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Project RITE (Research of Instructional Technology in Education) Research Proposal: How Does a Web 2.0 Based Technology Integration Course Develop TPACK Ready Preservice Teachers?

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Abstract

Today's educational environment is vastly different than it was even 5 years ago. The ever-changing landscape now involves not only more rigorous standardized testing but also requires more accountability by both student and teacher alike. These factors continue to require more classroom reform across the board, which has teachers somewhat scrambling for creative ideas to reach their students in new ways that impact test scores. This research study sought to determine how much more prepared preservice teachers are to integrate Web 2.0 technology into their content after completing a technology integration course. It evaluated 73 preservice teachers' responses to a 50-60 item survey. The survey, based on a 5-point Likert scale, evaluated how prepared preservice teachers were to utilize technology in their content area and how prepared they felt to teach after completing a technology integration course. Lastly it sought to determine the degree to which preservice teachers understand how technology affects pedagogy. Specifically, were they TPACK ready after completing a technology integration course. Results showed that they were indeed more TPACK ready as well as more prepared to use the Web 2.0 tools to better enhance their own specialty areas.

Introduction

Today's educational environment is vastly different than it was even 5 years ago. The ever-changing landscape now involves not only more rigorous standardized testing but also requires more accountability by both student and teacher alike. These factors continue to require more classroom reform across the board, which has teachers somewhat scrambling for creative ideas to reach their students in new ways that impact test scores.

Technology has long been looked at as a valuable resource to help teachers accomplish this task. However, it has been difficult at times as the resources to do so were not always available. In 1999, the federal government created the Preparing Tomorrow's Teachers to Use Technology (PT3) grant to help provide the necessary technology to schools (Mims, Polly, Shepherd, & Inan, 2006). While this has helped provide much needed resources to many schools across the board, there still has remained a missing piece to the preparation puzzle. Although the needed technology is now often in the schools, many teachers lack the necessary skills to properly integrate the technology into their classrooms. They simply do not have the needed integration skills to combine their pedagogy and technology skills to positively affect the learning environment.

The implementation of Common Core standards and standardized testing has brought on the need for a fresh look at how teachers prepare students. While teaching to the test now seems to be the norm, effectively teaching the knowledge and skills students need to be prepared for tests is a monumental challenge. Technology continues to be viewed as having a major role in helping improve test scores. The question then possibly becomes where does Web 2.0 technology and technology integration fit into the overall picture of effective instruction? What is its role in helping students learn? How does it mesh with the content knowledge and pedagogy of a teacher to impact instruction thus hopefully improving standardized test scores?

Literature Review

Technology Barriers

The utilization and implementation of technology in the classroom has been looked at in a variety of ways over that last several years in order to determine if it could play a vital role in education. For years the belief has been that technology *could* indeed have a very positive effect in helping educators reach students in the classroom in a more creative way. However, there have been many highly noted barriers that have at times prevented this from occurring (Pamuk, 2012).

While the technology has evolved through the years, many of the challenges have remained somewhat the same. One major issue has been availability of needed resources or lack of technology in the classroom. This was somewhat addressed in 1999 when the U.S. Department of Education created a grant program called Preparing Tomorrow's Teachers to Use Technology (PT3) where technology was provided to schools in need (Dilworth, Donaldson, George, Knezek, Robinson & Searson, 2012). Through these and other various grants many schools now are able to purchase various software, smart boards, laptops and even iPads for their schools. However, while some schools seem to now have a wide variety of technologies in the classroom for teachers and students to use, there are still other schools that simply only have one basic computer lab or a couple of basic desktop computers per classroom in some cases. The lack of needed resources is only one of several issues that arise when it comes to effective technology use in the classroom.

Another possible barrier is that often teachers do not know exactly what skills they should have in order to utilize technology in the classroom. Even when the technology is available, the lack of technology skills among both preservice and inservice teachers alike has continually been an ongoing problem at times (Kumar & Vigil, 2011). Many teachers are simply unaware of the skills they need. However, determining exactly what technology skills teachers should possess was addressed in 2000 by the International Society for Technology in Education (ISTE). ISTE developed the National Educational Technology Standards (NETS) for both teachers and students in order to identify exactly what technology skills teachers and students alike should possess (Roblyer, 2000). Often the problem is that unless directly involved in technology itself many teachers may not even know these standards exist since they would need to look outside their own curriculum area to find them. In many cases preservice teachers are possibly never exposed to these standards and thus feel unprepared.

In addition to lack of technology resources in the classroom and lack of technology skills by teachers, there still are other barriers at the forefront of this conversation that must be addressed. One such issue is that many teachers simply lack the ability to properly integrate the technological resources they do have into their classroom to achieve meaningful learning (Brush, Glazewski & Hew, 2008; Cottle, 2010; Graham, Tripp & Wentworth, 2009). Lack of technology integration skills has long been an ongoing issue for teachers (Browne, 2009; Lei, 2009; Sutton, 2011). The fact that teacher education programs continually deal with this is not a surprise either and often has become the focus of many professional development opportunities (Ham, 2010; Hutchison, 2012; Liu, 2013). Many teacher education programs may only have one required technology or technology integration course for preservice teachers. This fact has been the focus of many studies that indicate the importance modeling by other teacher educators as an integral way for preservice teachers to learn to integrate technology (Koch, 2009; West & Graham, 2007).

