impact might be to amplify or magnify internal variables. Ertmer (1999) summarized the balance between the importance of first- and second-order variables as follows: "While many first-order barriers may be eliminated by securing additional resources and providing computer-skills training, confronting second-order barriers requires challenging one's belief systems and the institutionalized routines of one's practice" (p. 48).
Impact of Attitudes toward Technology

Among the most prominent attitudinal obstacles toward deep technology integration into teaching is anxiety. Several previous researchers have provided evidence that anxiety stands in the way of technology integration. Redman and Kotrlik (2008) found that in random samples of business teachers in Louisiana, technology anxiety decreased only minimally between 2002 and 2007. Ropp (1999) used a highly reliable anxiety measurement scale ($a = .91$) and found that a group of pre-service teachers demonstrated interrelationships in their anxiety about technology, computer coping strategies, and other attitudinal characteristics. We can assume that, as teachers increase their comfort levels with technology, they will be more likely to base some of their instructional strategies on it. Conclusions from many previous studies support this notion, but the influence of anxiety and personal characteristics on technology integration should not be underestimated.

Impact of Training Experiences

Prior research has provided evidence that training experiences can improve teachers’ knowledge of technology, their comfort with technology, and may impact the frequency of technology use in their classrooms (Bauer, Reese, & McAllister, 2003). It should be noted, however, that research conducted to examine the influence of technology training on teachers’ attitudes and experiences is typically done with teachers who have enrolled in technology workshops, as was the case in the Bauer et al. (2003) study. The very nature of this choice suggests that the teachers have a sincere interest in changing their technology attitudes and behaviors. The current study focused on music teachers who may or may not show evidence of interest in technology, examining ways in which training experiences may influence their attitudes and experiences. This allows for comparison with data sets from another study with a broader population (Taylor & Deal, 2003) and with a study that reflects more recent attitudes (Dorfman, 2009).

Procedures

Survey Instrument

The Predictors of Music Technology Usage (PTMU), a researcher-created instrument, was composed of a total of 47 open- and closed-ended items that were derived from a review of the literature and the five general categories of the Quesiti's general extensibilities. It consists of PTMU revision.
the literature addressing music education technology and teachers’ attitudes toward technology. The initial survey items addressed the frequency and nature of the respondents’ technology use, their self-reported efficacy of technology use, and their ranking of the National Standards. Sections one, two, five, and six of the Teacher Attitude Toward Computers Questionnaire v5.11 (TAC) were used to assess the subjects’ general attitude toward computers, since the TAC was an extensively utilized instrument with high levels of internal consistency (Knezek Christensen, Miyashita, & Ropp, 2000). The PTMU was piloted by five music teachers; we made minimal revisions based on their feedback.

**Sampling**

The sampling population for this study was public school teachers in twelve states in the United States. These states (Alabama, Alaska, Arkansas, California, Illinois, Iowa, Florida, Kentucky, Massachusetts, Montana, New York, and Texas) were selected to give a sample from large and small states in each region of the United States. A list of public schools for each of these states and the District of Columbia was obtained from the National Center for Educational Statistics Common Core of Data database (U.S. Department of Education, 2011). All regular schools (as opposed to special education, vocational, and alternative schools) were included in the search parameter, including charter and magnet schools. From these lists, a sample of approximately 2% (n=665) of the schools in each state was randomly selected. Each school’s website was used to obtain the principal’s email address. Schools without an identifiable music teacher were eliminated and the next school on the list was selected until a sample of 2% per state was obtained.

**Survey Process**

The principal of each selected school was contacted via email and asked to indicate consent for the music teacher in their school to participate in the survey by forwarding the survey link to the music teacher. After four rounds of contact emails, 116 teachers completed the online questionnaire, representing a participation rate of 17.44%. These completed surveys came from teachers in twelve states (see Table 1).

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2The survey instrument, along with supporting appendixes for this study are available at http://tinyurl.com/q8fvhze.
Table 1

Respondents by State

<table>
<thead>
<tr>
<th>State</th>
<th>No. of Responses</th>
</tr>
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<tbody>
<tr>
<td>Alaska</td>
<td>1</td>
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<tr>
<td>Alabama</td>
<td>8</td>
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<td>Arkansas</td>
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<td>California</td>
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<td>Florida</td>
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<td>Illinois</td>
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<td>Massachusetts</td>
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<td>Montana</td>
<td>4</td>
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<tr>
<td>New York</td>
<td>16</td>
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<td>Texas</td>
<td>32</td>
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Responses to survey item 4, which asked about frequency of technology uses, are found in Appendix B (available online). These findings show that the teachers in this sample promoted frequent use of computers for students to engage in musical activities in class and outside of class. Fewer teachers responded that they frequently use computers for their own work, which contrasts previous research regarding teachers’ uses of technology (Dorfman, 2009).

