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Preparation versus practice: How do teacher education programs and practicing teachers align in the use of technology to support teaching and learning?

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ABSTRACT

Keywords:

Preservice teacher education
Technology use
Technology integration
Teacher technology use

There has been a renewed push from researchers to determine what information teachers should acquire in preservice programs and how to help them make the most of technology in the classroom. Topics related to technology were ranked by teacher educators and classroom teachers in this survey. Data was gathered from both teacher educators and practicing teachers using a two-phase mixed-methods research approach that used questionnaires and different case studies (interviews, documents). The results show that when it comes to using technology for personal productivity, presenting information, and accessing and using electronic resources to enhance teaching and learning, both teachers and teacher educators have comparable perspectives. When comparing how teacher educators and classroom instructors use technology for student data analysis, professional development documentation, and the promotion of higher-order thinking abilities, there were clear differences. In order to make teacher education programs more relevant for instructors, we suggest ways to include and handle technological issues.

1. Introduction

Some of our current teachers just don't have the innate talent or familiarity with technology that other occupations seem to have, according to the United States Department of Education. This is also true of many of the people in charge of education at the state and local levels, as well as at the universities that train future teachers (U.S. Department of Education, 2010, p. xii). Due to concerns raised by Pellegrino, Goldman, Bertenthal, and Lawless (2007) and the U.S. Department of Education (2010), leaders at the federal and state levels have increased their focus on ensuring that preservice teachers have ample opportunities to utilize technology throughout their teacher preparation programs. According to Pellegrino et al. (2007), the Preparing Tomorrow's Teachers to Use Technology (PT3) program, which is run by the U.S. Department of Education, has allocated more than \$750 million over the last decade to initiatives that aim to develop innovative ways of training future educators to make effective use of technology in the classroom. Education and government officials have advocated for better teacher preparation in technology integration, and substantial resources have been allocated to this end. However, there is a lack of research on the specific technology topics taught in teacher education programs, how these topics are influencing K-12 teaching practices, and what evidence supports their inclusion in teacher education curricula (Hew and Brush (2007); Lawless & Pellegrino, 2007; Pellegrino et al., 2007). Among 1439 four-year colleges and universities offering teacher preparation programs, 85.5 percent said they provide educational technology courses worth 1.0–4.0 credits (Kleiner, Thomas, & Lewis, 2007). Depending on the school, students enrolled in educational technology courses may learn anything from the fundamentals of computers to how to incorporate technology into lesson plans (Betrus & Molenda, 2002; Kleiner et al., 2007). For the aforementioned poll (Kleiner et al., 2007), respondents were asked to disclose the

technologies that are a part of their offerings. The poll found that more than 90% of teacher preparation programs included some aspect of integrating technology into the classroom. "Using technology to access or manipulate data to guide instruction," "utilising multimedia for instruction," "utilising technology to address content standards," "integrating technology into instruction," and "the use of Internet resources and communication tools" were some of the subjects covered. Report authors emphasised that their findings do not imply comprehensive or in-depth coverage of the subjects covered in the programs' curricula. Instead, the estimations just show that the three subjects were covered, although to a lesser extent. Kleiner et al. (2007) stated on page 6. As a result, gauging the breadth and quality of technology integration experiences offered to preservice teachers is challenging. In the United States, teacher preparation programs cover a wide range of technology topics; however, there is a dearth of research that looks at how these topics affect teachers' actual teaching methods (Kay, 2006; Pellegrino et al., 2007). Studying how K-12 educators make use of technology in the classroom might help researchers identify which technological concepts translate well into the classroom. According to most studies that have looked into this matter, most instructors utilise technology to help with simple curricular tasks including word processing, instructional games, computer-based tutorials, and drill and practice (Maddux & Johnson, 2006). By way of illustration, according to a 2007 national Speak Up survey (Project Tomorrow, 2008), 51% of the participating K-12 educators stated that the two main ways in which they "facilitate student learning" through the use of technology were (a) assigning computer-based homework (such as writing reports or conducting online research) and (b) utilising drill-and-practice software. These findings are somewhat supported by the high number of students (in grades 6–12) who participated in a separate poll at the same time. Students said they (a) wrote their tasks (74%), (b) did research (72%), and (c) checked their grades or assignments (58%). The majority of instructors utilise digital resources as supplemental tools in the classroom (66%), with 46% using them to assist pupils with subject-specific abilities like reading and maths (Project Tomorrow, 2009). Less than a quarter of educators surveyed in the follow-up said they use statistics, podcasts, videos, or games into their lessons to encourage pupils to think critically (Project Tomorrow). Despite these findings, a number of studies have shown that teachers still view technology as a crucial skill for their job and that students can benefit academically when teachers use technology appropriately (Ertmer, Gopalakrishnan, & Ross, 2001; Project Tomorrow, 2009; U.S. Department of Education, 2010). It follows that the problem could lie in the fact that educators do not see the technological competence they gained throughout their teacher preparation or professional development programs as having any bearing on their actual classroom work. Research by Ottenbreit-Leftwich, Glazewski, Newby, and Ertmer (2010) and Zhao (2003) suggests that teachers may not fully utilise technology resources when it comes to solving educational problems in their own classrooms. Zhao (2003) states that in order for teachers to effectively use technology, they must acquire the necessary expertise to transform technological possibilities into answers to their specific and contextualised educational challenges. The findings of Hew and Brush's (2007) literature study on efficient teacher professional development were consistent with these findings. Successful technology training for educators shared three hallmarks, according to the researchers: (1) an emphasis on technology skills and experiences in the classroom; (2) opportunities for "hands on" work with the specific technology resource; and (3) alignment with real-world needs and problems encountered by educators. According to Ottenbreit-Leftwich et al. (2010) and Zhao (2003), teachers find technology meaningful when they have knowledge of instructional problems that technology can solve, specific technology that can solve those problems, and how to use that technology in their own educational contexts.

11. Conceptual framework

Several researchers have indicated that some teacher education programs may not adequately prepare preservice teachers for the realities of the classroom (e.g., Goodlad, 1990), spending too much time on theory and too little time on developing actual practices (Barone, Berliner, Blanchard, Casanova, & McGowan, 1996). Authentic learning experiences can promote transfer of skills and knowledge from "classroom" settings to "real world" settings (Anderson, Reder, & Simon, 1996). This is particularly true for teachers as they typically develop their expertise by engaging in a variety of situations that are relevant and authentic (Putnam & Borko, 2000). By integrating more authentic learning experiences in their teacher education programs, teacher educators may facilitate increased transfer of skills and knowledge gained from their programs into preservice teachers' future teaching practices (Korthagen & Kessels, 1999). Therefore, it is critical to provide preservice teachers with learning opportunities that are as similar to actual K-12 classroom practice as possible.

