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How and Why Digital Generation Teachers Use Technology in the Classroom: An Explanatory Sequential Mixed Methods Study

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Abstract
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Keywords
Digital Generation, Student Teachers, Classroom Technology Integration, Internal and External Barriers

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How and Why Digital Generation Teachers Use Technology in the Classroom: An Explanatory Sequential Mixed Methods Study

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While teachers' conservative attitude toward technology has been identified as a barrier to effective technology integration in classrooms, it is often optimistically assumed that this issue will resolve when the digital generation enters the teaching profession (Morris, 2012). Using a mixed methodology approach, this study aimed to examine the current technology usage of digital generation student teachers and the impact of possible internal and external barriers (such as self-efficacy, risk taking, and technology access and support) on their use of technology. Seventy-one student teachers first responded to an online survey regarding their technology use in classrooms. Afterwards, six participants were purposefully selected, based on their survey responses, to participate in follow-up interviews about their attitudes toward technology and challenges of integrating technology to teaching. Findings of the study suggested that digital generation student teachers' use of technology in the classroom was significantly correlated with their self-efficacy, perceived computer skills, and technology access and support. However, the participants' perceived level of risk taking was not related to their use of technology in the classroom. Findings of the study suggest that digital native student teachers have not necessarily become more comfortable keeping pace with the fast rate of change in technology. Implications of findings are discussed.

INTRODUCTION

Rapidly evolving technology has not only fundamentally changed the way in which we live, work and communicate, but also revolutionized the education system. A wealth of studies investigating ways of harnessing technology to transform teaching and learning suggest that technology, when used appropriately, offers great promises to facilitate teaching, engage students and increase students learning achievement (e.g. Mann, Shakeshaft, Becker, & Kottkamp, 1999; Funkhouser, 2002-2003; Salpeter, 1999). Technology access in classrooms has been steadily growing in the last two decades and education is experiencing an increase in classroom technology demands (Martin, 2011).

Despite great potentials and increasing accessibility of technology in schools, teachers are usually portrayed as reluctant and skeptical technology users (e.g. Carlson & Gadio, 2002; Ertmer & Hruskocy, 1999; Eteokleous, 2008). Studies suggest relatively few teachers are willing to fully exploit technology within their classrooms (e.g. Marcinkiewicz, 1993; Wang, Ertmer, & Newby, 2004) and effective technology integration in classrooms is still remarkably low (Cuban, 2001; Cuban, Kirkpatrick, & Peck, 2001). Further, Lei (2009) reviewed the historical role of teachers in relation to technology and described it as "has not been very positive" (p. 88). Teachers' hesitancy around technology has become a prominent issue in education as the responsibility for effective technology integration inevitably falls upon individual teachers.

While teachers' conservative attitude toward technology has been identified as one of the top barriers in classroom technology integration, it is often assumed that this issue will mitigate when the digital natives enter the teaching profession (Morris, 2012). Digital natives, characterized by Prensky (2001), are individuals who grow up in the digital world with digital technology as an integral part of their lives. Palfrey and Gasser (2008) further define digital natives as those born after 1980 who have access to technology, possess technology skills, and feel comfortable using technology. Most of the existing literature has sketched a quite promising and exciting picture of digital natives (Lie, 2009). They are often described as the "millennial generation" (p. 421) that is socially connected, digitally literate, shows strengths in multitasking and collaboration, and values immediacy (McMahon & Pospisil, 2005). They are believed to live in a ubiquitous digital environment and are the truly native speakers of the digital language (Prensky, 2001). According to Winn (cited in Oppenheimer, 1997, p. 14), digital natives have a digital mindset with which they "think differently from the rest of us. They develop hypertext minds. They leap around. It's as though their cognitive structures were parallel, not sequential." Based on the above unique traits of digital natives, some researchers and educators posit that technology integration would cease being a problem when digital native teachers establish their curriculums and classroom practices (Carr, 2010).

Since digital natives have now entered the teaching forefront, is technology integration in classrooms no longer a problem as previously assumed? Unfortunately, a recent survey (The Richard W. Riley College of Education and Leadership at Walden University, 2010) revealed that although early career digital native teachers may be proficient users of technology in their personal sphere, they are NOT more likely to adopt technology in teaching compared to veteran teachers. This seemingly surprising finding is in agreement with a list of other studies, which suggest that new career teachers' technology skills are evidently improved (Polly, Mims, Shepherd, & Inan, 2010), yet enhanced technology skills do not automatically transform and augment curriculum (Wang, 2002; Zhao & Bryant, 2005).