Results

To address the first research question, we conducted an analysis of variance (ANOVA) for which the independent variable was the respondents’ expressed music education priorities, and the dependent variable was a measure of successful integration. Music education priority was determined through examination of the respondents’ ranking of the importance of the National Standards in their own teaching. The respondents formed seven priority groups, as represented in Table 2, which were used to establish the independent variable categories. The Kruskal-Wallis Test - a nonparametric alternative to standard ANOVA - was chosen because of the unequal distribution of the sample. It should be noted that nine respondents did not answer this set of items on the questionnaire.

The Kruskal-Wallis Test explored the impact of music education priority on successful technology integration. No statistically significant difference between groups was found based on music education priority \( (p = .45) \), indicating that successful integration is equally likely regardless of music
education priority. Additional comments regarding these findings will be provided in the Limitations section.

Table 2

Respondents' Self-Reported Priorities regarding NAFME Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>N</th>
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<tr>
<td>Singing, alone and with others, a varied repertoire of music</td>
<td>34</td>
<td>31.76</td>
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<tr>
<td>Performing on instruments, alone and with others, a varied repertoire of music</td>
<td>28</td>
<td>26.17</td>
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<tr>
<td>Improvising melodies, variations and accompaniments</td>
<td>5</td>
<td>4.67</td>
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<tr>
<td>Composing and arranging music within specified guidelines</td>
<td>1</td>
<td>0.93</td>
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<tr>
<td>Reading and notating music</td>
<td>20</td>
<td>18.69</td>
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<tr>
<td>Listening to, analyzing, describing and evaluating music</td>
<td>3</td>
<td>2.80</td>
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<tr>
<td>Understanding relationships between music and the other arts</td>
<td>16</td>
<td>14.95</td>
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Note. The N for each standard was determined by tallying the number of respondents who indicated a particular standard as their highest educational priority.

In order to explore the second research question ("To what extent do demographic variables such as geographic region, school socioeconomic level, predict technology usage in the music classroom?"), we again utilized the Kruskal-Wallis test to examine the Successful Technology Integration composite variable. Responses were grouped into four regions Northeast, Midwest, South, and West. No significant differences were found between regions ($p = .077$). To examine by community type, the responses were grouped into the following four categories: city, suburb, town, and rural, as designated on the NCES records. No significant differences were found between community types ($p = .116$).

The NCES data offered limited opportunity to deeply explore socioeconomic status (SES), but the percentage of students receiving free or reduced lunches allowed for a basic determination. The responses were grouped by quartile of percentage of students receiving free or reduced lunch. Again, there were no significant differences in the level of technology integration between the schools in each quartile, $p = .132$. 
To address the third research question, it was necessary to create an additional composite variable that we termed “Composite Technology Skills.” This variable was constructed by summing these two items:

1. Compared to your peers, please rate your general technology skills.
2. Compared to your peers, please rate your music technology skills.

We examined a Pearson Product-Moment correlation matrix to determine the influence of the Composite Technology Skills variable, the Successful Integration Variable, and all of the attitudinal measures on one another. Correlation tables (available online) demonstrated these linear relationships. Statistically significant relationships were found between the Composite Technology Skills variable and several of the attitudinal measurement items.

The most important of the analyses was a determination of the relationship between the Successful Technology Integration variable and the Technology Skills variable, each of which was a constructed variable based on the combination of several survey items. A weak, negative correlation coefficient ($r = -.37$) was calculated between these two variables.

To address the final research question (“What types of training experiences influence successful integration of technology into music teaching?”), a Pearson product-moment correlation coefficient was calculated between the Successful Technology Integration composite variable and the subjects’ rankings of training experience. Three moderate positive correlations were uncovered: External Course ($r = .325, p = .005$), State Conference ($r = .267, p = .008$), and Self Study ($r = .375, p < .001$).

**Conclusions**

Analysis related to the first research question determined that there was no statistically significant difference in successful integration of technology between groups with varying music education priorities. This contradicts a popular notion that some “types” of music teachers are more inclined to integrate technology into their music classrooms, and that some may do so more successfully than others. Further, it implies that there may be factors other than standards-based priorities that are better suited for predicting success. We recommend further research on this topic to determine whether factors such as educational background, age, gender, or experiences in certain types of music
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instruction might more accurately predict successful integration of technology into the music classroom.