Some critics suggest the gap may be due to the lack of alignment between the technology topics covered in teacher education programs and the way teachers currently use (or *should* use) technology to support teaching and learning in their classrooms. Specifically, these critics indicate there is "a disconnect between the strategies college students are learning in their teaching methods classes and the technology that teachers are recurrently using in the classroom to enhance student achievement" (Project Tomorrow, 2009, p.13).

Other critics state that a majority of K-12 teachers in the United States do not effectively leverage the affordances technology can provide in the classroom to support student learning in innovative ways (Maddux & Johnson, 2006; NEA, 2008; Project Tomorrow, 2009; US Department of Education, 2010). Researchers have called for renewed efforts in determining both what knowledge and experiences should be included in preservice teacher education programs with regard to technology, and how to best prepare teachers to effectively use that knowledge to support student learning (Lawless & Pellegrino, 2007). By examining those teachers that currently use technology, it may assist preservice teacher education programs in understanding which technology uses are most likely to be implemented by inservice teachers (Ottenbreit-Leftwich et al. (2010)). Although several studies have focused on examining the methods that result in the transfer of technology training from preservice teacher education programs to their actual classrooms (e.g., Kay, 2006; Polly, Mims, Shepard, & Inan, 2010), there are few recent studies that investigate the actual topics or uses of technology that preservice teachers are likely to use in their future classrooms.

12. Purpose of study

The purpose of this study was to begin to address the knowledge gap regarding what teacher education programs should do to best prepare teacher to integrate technology into their teaching by examining the current topics related to technology integration included in preservice teacher education programs, and how those topics compared to the ways in which teachers use technology to support their teaching and learning practices. Specifically, this study attempted to answer the following research question: What are the similarities and differences between the technology topics included in preservice teacher education programs and the technology topics teachers find relevant and meaningful to their teaching/learning practices? By investigating this question, it may help provide information regarding the alignment between preservice teacher education technology training and inservice teacher use of technology. The results may inform preservice teacher education technology training and inservice professional development to ensure the technology topics introduced are relevant and timely. Although the purpose and design of this study was originally proposed and funded by the U.S. Department of Education, before the data collection process had begun, the Department of Education decided to dedicate the remaining funds to alternative projects. The researchers used the design and instruments established through the collaborative effort with the U.S. Department of Education, but conducted the study on their own.

2. Method

The overarching research question (What are the similarities and differences between the technology topics included in preservice teacher education programs and the technology topics teachers find relevant and meaningful to their teaching/learning practices?) was addressed through a mixed-methods research design implemented in two phases. In the first phase, a survey design was utilized to collect general information from a larger population. In the second phase, a multiple case study design was utilized to collect in-depth information on the emerging themes discovered from analysis of data collected in the first phase. In each phase, two populations were investigated (teacher educators and practicing K-12 teachers) to compare how teacher education programs and practicing teachers align in their uses of technology to support teaching and learning. Participants, data sources, and data collection procedures for each population are described separately below.

2.1. Teacher education programs

2.1.1. Participants

To address what technology topics are included in teacher education programs, the Postsecondary Education Quick Information System was used to identify all four-year institutions in the United States that offered programs in general, elementary, and/or secondary education ($n = 1283$). A representative from each of these institutions with knowledge of the institution's educational technology requirements was contacted by email and asked to complete a 14-item online questionnaire describing the preservice educational technology requirements at their institutions. Of the 1283 institutions contacted, 426 institutions completed the questionnaire (response rate of 33%). Forty-four percent of institutions responding were public institutions, and the median number of teacher education students graduating from all institutions responding was 139. Forty-eight percent of the teacher educators responding for their institutions had over 10 years of experience at their institution, and 62% of respondents stated that they had primary responsibility for teaching educational technology courses.

From the 426 institutions responding to the questionnaire, twelve institutions were selected for follow-up analysis. Purposeful sampling was used to maximize the variety of institutions selected; selection of institutions was based on location of institution (West ($n = 3$), Northeast ($n = 2$), Southeast ($n = 3$), Midwest ($n = 1$), Southwest ($n = 3$)), size of the teacher education programs (Large ($n = 8$), Small ($n = 4$)), and institution type (Public ($n = 6$), Private ($n = 6$)). The teacher educator representative for each institution that completed the initial teacher educator questionnaire participated in the follow-up interview and document collection.

2.1.2. Data sources

Three sources of data were collected from the teacher educator participants. These included questionnaire responses (from all participants), and semi-structured interviews and supplementary documents (from the teacher educator representatives of the 12 institutions described above).

2.1.3. Teacher educator questionnaire

The teacher educator questionnaire consisted of 14 items separated into three sections. The first section contained four items focusing on demographic information such as institution name, location, and the responsibilities of the individual respondent (teacher educator) with regard to the program. The second section contained seven items focusing on the technology topics included in coursework and/or experiences required in the institution's teacher education programs. However, the items specifically focusing on types of programmatic technology experiences incorporated into teacher education programs (e.g., educational technology courses, technology activities included in methods courses) were not included in the analysis for this particular report as it focused on the topics covered in technology experiences. The final section requested additional contact information if they were willing to participate in follow-up data collection activities.

In terms of the items dealing with technology topics, one item provided respondents with a list of technology topics and asked them to select the topic(s) that were included in all or some of the teacher education programs they offered at their institution (personal productivity, information presentation, administration/classroom management, communication, access/use of electronic resources, analyze student data, facilitate specific teaching concepts, document personal/professional growth, support student learning styles, support higher-order thinking skills, support students with special needs, classroom preparation). The Cronbach-Alpha measure of internal consistency for this portion of the survey was .86. The second item in this section was open-ended, and asked respondents to indicate what technology topics they perceived to be the most important technology topics incorporated into the curriculum of their programs. To confirm the validity of the instrument, items were designed and vetted by a team of university faculty, K-12 teachers, and educational evaluation experts selected by the U.S. Department of Education based on experience and expertise in the area of technology integration.

214. Interviews

As indicated above, teacher educators from 12 institutions agreed to participate in follow-up interviews. Similar to the questionnaire instrument, items on the semi-structured interview protocol were developed by a team of experts in the area of technology integration. The interview protocol consisted of nine broad questions, with topics for the questions focusing on the technology topics/areas included in their teacher education programs, unique aspects of their specific programs with regard to technology integration, and programmatic challenges faced when attempting to infuse technology into teacher education.

215. Supplementary documents

For each of the 12 institutions selected for follow-up analysis, specific documents were also collected from a variety of sources (e.g., program websites, faculty). These documents included syllabi for various technology courses, overviews/program sheets for the teacher education programs offered at the institutions, sample assignments, course materials, and student work.

216. Data collection procedure

During the spring of 2009, a team of educational technology experts developed the teacher educator questionnaire instrument. The instrument was piloted with a small group of teacher educators over the course of the summer. Based on feedback received from the initial group of teachers, specific items were modified and the administration protocol was clarified. A similar development, piloting, and revision procedure was used during the same time period for the semi-structured interview protocol.