Clearly, there is a gap between digital native teachers' technology skills and effective classroom technology integration. What barriers are preventing teachers from effectively integrating technology in curriculum? According to Ertmer (1999), there are two types of technology barriers that may affect teachers' technology use: external and internal. External barriers encompass a range of topics mainly concerning institutional factors such as inadequate technology access, time, training and support. Osika (2006) posits

that support from the entire institution is essential to successful technology integration in curriculum. Unfortunately, systematic support from some institutions has been limited and inconsistent (Ronnkvist, Dexter & Anderson, 1998). Internal barriers include variables such as teachers' underlying attitudes and beliefs towards technology. Ertmer (1999) ranks external barriers as "first hand order" and internal barriers as "second hand order", and further states that it will be difficult to integrate technology with first hand order barriers present. However, even with first hand order obstacles cleared, teachers still may not "automatically use technology to achieve meaningful outcomes advocated" (p. 51). There is mounting evidence suggesting teachers' beliefs and attitudes toward technology may greatly influence their effective technology implementation in the classroom (e.g. Albion, 1996; Marcinkiewicz, 1993; Oliver & Shapiro, 1993; Woodrow, 1992).

The purpose of this mixed methods study was to investigate digital native teachers' use of technology in classrooms. In the initial quantitative survey phase of this study, the researchers aimed to examine the relationships between the external barriers (technology access and support), internal barriers (attitudes and beliefs—risk taking and self-efficacy) and technology use in digital native teachers' classrooms. The follow-up qualitative interview phase helped to explain the quantitative findings. The integration of survey results and interviews helps to build a deeper understanding of digital native teachers' use of technology in classrooms. Specifically, this study consisted of the following quantitative, qualitative, and mixed methods research questions.

Quantitative Research Questions:

1. Whether and to what extent does risk taking influence participants' use of technology in the classroom?
2. Whether and to what extent does self-efficacy influence participants' use of technology in the classroom?
3. Whether and to what extent does technology support and access influence participants' use of technology in the classroom?

After analyzing the quantitative data, the researchers found the need to explore the nonsignificant relationship between risk taking and use of technology as well as the significant relationship between external support and use of technology. Therefore, the researchers generated the following qualitative and mixed methods research questions:

Qualitative Research Questions:

1. Why does risk taking not influence participants' use of technology in the classroom?
2. How does technology support and access influence participants' use of technology in the classroom?

Terminology

Risk Taking. In the current study, risk taking refers to "teachers' emotional responses of comfort and anxiety when troubleshooting or risk-taking with new technology" (Hastings, 2009, p. 13). The possibility of facing failure prevents teachers from endeavoring with the implementation of new technology (Zhao & Bryant, 2005). Other forms of emotional discomfort that teachers experience with technology innovations are the fear of equipment failure, embarrassment and frustration (Means, 1994; Gahala, 2001) even though they are quite comfortable using it for personal use (Curtis, 2005).

Self-efficacy. Bandura (1997) defines self-efficacy as a person's belief in his or her capability to successfully accomplish a specific task. Mager (1992) suggests that self-efficacy can have an impact on one's motivation, behavior, perseverance and thought patterns, which in turn can affect their work performance. He further claims those with low self-efficacy may defer from taking risks. Studies suggest that teacher beliefs about the use of technology in teaching and best practices in classrooms are positively correlated (e.g. Albion, 1999).

METHODS

Research Design

This study employed the explanatory sequential mixed methods research design (QUANTITATIVE → qualitative = explanation), which included an initial quantitative survey and the follow-up qualitative interview with the priority on the quantitative phase. The qualitative results helped explain the initial survey results and build better understanding of the significant and nonsignificant quantitative findings.

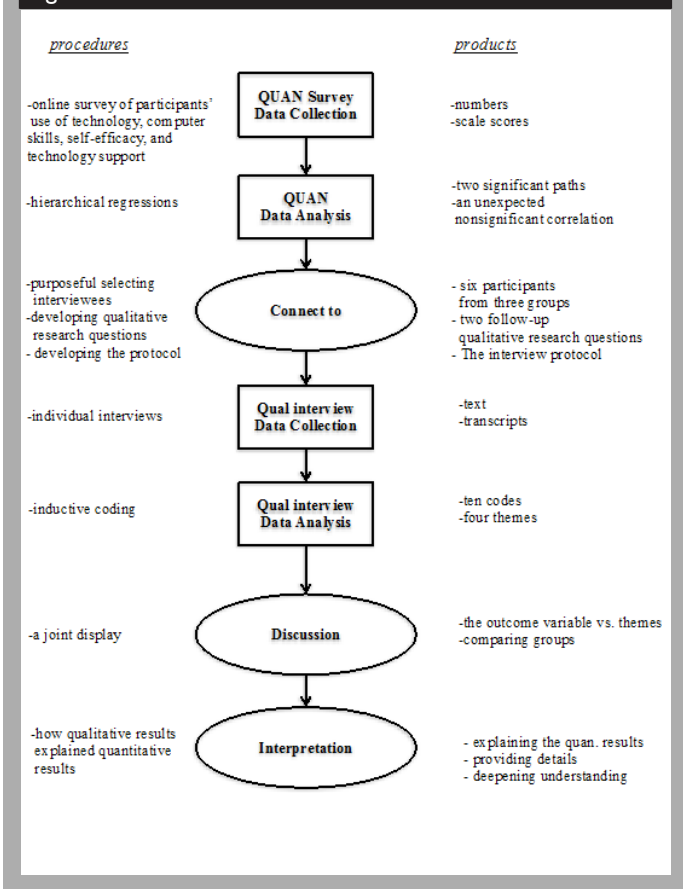
Mixed methods was defined as "a third methodological movement" following quantitative and qualitative methods (Teddlie & Tashakkori, 2009, p. 5). Mixed methods is both a method and methodology. As a method, it is an approach and techniques to collect, analyze, and mix qualitative and quantitative data. As a methodology, it involves the integration of qualitative and quantitative methods in many stages in the research process: from philosophical assumptions to data collection and analysis. The core rationale of using mixed methods is that the combined use of both qualitative and quantitative methods can provide a better understanding of research issues than a single method (Creswell & Plano Clark, 2012; Tashakkori & Teddlie, 1998).