The demographic analysis related to the second research question also failed to reveal significant differences in successful integration between teachers of various geographic regions and socioeconomic status. These findings contrast those of previous studies by Dammers (2012) and Reese (2002). The relatively small sample for the current study may have impacted these findings, because some demographics may have been underrepresented. Future research in these areas might use stratified sampling techniques to obtain greater representation of various demographics and levels of socioeconomic status.

The Pearson correlation analysis of research question three data revealed many statistically significant interactions. The weak negative correlation between the two constructed variables was perhaps the most surprising finding of this study, because, contrary to our preconceptions, greater technology skills did not positively correlate with more successful integration. This most likely indicates that the construction of the success and skill variables lacked validity, although the weakness of the r-value leads us to believe that a larger, more representative sample may modify the results of repeated measures.

The correlation table displays many significant relationships; the strongest of these relationships “make sense.” For example, there was a very strong relationship (r = .75) between “I get a sinking feeling when I think of trying to use a computer” and “Computers intimidate me.” Responses to “Working with a computer makes me nervous” also produced a strong correlation (r = .75) with “Computers intimidate me.” These were the two strongest correlations in the whole matrix. The strong responses to negative feelings about computers could indicate that the sample was skewed toward teachers who were not comfortable with technology and who felt negatively about its potential in the classroom. These findings, combined with the major finding of the negative relationship between skills and successful integration, lead us to conclude that the negative attitudes of our sample may impact their feelings of success regarding the integration of technology into their teaching.

Analysis for the final research question revealed that the three types of technology training experiences most strongly related to successful integration were all activities that could be considered self-motivated. As opposed to training opportunities such as pre-service coursework or mandated in-service experiences, the three training activities that demonstrated the strongest linear relationship with successful integration (external course, state conference, and self study) were types of training
that teachers would need to seek out on their own. It is possible that this indicates that the motivation to integrate technology successfully into music classrooms is related to motivation to seek out quality training experiences. The moderate level of these correlations leads us to draw this conclusion only tenuously, but there is certainly a similarity between the three types of training that respondents indicated were most frequently sought.

Limitations and Implications

This study was limited due to a low rate of participation, for which we propose two possible explanations. First, the sample may simply have been drawn from an over-surveyed population of American music teachers. Second, and perhaps more profound, was the method by which we contacted teachers, which was imposed by the Institutional Review Board at one of the authors' institutions. Rather than sending an email directly to teachers to invite them to participate, we were compelled to send the invitation to school principals, who would then indicate their consent by forwarding the email to their music teacher. We expected this extra step to severely impact the participation rate, and there is evidence to support our expectation.

The data presented in response to Research Question 1 showed that the majority of respondents to the survey held two of the National Standards ("Singing, alone and with others..." and "Performing on instruments...") as priorities. A possible interpretation of this result is that the majority of respondents were instrumental and vocal teachers. Future research might be conducted that focuses on the current teaching responsibilities of respondents, rather than their educational priority. If other priorities were underrepresented in the current study, the analysis may have been skewed. Additional research might focus on general music teachers; researchers might also strive to use balanced groups of educational priority.

Another limitation to this study, but perhaps one that can contribute to a greater understanding of technology-based music teaching, is that there has not been a widely recognized definition of success with this pursuit emerging from previous research. As such, we created a variable that we think reasonably represents success in technology-based music teaching. We propose that success is some combination of the frequency with which teachers plan technology experiences for their students and the impact that those experiences have on student learning. Based on the lack of significant findings, we can conclude that characteristics such as educational priority (as reflected in the National Standards) and demographics do not impact potential
t is possible technology motivation to level of these anxious, but "..." for success. We suggest further study to validate the weight of frequency of technology experiences and the impact of those experiences on some measure of success.

A final implication relates to the strength of the correlations regarding negative feelings about computers. The participants in this study indicated that the strongest feelings they held toward technology were negative. While it is a commonly held belief that teachers want to integrate technology into their teaching, the attitudes toward it — at least among those teachers in our sample — remain largely negative, reflective of intimidation, fear, and the potential to be replaced by technology. Successful integration may be related to these negative attitudes. If the music education profession can work toward changing perceptions of technology so that it is seen in a positive light, it is possible that successful integration may become the norm.

References


Teacher Education International Conference, San Diego, CA.