In September of 2009, a representative identified from each of the 1283 teacher education institutions was contacted via email and asked to participate in the study. The email contained a link to the questionnaire. After approximately four weeks, a second email reminder was sent to individuals who had not yet completed the questionnaire. A final email reminder was sent to individuals approximately six weeks after the initial citation.

During the spring of 2010, teacher educators from 20 institutions selected based on demographic variables described earlier were contacted and asked to participate in follow-up interviews; 12 agreed to participate. Interviews were scheduled and conducted over the course of three months via telephone; all interviews were completed by July of 2010. Each interview lasted approximately 45–60 min. All interviews were audiotaped and transcribed. Interviewees were asked to verify the accuracy of the information by reviewing the written interview transcripts.

Websites for the 12 institutions were reviewed in order to provide additional documentation regarding their teacher education programs (e.g., course of study forms, program overviews, syllabi). Individuals participating in follow-up interviews were also asked to provide supplemental information not available on their university websites (e.g., course syllabi, course materials). Collection of all supplemental information was completed by July of 2010.

22. Technology-using teachers

221. Participants

Technology-using teachers were recruited through a self-nomination procedure. Requests to participate in the study were sent via email to various listservs focusing on educational technology (e.g., ISTE special interest groups, ISTE state affiliates). The email requested that teachers complete a 23-item online questionnaire focusing on how they used technology in their classrooms. By completing the questionnaire, teachers self-nominated themselves for the study.

Respondents to the questionnaire were selected for the study based on two criteria. First, teachers needed to report that their primary professional responsibilities were directly involved in teaching PreK–12 students; technology coordinators and administrators were not included in the study. Second, teachers needed to have a high self-assessment of their classroom technology skills. One item asked teachers to rate their skills on a 4-level scale: (1) I'm not comfortable using technology in my classroom, (2) I'm somewhat comfortable using technology in my classroom, (3) I'm comfortable using technology in my classroom, and (4) I'm comfortable teaching others to use technology in their classrooms. Teachers were included in the study if they rated themselves as "I'm comfortable using technology in my classroom" or "I'm comfortable teaching others to use technology in their classrooms." A total of 457 individuals responded to the survey. Of those respondents, 316 met both of the criteria. Sixty-eight percent of these respondents taught at the secondary level, and 60% of these individuals had more than 15 years of teaching experience.

From the 316 teachers responding to the questionnaire, 27 teachers were selected for follow-up interviews and additional data collection. Purposeful sampling was used to maximize the variety of teachers selected for follow-up analysis; selection of teachers was based on subject areas and grade levels taught. The ten elementary ranged from 1st grade to 5th grade. The secondary teachers included eight middle school teachers and nine high school teachers.

222. Data sources

Similar to data collected from teacher educators, three sources of data were collected from teacher participants. These included questionnaire responses (from all 316 teachers), and semi-structured interviews and supplemental documents (from the 27 teachers selected for follow-up analysis).

223. Teacher questionnaire

The teacher questionnaire consisted of 23 items separated into three sections. The first section contained seven items focusing on demographic information such as current teaching position and location, grade level/content area, and years of teaching experience. The second section contained twelve items focusing on ways in which teachers used technology to support their teaching in a typical week, and the types of technology experiences completed in their teacher education programs. The items specifically focusing on the technology experiences included in respondents' teacher education programs (e.g., educational technology courses, technology activities in methods courses) were not included in the analysis for this particular report. The final section asked respondents to rate their technology expertise, rate their preservice teacher experiences, and requested additional contact information if they were willing to participate in a follow-up

interview. As with the teacher educator questionnaire, these items were designed and vetted by a team of university faculty, K-12 teachers, and educational evaluation experts selected by the U.S. Department of Education based on experience and expertise in the area of technology integration.

In terms of the items dealing with the ways in which teachers used technology to support their teaching in a typical week, one item provided respondents with a list of technology topics and asked them to select the topic(s) that best matched the ways they used technology to support their teaching during a typical week. The Cronbach-Alpha measure of internal consistency for this portion of the questionnaire was .70. The next three items in this section were open-ended, and asked respondents to indicate other ways that they used technology to support their teaching, and what they believed were the best ways to use technology to support teaching and learning.

22.4. Interviews

Twenty-seven teachers agreed to participate in follow-up interviews. Similar to the questionnaire, items on the semi-structured interview protocol were developed by a team of experts in the area of technology integration. The interview protocol consisted of ten broad questions, with topics for the questions focusing on how and why these teachers use technology for teaching and learning.

22.5. Supplementary documents

For each of the teachers participating in follow-up interviews, specific documents were collected from a variety of sources (e.g., teacher websites, email correspondences). These documents included specific teacher-developed activities, sample assignments, course materials, and student work.

22.6. Data collection procedure

During the spring of 2009, a team of educational technology experts developed the teacher questionnaire. The questionnaire was piloted with a small group of teachers over the course of the summer. Based on feedback received from the initial group of teachers, specific items were modified and the administration protocol was clarified. A similar development, piloting, and revision procedure was used during the same time period for the semi-structured interview protocol.

In September of 2009, an email solicitation was submitted to the listservs of the professional organizations identified above. The email requested participation in the study, and provided a link to the online survey instrument. After approximately four weeks, a second email solicitation was sent to the same listservs.

During the spring of 2010, 40 survey respondents selected based on demographic variables described earlier were contacted and asked to participate in follow-up interviews. Of the 40 initial contacts, 27 individuals agreed to participate. Interviews were scheduled and conducted over the course of three months via telephone. All interviews were completed by July of 2010. Each interview lasted approximately 45 – 60 min. All interviews were audiotaped and transcribed. Interviewees were asked to verify the accuracy of the information collected during the interviews by reviewing the written interview transcripts. Supplemental information was solicited from each of the interview participants (e.g., teacher-developed materials, sample student work). Collection of all supplemental information was also completed by July of 2010.

23. Overall data analysis procedure

For the first phase of data analysis (online questionnaire), the demographic questions and close-ended questionnaire items were analyzed using frequency counts. The closed-ended questionnaire teacher educator item asked teachers to select from list of technology topics that were included in all, some, none, or optional in their teachers education programs (see Table 1). Teachers were given the same list of technology topics and were asked to indicate which technology topic they use during a typical week.

The open-ended questionnaire items were analyzed using constant comparative coding to establish a general overview of the topics included in teacher education programs and an overview of the topics teachers found relevant/meaningful. Teacher educators were asked to describe the most important technology-related topic included in their programs. Teachers were asked to describe the best ways to use technology for teaching and learning, and provide an example of how they used technology for student learning. The responses were analyzed using a deductive code list generated from the close-ended question described above. However, two codes were combined with

Table 1
Technology topics.