The explanatory sequential design is one of the most common designs in mixed methods research. It consists of two distinct interactive phases: the initial quantitative phase and the follow-up qualitative phase. The explanatory design is usually used when researchers need qualitative data to explain quantitative significant or nonsignificant results; or when researchers want to form groups based on quantitative results and follow up with the groups through subsequent qualitative research (Creswell & Plano Clark, 2012; Morgan, 1998; Tashakkori & Teddlie, 1998). Accordingly, the explanatory design was best suited for this study because 1) the researchers wanted to further understand the survey results in depth through a follow-up interview, and 2) the researchers needed to purposefully select participants for the interview according to the initial quantitative results. The procedures of this study are demonstrated in Figure 1.

Participants and Sampling

Quantitative phase. The precise group of teachers that possesses the characteristics of digital generation that was questioned in this study should be composed of novice teachers. As discussed earlier, Palfrey and Gasser (2008) defined digital generation as people who were born after 1980 and who have access to technology, possess technology skills, and feel comfortable using technology. Based on their definition, the target population in this study was young teachers in their early 20's and new to this profession. Therefore, this quantitative survey used a convenience sample, which consisted of 76 pre-service teachers at a mid-western US university who

FIGURE 1. The diagram of the explanatory sequential design.



were student teaching. Ethnically, the majority of participants were Caucasians (93.4%, N=71). Females (67.1%, N=51) were more than males (32.9%, N=25). Most of the student teachers were between 22 and 24 years old (65.3%, N=49). Participants were teaching grades 7-12 in multiple and various subjects, including science (44.8%), math (34.3%), language arts (34.4%), social studies (32.8%), and world language (4.5%). An initial analysis of the data did not find significant differences among the student teachers from different subject areas, namely science teaching and other subjects teaching. Regardless of subject areas, student teachers were not different in their use of technology in classroom, technology skills, self-efficacy, risk taking, nor external support. In the survey, the participants were asked to indicate if they would be willing to participate in the follow-up interviews.

Qualitative phase. After the quantitative data analysis, the researchers grouped the participants into three groups based on the level of their use of technology: low, medium, and high. In each group, the researchers purposefully selected two participants if they had agreed to participate in the interviews and if their scores were mostly close to their group average.

Procedures

Quantitative phase. One hundred and forty one student teachers were initially identified, and their emails were obtained from their mentor teachers. Afterwards, a recruiting email with a link was sent to all identified participants to invite their participation in the online survey regarding their technology use in classrooms. Seventy-six student teachers responded with a response rate of 54%.

Qualitative phase. The interview protocol was designed based on the survey results and qualitative research questions. It consisted of six questions as well as potential probes (see Appendix A). The six selected participants teaching in different subject areas (Language Art, Social Studies, Reading, Science and Math) were individually interviewed about their attitudes toward technology and challenges of integrating technology to teaching. The average interview time was 20 minutes. All interviews were tape-recorded and transcribed. The data were analyzed using MAXqda 10 (qualitative data analysis software).

Measures

Self-reported Computer Skills. Participants responded to the item "How would you rate your overall computer skills on a 10-point scale, with 1 being 'Extremely Poor' and 10 being 'Excellent'? The mean response of this item was as high as 8.24 (range: 5-10).

Risk-taking was measured using Risk Taking and Comfort with Technology (Vannatta & Banister, 2009). Participants reported their emotional responses of comfort and anxiety when troubleshooting or risk-taking with new technology on a 4-point Likert scale with 1 representing "Strongly Disagree" and 4 representing "Strongly Agree". The scale includes statements such as, "I enjoy finding new ways that my students and I can use technology in the classroom", "I get anxious when using technology with my students", and "I feel comfortable about my ability to work with computer technologies". The mean across items of this 9-item scale (reliability: Cronbach's α = .87) served as the outcome for the variable of risk-taking. Higher scores indicated a higher level of comfort and willingness to take risks with new technology.

Self-efficacy Beliefs about Technology Integration was assessed using Self-efficacy Beliefs about Technology Integration (Burgoon, 2009). Participants reported their beliefs in their capabilities of using technology in classrooms on a 5-point scale: 1 representing "Strongly Disagree" and 5 representing "Strongly Agree". The scale includes statements such as, "I know how to use technology to get my students more excited to learn", "I do not know what to do to get students excited about using technology", and "I wonder if I have the necessary skills to integrate technology into my classroom lessons". The mean across items of the 10-item scale (reliability: Cronbach's α= .80) served as the outcome for the variable of self-efficacy beliefs. Higher scores indicated stronger self-efficacy beliefs.

Technology Support and Access. This scale is adapted from an existing Support and Access scale (Vannatta & Banister, 2009), and includes statements such as, "Technology support is available in my building to assist with troubleshooting" and "My building principal encourages faculty to integrate technology in the classroom". In addition, nine more items measuring participants' access to common classroom technology (such as computers, electronic whiteboards, digital/video cameras, and student response systems) were added to the scale. These nine items were theoretically hypothesized as the indicators of a third factor of the scale: access to technology in classrooms. This hypothesized three-factor model was tested using confirmatory factor analysis in Mplus 6. The model fit the data acceptably with the small sample size, $X^2_{(74)}$ = 116.07,

p = .0013; RMSEA = .08; CFI = .89; SRMR = .07. After confirming the three dimensions of this adapted scale, the researchers further tested its reliability, Cronbach's α = .82. Since this scale was reliable, the mean across items served as the outcome for the variable of technology support and access in this study. Higher scores indicated more technology support and access.

Use of Technology. Participants' use of technology was assessed using five selected items (Cronbach's α = .81) from the one-dimensional scale of Teacher Instruction and Instructional Support (Vannatta & Banister, 2009). Participants indicated the level of frequency they used technology for instructional purposes on a five-point scale (1=Never, 5=Daily). Scale items include "Use technology to present information to students", "Use technology to assess student learning", and "Use technology to adapt an activity to students' individual needs". The mean across items of this scale served as the outcome for the variable of use of technology. Higher scores indicated more use of technology.

Analytic Strategy

Quantitative phase. Data screening indicated that five subjects in the sample had missing scores on almost all variables. Thus, these five cases were deleted from the data. Accordingly, the sample size in the data analysis procedure was 71.

First, Pearson's correlation was run to test the bivariate relationships between the hypothesized predictors and the criterion variable. One of the predictors, risk taking, was found not associated with the criterion: teachers' use of technology. Therefore, this hypothesized predictor was dropped from the following regression analyses.

Second, through two models/steps in SPSS 19, hierarchical multiple regressions were conducted to investigate the impacts of student teachers' self-efficacy beliefs about technology integration and the external technology support and access on student teacher's use of technology. In addition, teachers' self-reported computer skill was controlled for as a covariate that was not of direct interest in the study. Specifically, the first model investigated the extent to which teachers' self-efficacy beliefs predicted teacher's use of technology, controlling for their computer skills. At step two, the external technology support and access was included in the model to investigate the extent to which this predictor influenced teachers' use of technology, controlling for their computer skills and their self-efficacy beliefs about technology integration.

Qualitative phase. All transcripts were inductively coded following the instructions of Miles and Huberman (1994). Ten codes were assigned to the information segments in the six transcripts. These codes were then aggregated into four broader themes. Two validation strategies were used in data analysis. First, the computer software, MAXQDA version 10, was used in the inductive coding procedure. Second, peer debriefing was conducted to confirm the emerged themes. Two researchers reviewed and confirmed the qualitative results.

RESULTS

Descriptive statistics and correlation coefficients

Means, standard deviations, and Pearson's bivariate correlations among all study variables are reported in Table 1. The mean of teachers' use of technology was 3.35 on a 5-point scale. Participants' average self-efficacy beliefs was 3.85 on a 4-point scale. In contrast, the mean of external support and technology access was only 2.50 on a 4-point scale. As Table 1 indicates, the criterion measure (teacher use of technology) was significantly correlated with computer skills, self-efficacy beliefs, and technology support and access, with r ranging from .26 (weak correlation) to .40 (moderate correlation).

TABLE 1. Descriptive statistics and correlation coefficients among all study variables.

	1	2	3	4	5
1. Risk-taking and Comfort with Technology	1.000				
2. Computer skills	.140	1.000			
3. Self-efficacy beliefs	.267*	.072	1.000		
4. Tech. support and access	.046	-.159	.106	1.000	
5. Teacher use of technology	.160	.257*	.332**	.397**	1.000
Mean	2.77	8.24	3.85	2.50	3.35
SD	.18	1.08	.47	.50	.89

Note: N=71; *p<. 05; **p<. 01;

TABLE 2. Results of hierarchical multiple regressions for teacher use of technology.

	Model 1			Model 2		
Predictors	B	SE	β	*B*	*SE*	β
Constant	3.35	.098		3.35	.088	
Computer skills	.194*	.092	.234*	.252**	.084	.304**
Self-efficacy beliefs	.600**	.211	.315**	.506**	.192	.266**
Tech. support and access				.737***	.180	.417***

Note: N=71. *p<. 05; **p<. 01; ***p<. 001. B: unstandardized regression coefficient; SE: standard error; β: standardized regression coefficient.

Participants' risk taking averaged 2.77 on a 4-point scale. It was not significantly correlated with teachers' use of technology, $r = .16$, $p > .05$, indicating there was no relationship between teachers' risk taking and their use of technology.