List items	Examples
I generally don't use technology during a "typical" week	None
Personal productivity	Word processors, spreadsheets
Information presentation	Powerpoint, digital media
Administration and classroom management	Gradebooks, attendance, seating charts
Communication with peers/parents/students	E-mail, online chats, parent news letters, class websites
Access and use electronic resources	Websites, online databases
Analyze student achievement/performance data	Identify trends, provide remediation to learners
Facilitate teaching specific concepts	Computer-based courseware, tutorials
Document personal/professional growth	Electronic teaching portfolios
Support various student learning styles	Use of media for auditory and visual learners
Support activities that facilitate higher-order thinking	Collaborative problem-based activities, activities that require analysis and synthesis of information
Facilitate your support of students with special needs in your classroom	

others due to an overlap in teacher responses. The *Teaching Specific Concepts* code was folded into a *Classroom Preparation* code. Both codes emphasized searching for resources and less on planning to teach specific concepts. The *Learning Styles* code was folded into the *Special Needs* code. When teachers referenced using technology to address learning styles, they typically mentioned that students have special needs for learning and technology could be used to address those special needs and learning styles; there was little differentiation between these two categories.

Four researchers used the code list with descriptions and examples to code participant responses separately; two researchers reviewed the teacher educator responses, and two reviewed the teacher responses. Researchers coding the teacher educator responses obtained inter-rater agreement of over 90%. Researchers coding the teacher responses obtained inter-rater agreement of over 80%. The researcher evaluated all the coded participant responses where disagreements occurred and resolved each issue separately.

To compare differences in overall responses between teachers and teacher educators on the close-ended and open-ended questionnaire items described above, Pearson's Chi-square analyses were conducted on those item responses. Since multiple tests were conducted on each item, the alpha level was set at a more conservative $.05/10 \frac{1}{4} .005$. To further determine the magnitude of the effect for each comparison, Cramer's V was computed and reported for each Chi-square test conducted.

In the second phase, researchers used multiple case analysis procedures to analyze data obtained from interviews and artifacts. For each case, data were reorganized topically by the codes established in the first phase, thus developing a case record for each teacher and teacher educator participating in follow-up data collection. One researcher reviewed each case record and recorded margin notes on emerging themes. The research team then collectively discussed the emerging themes identified both within and across the cases. Refer to Table 2 for examples of codes and corresponding themes (not all are listed).

24. Validity, reliability, and limitations

A detailed earlier, the instruments (questionnaires and interview protocols) were developed through extensive consultation with an expert team or researchers and expert teachers brought together by the United States Department of Education. The Cronbach-Alpha measure of internal consistency was utilized to test the reliability of the questionnaires. The reliability of the analysis of the open-ended questionnaire items and the interviews was triangulated through multiple researchers coding both data sources.

We acknowledge that although a large simple size was used for both the teacher education programs and teachers samples, this study has limited generalizability due to how the populations were selected. The population for the teacher education programs were a convenient sample resulting from how many actually responded but are not necessarily representative of all teacher education programs. Although, those invited to participate in the study consisted of all initial licensure teacher education programs within the United States ($n=1283$ institutions), only 426 responded. Therefore, their responses may not be entirely representative of all teacher education programs. In terms of the teachers sample, the teachers were solicited from listservs focusing on discussions related to technology integration. Once again, this recruitment process may limit the generalizability of results to a broader teaching population. However, the researchers believed that exploring a population of self-identified "technology-using teachers" would provide the most valuable database on the overall goal of examining how to best prepare preservice teachers to be effective technology-using teachers in their future professional placements.

3. Results

As there was only one research question to investigate the similarities and differences between the technology topics included in preservice teacher education programs and the technology topics teachers find relevant and meaningful to their teaching/learning practices, the results are separated by data source. For each data source, the results of both populations (teacher educators and teachers) are presented and compared.

Table 2
Emerging themes examples based on topic codes.

Code	Emerging theme	Example of emerging theme
Productivity	Presentations- using technology to present information (the importance of being able to do this)	"They have to pass a test - They have to actually do a presentation with Smartboard. I make sure that our teachers are ready to go out." (Teacher Educator E, lines 362-375)
Administration/classroom management	Gradebook/course management system	"We do all our report cards on the computer. We have PowerGrade." (Teacher B, lines 170-172)
Communication	Website (to communicate or post resources for students). Teacher education programs model this, students are not required to complete.	"The gradebook program we used was called <i>SmartWeb</i> - is probably one of the more useful tools to me as a teacher - pushing that accountability factor onto the parents. I register every parent and make them accountable for being aware of what their children are doing - I put current grades weekly in there." (Teacher Y, lines 200-214)
Access and use electronic Resources	Webquests, Google searches, Websites, Online databases	"We use Quest Garden. Questgarden.com . Bernie Dodge has a whole business online." (Teacher Educator G, line 144)
Assessment/analyze student performance data	Clickers, cell phones, immediate feedback, accelerated reader results	"We have an SMART Responses system - I use that to generate what groups I'm going to be working with. I don't want to pull kids that don't need extra help that can be working and be furthering themselves." (Teacher G, lines 124-143)
Document personal/professional growth	Professional growth	

"Spend 10–15 min going through Twitter reading and looking.

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31. Close-ended questionnaire item

In the close-ended questionnaire item, teachers selected the way they used technology in their classrooms during a typical week from the same list of possible technology uses. A chi-square statistical procedure was used to compare the results obtained from these two populations. Fig. 1 provides a graphical representation of these results.

Significant differences between responses provided by teachers and teacher educators were found for all technology topics/areas (see Table 3). To further examine the magnitude of these differences, the Cramer's V effect size procedure was computed for all comparisons. Based on these data, a moderate to strong effect size was determined for administrative purposes (.508), communication (.482), access and use of electronic resources (.344), analyze student achievement data (.300), teach specific concepts (.335), support variety of learning styles (.401), and support higher-order thinking (.334).

32. Open-ended questionnaire items

One of the open-ended questionnaire items on both the survey administered to teachers as well as the one administered to teacher educators was designed to garner perceptions of the importance of specific technology uses. Teacher educators were asked to describe the most important technology topic covered in their teacher education programs, while teachers were asked to describe the best way to use technology for teaching and learning. The results reported were based on the percentage of teacher educators ($n=366$) and teachers ($n=312$) who responded to the open-ended questionnaire item (see Fig. 1).