Multiple Regression Analysis

Table 2 shows the predictors entered at each step and the parameter estimates for each predictor in the model created at each step. The first model, with computer skills and self-efficacy beliefs as the predictors of teacher use of technology, fit the data well [$F(2, 68) = 6.722$, $p < .01$]. The effect size was medium according to Cohen (1992) [$R^2 = .165$; $f^2 = .20$]. Controlling for computer skills, teachers' self-efficacy beliefs about technology integration significantly and positively predicted teacher's use of technology [$t(69) = 2.839$, $p < .01$]. For each additional 1-unit increase in teachers' self-efficacy beliefs, there was a significant .6-unit increase in teachers' use of technology, controlling for their computer skills.

The second model, with technology support and access added to the predictors, fit the data better than the first model [$F(3, 67) = 11.113$, $p < .001$; $R^2 = .332$; $\Delta R^2 = .167$, $p < .001$]. The effect size was large ($R^2 = .332$; $f^2 = .49$) according to Cohen (1992). Participants' use of technology was 3.35 on a 5-point scale when they have the average level of computer skill at 8.25 (10 pt scale), the average self-efficacy at 3.85 (4 pt scale), and the average external support at 2.50 (4 pt scale). The new predictor, technology support and access, significantly and positively predicted teachers' use of technology [$t(69) = 4.096$, $p < .001$], controlling for their computer skills and self-efficacy beliefs. Specifically, for each additional 1-unit increase in the external technology support and access, teachers' use of technology significantly increased .737 units, controlling for their computer skills and self-efficacy beliefs.

Qualitative results

Demographic information of the six interviewees (all pseudonyms used). The selected two participants in the low use of technology group were Lacy and Lily. Lacy is a Caucasian female at age of 24. Her use of technology in the classroom was 12 out of 25. Lily is a Caucasian female at age of 30. Her use of technology

TABLE 3. A joint display of the quantitative and qualitative data of the study.

Use of technology	Themes			
	Perception	Beliefs	Difficulties	Resources
Low (scores [9,14]; n=)	"I'm going to have to work hard to understand it, but I mean I would say that I understand. "	"If it makes it easier and if it makes sense." "in science, it's a lot more difficult to incorporate the Smartboard	"and there's no Wi-Fi, so that is a problem with using technology."	"I wish I could use more of it, do away with paper." "…just to give us a refresher…"
Medium (scores [15,20]; n=)	"I have to take extra time and work hard to understand and use some new stuff."	"language arts for me, I do more hands-on things, um, just tangible objects not just technology."	"it doesn't always work right when you need it … and they're not working or the laptops aren't staying on for more than two minutes. That makes me not want to use it every day and waste time." "the lack of computers as well, the lack of resources, there are no 'carry carts' of laptops or iPads, or any type of technology, ... So, it really hinders a lot of technology to be integrated into the classroom. "	"I like the idea of having the, like, being able for first year teachers to come back and use some of the technology resources they have here. " "I really think now that technology is so important in learning that it would be really helpful to us to practice making lesson plans with technology in all of them."
High (scores [21,25]; n=)	"…part of that is just keeping up with it." "things change, but I think I'll be ok." "I try to use it as much as possible."	"I think being more interactive with the kids and actually getting them up using the technology that would be part of it."	"… like the Adobe programs, maybe like PhotoShop. I just don't really know much about those."	"I think having more classes and have them spread out to where you are having one…" "I would just say more hands-on, especially using technology in all the classes."

was scored at 13. The two selected participants in the medium use of technology groups were Maria and Malenie. Both of them are 24-year-old, Caucasian females. Their use of technology was 18 and 16, respectively. The two participants in the high use of technology group were Hali and Hank. Hali is a Caucasian female, age of 24, with a use of technology score of 25 out of 25. Hank is a Caucasian male, age of 27, with a use of technology of 24.

Four qualitative themes. Analyzing the qualitative data, the researchers generalized four themes based on ten codes: 1) perception on the use of technology (useful, updating), 2) beliefs on the use of technology (student, subject), 3) difficulties encountered (support, need to learn diverse tools, access), and 4) resources (school programs, on-going training). The qualitative results demonstrated how participants perceived the features and advantages of technology integration in classrooms and what difficulties they encountered in using technology.

First, all participants seemed comfortable with using technology. They not only commented on their computer skills as above average but they also highly valued their use of technology in classrooms, such as: "the integration of technology could make lessons more interesting and understandable." and, "it could get students more involved in class activities." Moreover, participants all realized "technology is always changing and it is a learning process in integrating ICT (Information and Communication Technology) in class." However, their attitudes toward the evolving nature of technology varied between groups (See the mixing results in Table 3).

A second theme was how participants decided to use or not to use technology in classrooms. The interviewees generally pointed out two concerns: advantages and disadvantages of technology on student learning and the potential usefulness of technology on subject teaching. Interviewees in the three groups identified multiple advantages of technology including visual effects and rich resources. But they were also concerned about the possible distractions that technology would bring to the students. In addition, interviewees' beliefs and willingness of employing technology in different subjects varied between groups (See the mixing results in Table 3).

Third, all participants discussed the difficulties in using technology due to no or low access to certain types of technology, worries in using diverse technologies, and low technology support. They desired more access to technology, including the availability of a wireless connection in the classroom, computers, power outlets, and computer labs. In addition, some teachers had the worries and stress of learning diverse technologies in order to fulfill different teaching requirements. Lastly, teachers particularly felt that the lack of technology support hindered their use of technology. With inadequate technology support, they were dramatically discouraged to incorporate ICT into their classroom instruction.

Last, when teachers talked about their resources and expectations on the external support, they all appreciated the college programs that well prepared them for the technology integration in the classroom. Therefore, they wished they could have the opportunity to receive the on-going training and support from the local college after graduation. Such expectations not only reflected the practical issues of inadequate technology support for teachers, but also revealed these teachers' demands to be more engaged in using technology in the classroom.

All together, in answering the qualitative research question, why risk taking did not significantly influence participants' use of technology in classrooms, the interview results suggested that participants' decision of technology use may have been mediated by their attitude towards updating the changing and diverse technologies and their perceived benefits of using technology on student learning and subject teaching. In other words, even though participants felt comfortable using technology and would like to take the risk, they might have decided not to due to their negative attitudes towards updating technologies and the conservative use of technology in certain subjects.

In answering the qualitative research question, how technology support and access influenced participants' use of technology in classrooms, the results suggested that the availability of technology support in the classroom and the adequate access of technology to both students and teachers could encourage and facilitate teachers' use of technology in teaching. Moreover, on-going training programs could meet teachers' demands of updating with new technologies and play a critical role in participants' decisions on what tools to use and how these tools should be used. As Ertmer and Hruskocy (1999) posit, technology integration would be unattainable if teachers have no access to technology and do not have support.

DISCUSSION AND CONCLUSION

The results of this study indicate that participants' level of risk taking was not significantly correlated with their use of technology in the classroom. However, participants' use of technology in the classroom was significantly correlated with their self-efficacy, perceived computer skills, and technology access and support. The findings of the study support much of what is already known about teachers' use of technology in the classroom. Specifically, internal barriers to teachers' use of technology, such as self-efficacy and perceived computer skills, and external barriers, including technology access and support, significantly impact teachers' use of technology in the classroom (Ertmer, 1999). However, the results of the present study also contradict previous studies (Albion, 1996; Marcinkiewicz, 1993; Oliver & Shapiro, 1993; Woodrow, 1992) in that the participants' perceived level of risk taking was not related to their use of technology in the classroom.

The analysis of the follow-up interviews suggest that participants at all levels of ICT implementation felt comfortable using technology in general (risk-taking); however, in the high-risk environment of the classroom when a teacher's use of technology may be distractive or ineffective and negatively impact student learning, the participants' self-efficacy was lower among participants who used less technology in the classroom and higher among those whose classroom technology use was high. Thus, as has been shown in a variety of aspects of teacher practices, self-efficacy greatly affects a teacher's decision to implement new instructional strategies (Borchers, Shroyer, & Enochs, 1992; Watters & Ginns, 1997).

In his Social Cognitive Theory, Bandura (1986) identified two aspects of efficacy. Personal self-efficacy is defined as how well one feels s/he can perform a task. Outcome expectancy is defined as an individual's belief about how his/her behavior will lead to a specific outcome. It may be the latter component of efficacy that is associated with whether the participants were high, medium or low users of technology in the classroom. With more at stake in the classroom than in everyday life, the more positively the participants' perceived the outcome of using technology on their stu-

dents' learning the more likely it was that they would integrate ICT into their classroom practices.

The interviews further revealed that low and medium users of technology were more troubled by the need to keep current with changes in technology than the high users. Low and medium users also expressed more conservative beliefs about the advantages of technology in the classroom than the high users. Thus, contrary to expectations (Morris, 2012), the digital natives in this study have not necessarily become more comfortable keeping pace with the fast rate of change in technology or hold optimistic views of the value of ITC in boosting student engagement and performance. It may be too early to assume that the digital generation teachers will automatically and enthusiastically adopt technology in instruction. Continuous support and nurturing to encourage new career teachers to explore and integrate effective technology in curriculum may still be needed.

Implications

Although digital generation student teachers who participated in this study felt positive about their use of technology in everyday life and believed their education prepared them well to use technology, there is a tremendous need to provide them with additional support to scaffold the use of classroom technology in the field and increase their access to classroom technology in order to increase their integration of ICT in the various disciplines. For example, online professional learning communities (PLCs) could be organized to include 4-6 student teachers in the same content field (e.g., social studies, science, English/language arts, and mathematics) and one faculty member from each of the following areas: educational technology, the content area, special education, and the ESL program to serve as professional development resources to suggest and help implement appropriate classroom technology to meet the needs of diverse learners. Universities can also institute a technology-lending program for student teachers with materials to include tablets, applications, digital cameras, portable document cameras, and a variety of hand-held devices, such as science sensors and microscopes. The PLCs can provide targeted support as student teachers begin to implement these technologies in their classroom. Finally, the scaffolding process could be initiated at an earlier time the teacher preparation program. For example, most early field experiences do not require lesson planning and/or whole-class instruction. With the guidance of instructional technology instructors and/or classroom mentor teachers, these preservice teachers may be better able to focus their attention to ICT integration because there is less importance placed on other aspects of teaching.