Based on the coded descriptions provided by teacher educators, the most important technology topic was introducing future teachers how to use technology for classroom preparation and teaching specific concepts (30.6%). In contrast, when teachers were asked to describe the best ways to use technology for teaching and learning, almost half (47.4%) described technology uses that support higher-order thinking. To further examine the magnitude of the effects, Cramer's V was computed for all comparisons. Based on these data, a moderate to strong effect size was determined for support higher-order thinking (.429). Using technology to support higher-order thinking showed the widest disparity between teachers and teacher educators in terms of perceptions regarding the importance of specific technology uses (see Table 4). When asked to describe the most important topic covered in teacher education programs, 30% of the teacher educators described technology uses that supported classroom preparation and teaching specific concepts. This typically involved searching for free resources, creating class materials, or creating lesson plans (e.g., "Development of technology lesson plan: Students' lesson plans can demonstrate students' knowledge and skills to incorporate technology in classroom settings." [Teacher Educator 15], "We insist that our students make connections between state curriculum standards learning objectives and technology usages. We are not interested in technology for its own sake, but only to accomplish content area standards" [Teacher Educator 50]). Other common responses for the most important technology topic covered in teacher education programs included using technology for personal productivity (21%) and documenting professional growth (20.8%).

In an open-ended questionnaire item, teachers were asked to discuss what they believed was the best use of technology to support teaching and learning in their classrooms. Nearly half (47.4%) of the teachers that responded indicated that they believed that best way to use technology was to facilitate student learning. Teachers mentioned the best uses of technology to facilitate student learning included using the collaborative capabilities of technology (e.g., "The best way to use tech to support teaching and learning are to take advantage of its collaborative abilities. Connect your students to the world around you" [Teacher 426]), increasing student engagement (e.g., "Creating interactive lessons with visuals and high interest activities engages the students" [Teacher 396]), or facilitating student-centered activities (e.g., "Student centered technology [is the best use]. The ability to have each student investigate and use technology" [Teacher 318]). The other most common responses for the best use of technology were for the purposes of productivity tools/computer literacy (34%), classroom preparation (30%), and access/use of electronic resources (22%).

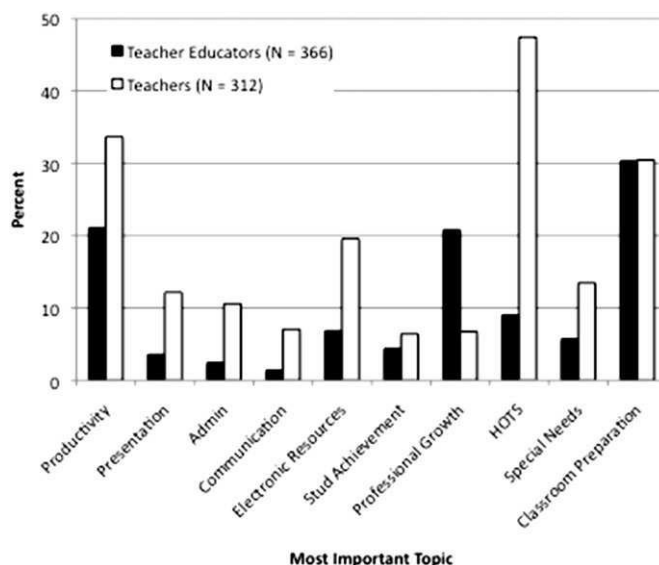


Fig. 1. Comparison of perspectives regarding the importance of specific technology uses: Percentage of teacher education representative versus teacher responses.

Table 3
Comparison of selected technology topics covered by teacher education programs and used on a weekly basis by teachers.

Topic/use of technology	Teachers ^a (N/4368)	Teacher educators ^b (N/4406)	C ²	Cramer's V
Personal productivity	97.8	78.3	67.35***	.295
Information presentation	92.4	75.6	39.61***	.226
Administrative purposes	88.6	39.4	199.82***	.508
Communication	99.2	59.3	178.90***	.482
Access and use of electronic resources	95.7	69.0	91.77***	.344
Analyze student achievement data	54.3	25.1	68.94***	.300
Teach specific concepts	68.5	35.0	86.33***	.335
Document professional growth	41.0	55.1	15.20***	.140
Support variety of learning styles	76.9	37.1	123.81***	.401
Support higher order thinking	69.8	36.5	85.83***	.334

^aRepresents percentage of respondents who indicated that they used technology for this purpose on a weekly basis.

^bRepresents percentage of respondents who indicated that this technology topic was included in all teacher education programs at their institutions.

33. Multiple case records

Analysis of interview and artifact data revealed several emerging themes that highlighted some differences between teacher education program and K-12 teachers with regard to the use of technology to support teaching and learning. These are represented below.

33.1. Communication

The emerging theme from the 'communication' code was using email, websites, newsletters, and/or blogs to communicate with parents and students. Almost all of the 27 teachers interviewed discussed using technology for communication purposes in their classrooms. They described using a range of technologies from more traditional newsletters and websites, to blogs and email. Teachers often specified having a particular form of communication they preferred and stressed to parents/students. Some teachers described using websites or blogs to keep parents and students up-to-

date on classroom events and homework: "I have my own website where I have the links to all the games. I also post our daily homework assignments - usually post a lot of links up there, to give background knowledge for [future] projects or to give them further information for the projects they are doing currently" (Teacher y, lines 33-37). One teacher described email as her preferred method of communication, but mentioned the importance of keeping traditional methods of communication such as newsletters: "Before the first day of school we tell parents, 'E-mail is the best way to communicate with me.' We try to push email. We have weekly newsletters - we still have a large number of people who don't have Internet and computer at home" (Teacher h, lines 125-129).

Some teachers stated that they used technology for communication purposes in order to facilitate instruction and feedback, encouraging student participation. One teacher described using email to engage students in this process: "[My students] all have an online email account - I'll send them a message on their email and then it might just be like, 'What did you like best about magnetism? Answer with two sentences.' They have to go online at night or during recess or when we have downtime in the classroom and respond back" (Teacher f, lines 25-30). Another teacher provided her classroom blog with a platform to engage students and allow them to collaborate.

In contrast, very few teacher educators interviewed mentioned preparing preservice teachers to use technology for communication purposes. Those programs have preservice teachers create newsletters or static websites to inform "parents" of classroom events. One teacher educator discussed how their program specifically requires production of a newsletter: "One of the biggest things is they have to design and implement a newsletter. Students not only give a summation of what has happened on a field trip but to incorporate the use of

a digital camera and uploading pictures to their teacher website and newsletter" [Teacher Educator H, lines 88-94]. Another program requires preservice teachers to design their own homepages as well as an electronic newsletter:

"One of the things that they're in charge of doing is developing their own homepage. Scholastic has a free homepage that teachers can set up - they have certain criteria that they have to follow, but some of the things that we've noticed from schools that they're wanting is an announcements page, a place for forms in case a student loses a form and a parent needs a quick copy of it and downloadables. Another thing is we try to get to is newsletters. Most of the schools now have gotten away from print copies and they've gone electronic with all of that" (Teacher Educator E, lines 68-97).

Table 4
Comparison of perspectives regarding the importance of specific technology uses: teacher education representative perceptions versus teacher perceptions.