Limitations

Although the results of this study add to our understanding of factors related to the use of technology in the classroom, there are a number of limitations that should be noted. First, this study relied on self-reporting by participants using a variety of surveys instruments. Of all potential participants, 54% volunteered to be part of the study. Before they participated in the study, participants may not have been equivalent in certain characteristics such as academic performance level and motivation. However, participants did have very similar experiences with the use of classroom technology in their respective teacher preparation programs and they maintained a G.P.A. of 2.75 or better overall and in their major(s). Another limitation lies in the population used in this study. Participants were student teachers in grades 7-12. Findings of this study may not be generalized to other populations, such as student teachers at different grade levels or practicing teachers.

Future Studies

To better understand the factors associated with student teachers' use of classroom technology, several larger scale studies are needed. Larger sample sizes would make it easier to detect important associations and trends that would otherwise be overlooked in smaller studies. Quasi-experimental studies in which scaffolding is provided to the treatment group but not the control would add more validity to the findings. Future studies are also warranted to further investigate the relationship between risk-taking and teachers' use of technology in the classroom. In addition, the treatment can be provided at different phases of the teacher preparation program to determine if there is an optimal time to provide ICT scaffolding.

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REFERENCES

Albion, R. R. (1996). Student teachers' use of comput-ers during teaching practice in primary classrooms. Asia-Pacific *Journal of Teacher Education, 24*, 63-73.

Albion, P. R. (1999). Self-Efficacy Beliefs as an Indicator of Teachers' Preparedness for Teaching with Technology. In J. Price et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 1999* (pp. 1602-1608). Chesapeake, VA: AACE.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1997). Self-efficacy: *The exer-cise of control.* New York, NY: Freeman.

Borchers, C. A., Shroyer, M. G., & Enochs, L. G. (1992). A staff development model to encourage the use of microcomputers in science teaching in rural schools. *School Science and Mathematics, 92*(7), 384-391.

Burgoon, J. N. (2009). Self-efficacy Beliefs about Technology Integration Scale. Unpublished Instrument.

Carlson, S., & Gadio, C. T. (2002). Teacher professional development in the use of technology. In W. D. Haddad, & A. Draxler (Eds.), Technologies for education: Potentials, parameters and prospects (pp. 118-132). Paris/Washington, D. C., UNESCO/Academy for Educational Development.

Carr, N. (2010). Are we teaching digital natives yet - and does it matter? In J. Wright (Ed.) *Proceedings of AARE 2010 conference papers collection.* Melbourne, Australia, (pp. 1-14).

Cohen, J. (1992). A power primer. Psychological Bulletin, 112(1), 155-159. Cuban, L. (2001). *Oversold & underused: computers in the classroom*. Cambridge, MA: Harvard University Press.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal. 38*(4), 813-834.

Curtis, P. (2005). Report reveals teachers' fear of classroom technology. *The Guardian.* Retrieved from http://www.guardian.co.uk/education/2005/sep/13/schools.news

Creswell, J. W. & Plano Clark, V. L. (2012). D*esigning and conducting mixed methods research* (2nd ed.). Thousand Oaks, CA: Sage.

Ertmer, P.A. (1999). Addressing first- and second-order barriers to change: Strategies for Technology integration. *Educational Technology Research and Development, 47*(4), 47-61.

Ertmer, P. A., & Hruskocy, C. (1999). Impacts of a university-elementary school partnership designed to support technology integration. E*ducational Technology Research and Development, 47*(1), 81-96.

Eteokleous, N. (2008). Evaluating computer technology integration in a centralized school system. *Computers and Education, 51*(2), 669-686.

Funkhouser, C. (2002-2003). The effects of computer-augmented geometry instruction on student performance and attitudes. *Journal of Research on Technology in Education, 35*(2), 163-175.

Gahala, J. (2001). *Critical Issue Promoting Technolo-gy Use in Schools*. Retrieved from http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te200.htm

Hastings, T.A. (2009). Factors that predict quality classroom technology use. (Doctoral dissertation). Retrieved from OhioLINK ETD. (bgsu1257194863)

Lei, J. (2009). Digital natives as preservice teach-ers: What technology preparation is needed. *Journal of Computing in Teacher Education, 25*(3), 87-97.

Mager, R. F. (1992). *What every manager should know about training: or "I've got a training problem"…and other odd ideas*. Belmont, CA: Lake Publishing.

Mann, D., Shakeshaft, C., Becker, J., & Kottkamp, R. (1999). West Virginia story: Achievement gains from a statewide comprehensive instructional technology program. Retrieved January 22, 2013 from *www.mff.org/pubs/ME155.pdf*

Marcinkiewicz, H. R. (1993). Computer and teachers: Factors influencing computer use in the classroom. *Journal of Research on Computing Education, 26*(2), 220-237.

Martin, E. M. P. (2011). *Digital natives and digital immigrants: Teaching with technology* (Doctoral dissertation, Northeastern University Boston).