Topic/use of technology	Teachers ^a (N/4312)	Teacher educators ^b (N/4366)	C ²	Cramer's V
Personal productivity	33.7	21.0	13.65***	.142
Information presentation	12.2	3.6	18.02***	.163
Administrative purposes	10.6	2.5	19.10***	.168
Communication	7.1	1.4	14.24***	.145
Access and use of electronic resources	19.6	6.8	24.61***	.191
Analyze student achievement data	6.4	4.4	1.39	.045
Class preparation and teaching concepts	30.4	30.6	.00	.002
Document professional growth	6.7	20.8	27.06***	.200
Support students with special needs	13.5	5.7	11.92*	.133
Support higher order thinking	47.4	9.3	124.80***	.429

$p < .05/10\% .005; ***p < .001/10\% .0001.$

^aRepresents percentage of respondents who indicated that they viewed this use of technology as the best/most important way to use technology for teaching and learning.

^bRepresents percentage of respondents who indicated that this technology topic was the most important topic covered in the teacher education programs at their institutions.

332. Analyzing student data

The code 'analyzing student data' included statements about using technology for data-driven decision making, feedback, and assessment-specifically examining student data. For this particular code, three distinct themes emerged. For teachers, they mentioned using classroom performance systems (clickers) and portfolios for assessment purposes. Teacher educators did not discuss either of these themes, but some interviewees described the importance of designing assessments that aligned with objectives.

Several teachers described using clickers to evaluate student learning. In fact, when asked to describe the best way to use technology for teaching and learning, two teachers specifically mentioned clickers: "The best way to use technology? The active votes with the Promethean Board, which allows the children to participate in evaluation and they can vote and show what their answer might be in any subject area" (Teacher h, lines 54–56). One teacher described the importance of being able to view student responses and address misconceptions: "I can put out a question and all the kids in the class can respond to it at the same time. If they're wrong I can give them quick feedback, 'think of it this way.' It requires every single one of them to give you an answer rather than two kids who always raise their hands" (Teacher p, lines 124–130).

Teachers also mentioned using technology for monitoring student progress (e.g., student portfolios, student logs). One teacher described using her classroom wiki to check student reading logs and provide feedback: "Most of the pages are actually the students - there's 52 student log pages. I can go in there and I have a column for teacher comments where I can go in and read what they're reading, check-up on them, and give them feedback on, probe them deeper, or ask them, 'I'm noticing that you're not finishing these books or you're abandoning them. What's going on?'" (Teacher a, lines 134–138). Other teachers have systems (e.g., *Compass Learning*) that track students' performance and help teachers assign individualized learning modules based on student achievement: "The district provides *Compass Learning* that will immediately individualize depending on how I set it up" (Teacher g, lines 110–112).

The majority of teacher educators interviewed did not mention teaching preservice teachers how to use technology for analyzing student data. So we described the importance of teaching preservice teachers how to design strong assessments, one that would align with the objectives for the lesson: "In the lesson plans, they have to have the objectives or outcomes that they are trying to achieve with their learners. And so their assessments have to be aligned to that." (Teacher Educator H, lines 109–113).

333. Professional growth

The code for 'using technology to document or engage in professional growth' included any informal uses (e.g., collaboration with other teachers), or formal uses (e.g., e-Portfolios). Themes emerging from this code were personalized learning networks (PLN) and the creation of an electronic portfolio.

Most teachers responded that technology provided them with a constant source of professional growth. With the amount of resources and information available on the Internet, teachers established their own PLN's through a variety of technology (e.g., Twitter, blogs, Google bookmarks). One teacher stated that the Internet was "a floodgate. I'm just constantly bookmarking, dogearing different things here and there" (Teacher e, line 144). One English teacher described using particular websites like webenglishteacher.com and collaborating with other teachers. Another specifically described how she used Twitter and Google bookmarks: "Personally/professionally, I follow a lot of people on Twitter that kind of send up links about a lot of cool tools they found. I use Google bookmarks to keep track of all the websites - Some things work well then I'll try another thing, and it just won't work" (Teacher g, line 167–171).

Perhaps the strongest theme revealed from interviews with teacher educators was the use of electronic portfolios. Electronic portfolios tended to be used to encourage preservice teacher reflection and documentation of technology skills and pedagogical knowledge. Most teacher educators indicated that portfolios required preservice teachers to document how they addressed the standards: "They store a lot of different things in their working portfolio, and then toward the end they reflect on it and they talk about why that particular item shows that they've learned in a particular area, relates to the standards" (Teacher Educator D, lines 133–135), "They create a portfolio before they leave, showcasing what they've done with technology, and some people say it really does help" (Teacher Educator K, lines 111), and "Ideally students would collect artifacts in an electronic portfolio over the course of their program. This ePortfolio would also eventually include text video audio and other multimedia samples as evidence of their competency with effective tech integration" (Teacher Educator L, lines 97–101). Several of the teacher educators mentioned that the portfolio was continuously developed as preservice teachers progressed through their teacher education programs.

334. Higher-order thinking skills

For the code 'using technology to support activities that facilitate higher-order thinking skills', two themes emerged: using Web 2.0 technology tools to support student collaboration, and using technology to support project-based learning. Both teachers and teacher educators discussed these two emerging themes.

Teachers reported using various technology tools to facilitate student collaboration. One teacher described using blogs and the commenting feature: "I allow them to comment on each other's blogs. We have a lot of discussion. I require at least two full sentences" (Teacher d, lines 122–123). Another teacher described using a social networking tool to facilitate student collaboration through an interest project:

"When I teach American Literature, we teach the literature in a area. There are the Colonials, the Rationalists, and the Romantic etc. I set up a social networking site and I assigned each girl a writer and they had to reform the groups that they belonged to. They're producing a social networking format what was going on in the literature that we were studying. And each girl created a profile for her writer." (Teacher v, lines 175–182)

Teacher educators did not discuss teaching preservice teachers how to use technology to support K-12 student collaborative projects. Instead, teacher educators described how they modeled the use of technology for collaboration by assigning preservice teachers to group projects, and using Web 2.0 technology to facilitate collaborative activities involved in completing those projects. For example, one interviewee described the importance of having preservice teachers using Web 2.0 to collaborate: "You know, if ever a kid is making their own PowerPoint, that's interesting - but if kids are getting together to discuss how to build one PowerPoint and it's a group aspect of the PowerPoint, you've got much richer and more meaningful use of technology there. And I think by focusing on the collaborative aspect of Web 2.0 technology, you get your foot in the door here, very naturally too" [Teacher Educator L, lines 94–98]. Analysis of course assignments

revealed that many programs incorporated other Web 2.0 tools (e.g. Google Docs, Titanpad) into the activities preservice teachers completed.

Both teachers and teacher educators also discussed using technology to support project-based learning. Teachers described using technology to present information to their students on one particular topic, as well as enable students to conduct research and create products. One English teacher described her project-based learning unit that focused on the Canterbury Tales:

"I didn't know how to make the Canterbury Tale become alive to them because the language is just distant to them. After we studied it a little but, I assigned each one of them a pilgrim and they collaborated with two other classes in the building. One group had to create an autobiography of the pilgrim, another created an interview between a modern-day interviewer and the pilgrim. My kids were doing a diary of the journey to Canterbury. The journey had to reflect that pilgrim's voice and take in the sights and the sounds along the way. It worked. It absolutely grabbed them." (Teacher U, lines 166-183)

A middle school science teacher mentioned how her students collaborate on a large project with the local museum to create a new exhibit: "We do a huge collaboration with our museum here in town, and they create an exhibit to install. We have done four, and we are getting ready to do the fifth on agriculture. Now within and out of class time we do blogs. We have done podcasts, we've done a lot of research, a lot of videotaping experts, like in the medical field for our medical exhibit" (Teacher O, lines 127-133). Technology tools were described for a wide-range of purposes in order to help facilitate project-based learning.

Several teacher educators described having preservice teachers design and create webquests. One teacher educator described their webquest assignment and how it supports project-based learning: "Project-based learning and effective technology integration is currently achieved through design and completion of a webquest. Student create these in terms of three usually based on certification areas (e.g. El Ed Sec Ed Special Ed.)" (Teacher Educator E, lines 123-127). Another teacher educator indicated that the webquest assignment was a significant part of their technology experiences: "We create a webquest. And that's a pretty substantial piece. They put time into that in teams. And those are - sometimes created for teachers in the field who don't have the time to create one for themselves" (Teacher Educator D, lines 93-97).

4. Discussion

The purpose of this study was to examine the knowledge gap regarding what teacher education programs should do to best prepare teachers to integrate technology into their teaching. This study examined the topics related to technology integration included in preservice teacher education programs, and how those topics compared to the ways in which teachers use technology to support their teaching practices. Specifically, the research questions examined were: (1) What technology topics are included in preservice teacher education programs?, (2) What technology experiences and topics do teachers perceive as relevant and meaningful to their teaching and learning practices?, and (3) What are the similarities and differences between the technology experiences and topics included in preservice teacher education programs and the technology experiences and topics teachers find relevant and meaningful to their teaching and learning practices?

Based on the results of this study, there are a wide variety of technology topics included in teacher education programs that seem to align with teacher practices. The most prevalent topics included in teacher education programs were the use of technology for personal productivity, information presentation, and the access and use of electronic resources to support teaching and learning. In terms of teachers' use of technology, data indicated that teachers also tended to use technology frequently for personal productivity, information presentation, and to access and use electronic resources. In addition, both teacher educators and teachers reported that using technology for classroom preparation is important and one of the best uses of technology for teaching and learning. However, there were several technology topics in which teachers and teacher educators differed in terms of the frequency of inclusion in teacher education programs versus the prevalence of use in the classroom, as well as the ways in which various types of technology were incorporated into teacher education programs or used by teachers. These similarities and differences are highlighted below.

4.1. Technology to support communication

Almost every (99.2%) teacher participating in this study indicated that they used technology to support communication on a weekly basis. In contrast, only 60% of teacher educators indicated that they included this topic in all their teacher education programs. There was a significant difference between these populations and a moderate to strong effect size was determined for this topic. In the open-ended questionnaire item, few teachers (7.1%) and even fewer teacher educators (1.4%) indicated that this was the best use of technology or most important topic covered. However, almost all 27 teachers in their interviews described how they used technology in their classrooms to support communication. Most teachers used a wider range of communication technology (e.g., blogs, websites, newsletters, email), while teacher educators tended to cover more static forms of technology (websites, newsletters). Many of the communication technology teachers used encouraged parents and students to participate while more static forms (websites, newsletters) delivered information and were more teacher-centered.

More teachers are beginning to use technology to communicate with parents. Thompson (2008) reported that parents and teachers use email to communicate about a wide variety of topics (grades, scheduling, health issues, behavior, social issues). Perhaps the more important role of teacher education programs is to help preservice teachers consider the different affordances communication technologies offer and how to select the most appropriate tool, as well as how to use such tools. For example, email may be an appropriate technology to individually speak with a parent about a behavioral issue, however, due to a lack of contextual conversational clues (e.g., body language, intonation), it is important to be clear in email so parents do not misinterpret information. In addition, teacher education programs should expose preservice teachers to Web 2.0 technologies that can encourage participation from both parents and students, as well as present ideas on how to use these interactive communication technologies in the classroom.

In K-12 education, demands for parent involvement, and particularly parent-teacher communication has increased (Rogers, 2006; Sheldon & Epstein, 2002). This may be due to the research-based practices linking parental involvement to student achievement (Chen, Yu, & Chang, 2007; Cutrona, Cole, Colangelo, Assouline, & Russell, 1994; Rodriguez, 2002). One research study (Lewin & Luckin, 2010)

found that flexible interactive technologies help develop parental engagement. However, although not as interactive, more static technologies require less time (e.g., websites, email) but still yield some parent involvement (Lewin & Luckin, 2010).

Perhaps the most evident difference between teachers and teacher educators was that teacher educators reported that their program tended to teach the use of static technologies (e.g., newsletters, webpages), while teachers used more interactive technologies (e.g., email, blogs). These teachers tended to engage students and parents by using communication technology and asking for participation. However, it may be difficult for teacher education programs to teach communication technology because preservice teachers lack their own classrooms, and subsequently cannot practice communication with their own students or students' parents. Programs could be creative by having preservice teachers form teams and exchange communications, or have preservice teachers interview in-service teachers to document their experiences and how they dealt with difficult communications with parents or students.

42. Technology to support analysis of student data

Using technology to analyze student data was the least reported technology topic included in teacher education programs (25%), and the second least reported technology use by teachers (54%). However, there was a significant difference between these two populations, and a moderate effect size (.300) was determined for this topic. In interviews, teachers mentioned using classroom performance systems (clickers) and portfolios for assessment purposes. In contrast, a small number of teacher educators described the importance of design in gas assessments that aligned with objectives. Based on the interviews, the technologists taught to preservice teachers in order to analyze student data (assessments) are vastly different from how teachers are using technology to analyze student data (e.g., clickers, portfolios). This could be due, in part, to the influence of teachers' school/district initiatives that promoted clickers or portfolios. When it comes to data analysis, individual teachers may not have the ability to make decisions about some of the tools they have access to in their classrooms. However, if teacher education programs expose preservice teachers to these tools, they may be able to request certain tools to assist with data analysis or use free versions of similar tools (e.g., Poll Everywhere).