McMahon, M., & Pospisil, R. (2005b). Laptops for a digital lifestyle: Millennial students and wireless mobile technologies. In H. Goss (Ed.), *ASCILITE 2005 balance, fidelity, mobility: Maintaining the momentum? Proceedings of the 22nd annual conference of the Australasian Society for Computers in Learning in Tertiary Education* (Vol. 2, pp. 421-431). Brisbane: ASCILITE

Means, B. (Ed.). (1994). *Technology and integration reform: The reality behind promise*. San Francisco, CA: Jossey-Bass Publishers

Miles, M. B. & Huberman, A. M. (1994). *Qualitative data analysis* (2nd ed.). London: Sage.

Morgan, D. L. (1998). Practical strategies for combining qualitative and quantitative methods: Applications to health research. *Qualitative Health Research, 8*(3), 362-376.

Morris, N., "*Learning and teaching with emerging technologies: Preservice pedagogy and classroom realities*" (2012). Electronic Theses and Dissertations.

Oliver, T. A., & Shapiro, E (1993) Self-efficacy and computers. *Journal of Computer Based Instruction, 20*, 81-85.

Oppenheimer, T. (1997). The computer delusion. *The Atlantic Online*. Retrieved from http://www.theatlantic.com/past/docs/issues/97jul/computer.htm

Ronnkvist, A. M., Dexter, S. L., & Anderson, R. E. (1998). T*echnology support: Its depth, breadth and impact in America's schools. Teaching, Learning, and Computing* (Vol. 5). National survey report. Retrieved from http://www.crito.uci.edu/tlc/findings/technology-support/report_5.pdf

Osika, E. (2006). The concentric support model: A model for the planning and evaluation of distance learning programs. *Online Journal of Distance Learning Administration, 9*(3). Retrieved from http://www.westga.edu/~distance/ojdla/fall93/osika93.pdf

Palfrey, J., & Gasser, U. (2008). *Born digital: Understanding the first generation of digital natives.* New York: Basic Books.

Polly, D., Mims, C., Shepherd, C., & Inan, F. (2010). Evidence of impact: Transforming teacher education with preparing tomorrow's teachers to teach with technology (PT3) grants. *Teaching and Teacher Education, 26*(4), 863-870.

Prensky, M. (2001). Digital natives, digi-tal immigrants: Part 2. *On the Horizon, 9* (6), 1-9.

Salpeter, J. (1999). Taking stock: What's the research saying? *Technology and Learning, 18*(9), 24-30.

Tashakkori, A. & Teddlie, C. (1998). *Mixed methodology: combining qualitative and quantitative approaches*. Thousand Oaks, CA: Sage.

Teddlie, C. & Tashakkori, A. (2009). *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences.* Thousand Oaks, CA: SAGE Publications, Inc.

The Richard W. Riley College of Education and Leadership at Walden University. (2010). *Educators, technology and 21st century skills: Dispelling five myths*. Retrieved December 14, 2012, from http://www.waldenu.edu/Degree-Programs/Masters/36427.htm

Vannatta, R., & Banister, S. (2009). Validating a measure of teacher technology integration. In C. Maddux (Ed.), *Research Highlights in Technology and Teacher Education 2009* (pp. 329-338). Chesapeake, Virginia: SITE

Wang, Y. (2002). When technology meets beliefs: preservice teachers' perception of the teacher's role in the classroom with computers. *Journal of Research on Technology in Teacher Education, 35,* 150-161.

Wang, L., Ertmer, A. P., & Newby, J. T. (2004). Increasing preservice teachers' self-efficacy beliefs for technology integration. *Journal of Research on Technology in Education, 36*(3), 231–250.

Watters, J. J., & Ginns, I. S. (1997). An in-depth study of a teacher engaged in an innovative primary science trial professional development project. *Research in Science Education, 27*(1), 51-69.

Woodrow, J. E. (1992). The influence of programming training on the computer literacy and attitudes of preservice teachers. *Journal of Research on Computing in Education, 25*(2), 200–218.

Zhao, Y., & Bryant, F. (2005). Can teacher technology integration training alone lead to high levels of technology integration? http://ejite.isu.edu/Volume5/Zhao.pdfA qualitative look at teachers' technology integration after state mandated technology training. *Electronic Journal for the Integration for Technology in Education, 5,* 53-62.

APPENDIX A
Sample of the interview protocol

Thank you very much for taking part in this interview. So, I'm just gonna ask a couple of questions about your instruction in classroom technology.

1. Could you tell me a little bit about yourself, about the grades and the subjects that you're teaching?

2. What ICT skills do you confidently carry out ICT integrated activities?

3. What subject areas are you more confident in teaching integrated technology and why?

4. How do you decide whether or not to integrate certain ICT tools in your classroom?

5. What barriers do you perceive to use technology in your classroom?

• Potential probes: what are the specific incentives and practices

your school or district offers to help you?

• How well do you feel you were prepared in teacher preparation programs at BGSU regarding ICT skills and integration skill?

6. And finally, what else can you tell us about yourself and your use of ICT in teaching?

Thank you for your time participating in the interview!