Using technology to analyze student data is currently considered an important educational trend by stakeholders (Means, Padilla, & Gallagher, 2009; U.S. Department of Education, 2010). In the U.S., standards and accountability in educational policies have highlighted the essential role of evidence in decision-making for continuous school improvement (Moss & Piety, 2007). *No Child Left Behind* mandates the aggregation and reporting of student achievement data. Such evidence-based decision-making is referred to in the literature as data-driven decision-making, or DDDM (Marsh, Pane, & Hamilton, 2006). DDDM is "a system of teaching and management practices that gets better information about students into the hands of classroom teachers" (McLeod, 2005, p. 1). There is strong empirical evidence that, when implemented properly, DDDM can have a significant positive impact on student achievement (Marsh et al., 2006). Specifically, effective use of data can measure student progress, evaluate program and instructional effectiveness, guide curriculum development and resource allocation, and promote accountability (Kowalski & Lasley, 2009).

There are a wide variety of technology tools with specific functionalities that schools can use for generating and organizing data (Means et al., 2009; Means, Padilla, & Gallagher, 2010). In this study, teachers reported using two types of technology to analyze student data: clickers and student tracking systems (e.g., portfolios, learning management systems). In order to properly implement DDDM, appropriate training and ongoing support is critical (McLeod, 2005), beginning at the preservice level.

Teacher education programs may want to attempt to demonstrate how to use various technologies (e.g., clickers, portfolios) to analyze student data, particularly ones that are already being used by other university faculty and might be available at their institutions. For example, the Indiana Department of Education has constructed a "sandbox" within its state-wide student management system (the *Learning Connection*) for higher education program students to use (Indiana Department of Education, 2009). The sandbox provides sample student data to help preservice teachers experiment with using technology tools and make data-driven decisions.

43. Technology to support professional growth

Using technology to support and document professional growth was the only technology topic that more teacher educators indicated was included in their teacher education programs than teachers reported they utilized in their teaching. Although there was a significant difference between the two groups in this close-ended questionnaire, the magnitude of the effect was small. In the open-ended questionnaire item, 20% of teacher educators indicated that using technology for professional growth was the most important technology topic they covered, while only 6.7% of teachers expressed this as the best way to use technology to support teaching and learning. Once again, there was a significant difference between the two groups but only a small effect. In the interviews, teachers described using technology to participate in personalized learning networks (PLN) while teacher educators focused on using technology to create an electronic portfolio for reflection and documentation of technology knowledge.

Many teacher education programs have used electronic portfolios (eportfolios) as a form of technology integration reflection (e.g., Britten, Mullen, & Stuve, 2003). As teachers reflect, they consider their teaching practices in a way that may challenge their current beliefs and necessitate change, especially with regard to technology (Ertmer, 2005). The eportfolio necessitates that preservice teachers document their learning process and reflect upon their growth as teaching professionals. Some programs use portfolios as exit requirements, requiring that preservice teachers meet a set of standards before granting them a degree (Strudler & Wetzel, 2005). Studies have shown that teachers (e.g., National Board Certified teachers) that construct portfolios show stronger indications of the four correlates of high-quality teachers: instructional practice, classroom management, teacher efficacy, and teacher leadership (Hudson, 2010).

Often times, preservice teachers indicate they do not value constructing an eportfolio (Hyndman, Wirtz, Pierce, & Erickson, 2007). Teacher educators may need to reflect on the integration of eportfolios into their programs to persuade both preservice and practicing teachers of their value in supporting enhanced teaching and learning. Perhaps one of the mechanisms to improve teachers' beliefs regarding the usefulness of eportfolios can be extracted from the new performance-based pay trend that is emerging for teachers. As more states require teachers to document their performance, eportfolios may be more useful to teachers. Teachers can use eportfolios to demonstrate and document the effects they are having on students' learning.

In this study, several teacher educators explained that one weakness of the eportfolio was the lack of continued development of the portfolio throughout the entire teacher education program. In our follow-up interviews, two teacher educators indicated that their programs implement the portfolio over the entire course of the teacher education program and remark about its success. Many researchers agree that in order for eportfolios to be successful, they need to be implemented over the entire teacher education program (Doty & Hillman, 2001; Hyndman et al., 2007). Teacher education programs may be more successful at enhancing the effectiveness of eportfolios if they work to implement the portfolio throughout their programs.

4.4. Technology to support the facilitation of higher-order thinking skills

Seventy percent of teachers reported that they used technology to support the facilitation of higher-order thinking skills during a typical week, while only 37% of teacher educators reported that they included this topic in their programs. There was a significant difference between the two groups and a moderate effect (.334). In the open-ended questionnaire item, 47% of teachers reported using technology for higher-order thinking skills as the best way to use technology for teaching and learning. Only 9% of teacher educators described this as the most important topic included in all teacher education programs. Once again, there was a significant difference between the two populations and a moderate to strong effect (.429). In the interviews, both teachers and teacher educators described using Web 2.0 technology tools to support student collaboration and using technology to support project-based learning.

Typically, teacher educators and researchers have purported that student-centered uses of technology are the best methods for supporting student learning (Lawless & Pellegrino, 2007). Interestingly, there has been significant research indicating that teachers tend to use technology in less student-centered ways in their classrooms (Maddux & Johnson, 2006). However, in this particular study, less than half of teacher education program surveys reported that they covered technology uses that facilitate higher-order thinking skills, and very few teacher educators rated this as the most important technology topic. Conversely, a majority of the teachers stated that they use technology to address higher-order thinking skills during a typical week although it should be noted that teachers were not asked to indicate the frequency with which they used technology to address higher-order thinking skills. In addition, almost half consider this to be the best way to use technology for teaching and learning. This misalignment could be due, in part, to the placement of the technology experiences within teacher education programs. Many programs tend to include technology experiences in the beginning of the program. This may cause difficulties due to the lack of pedagogical knowledge of the preservice teachers enrolled in the experience. They may not have the abilities to understand the construction of student-centered lesson plans—a topic that many preservice teachers tend to have difficulties mastering.

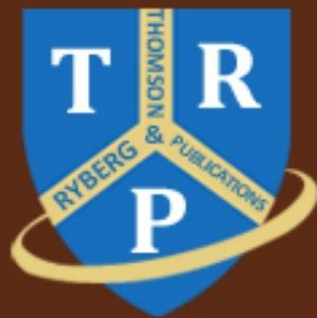
5. Conclusion

Researchers have called for renewed efforts in exploring both what technology topics should be addressed in preservice teacher education programs with regard to technology, and how to best prepare teachers to effectively use technology to support student learning (Lawless & Pellegrino, 2007). This study found that the technology topics included in preservice teacher education programs and the technology topics perceived relevant and meaningful by technology using teachers had both similarities and differences. Some of the most striking differences focused on using technology for communication, analyzing student data, documenting professional growth, and facilitating higher-order thinking skills. Overall, teacher education programs and teachers should form more partnerships to collaboratively work toward identifying and teaching the best methods for using technology to support teaching and learning. Although some studies have been conducted investigating individual partnerships between teacher education programs and schools (Polly et al., 2010), future research should examine sustainable partnerships that facilitate discussions of best practices and implement those into both teacher education classes and inservice teacher professional developments.

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