Additionally, the lack of professional development opportunities for teachers to assist them in learning new technologies continually comes up in studies as an important piece (Skoretz, & Childress, 2013). Still, numerous research studies have been done to determine the best way to approach the issue of providing both inservice and preservice teachers with the needed training to properly integrate technology into their classrooms.

Another issue is the attitudes teachers have toward technology or integration itself. These preconceived attitudes or perceptions can effectively hamper their growth in utilizing technology. As Ertmer and Ottenbreit-Leftwich (2010) state, teachers' must change their thought process to the idea that without the proper technology integration, teaching is not effective.

Studies suggest that taking a technology or technology integration course within the teacher education program can help preservice teachers overcome some of the barriers they may have. In their study of 62 preservice teachers, Lambert and Gong (2008) found that by taking a technology course within the teacher education program, preservice teachers' attitudes toward using technology were significantly influenced after having the course. In addition, Chai, Koh and Tsai (2010) found that by taking a technology course preservice teachers were indeed better prepared for using technology in their classrooms.

Web 2.0

Historically, using or integrating technology into the classroom basically involved word processing or research on the Internet. For years teachers felt they were integrating technology by simply having students complete an assignment in word processing or look up some resources on the Internet. While these things are somewhat useful, there is now much research indicating that integration is much more involved and detailed than what teachers previously had thought (Nelson, Christopher & Mims, 2009). In fact, as technology continues to develop, more and more research is being conducted to examine just how teachers might pair certain technologies to specific educational standards. Consequently, as technology has continued to evolve there has been a movement toward using a variety of web-based programs, applications and tools that are both free and easy to access and that link or address various educational standards (Tunks, 2012). Liu, Kalk, Kinney & Orr (2012) conducted a full review of literature concerning Web 2.0 from 2007-2009 and found that the most referred to tools were blogs, wikis, podcasts, social networks, and virtual environments.

The various Web 2.0 tools have totally transformed the learning environment from a more teacher-centered to student-centered approach. Not only do teachers now have new ways to reach their students but students are now learning in a variety of different ways that includes collaboration often as a centerpiece (Tunks, 2012). There are numerous research studies that look at various Web 2.0 tools such as blogs or social media to try and determine the best approach or tools to use (Boulton, & Hramiak, 2014; McEwan, 2012). There are also studies that look at the effect one particular tool has in a classroom setting or even the effect Web 2.0 has on a particular group of students like elementary education students (Phirangee, 2013).

Regardless of which tools are used, there is no doubt that Web 2.0 tools have changed many of today's classrooms but determining exactly what the best, most productive or most effective tools are is still up for much debate. As stated by Hew and Cheung (2013), while the research supporting the actual impact Web 2.0 tools have had on student learning appears to still be very weak, the use of Web 2.0 tools still appears to have a very positive effect on student learning.

TPACK

While all the above barriers are well known factors affecting technology usage and integration in the classroom, *how* technology fits into the classroom has also been a major concern historically. Teacher education programs may do well in training teachers to learn to teach (pedagogy) and teaching them their specific curriculum content. However, technology has often been the missing piece. Knowing where it fits or how it fits into the educational equation has been somewhat difficult if not a mystery for many teachers. Furthermore, while teachers historically have acquired the pedagogy and content knowledge, they often have a hard time understanding how technology can productively mesh to benefit them in the classroom.

In 2006, Mishra and Koehler developed The Technological Pedagogical Content Knowledge (TPACK) model to address this issue. The TPACK model helped define how technology, content knowledge and pedagogy are all connected. Since then, various studies have been conducted to look at how the TPACK model can be utilized across the educational spectrum (Chai, Koh & Tsai, 2013; Fougler, Buss, Wetzel & Lindsey, 2012; Hofer & Grandgenett, 2012).

With TPACK now being defined and the various parts being identified, Schmidt et al., (2010) felt the next step was to determine where preservice are in relation to TPACK. In order to do this, their research was geared toward developing a survey for identifying how preservice teachers develop throughout a teacher education program in relation to TPACK. Their study including 124 preservice teachers' self-assessment data based on the various parts of the TPACK model. From the study, Schmidt et al. (2010) produced a valid and reliable survey instrument that specifically measures where preservice teachers are currently at in relation to TPACK. The 75-item, self-assessment is based on a Likert scale and involves seven TPACK domains and appears to be the first of its kind. This has led to many researchers using this survey as a means to learn more about preservice teachers' preparation in a variety of ways in relation to TPACK.

For example, Abbitt (2011) utilized the aforementioned survey that evaluated the relationship between preservice teachers' self-efficacy beliefs toward technology integration and the areas of TPACK. The study found that the perceived knowledge in many of the TPACK domains was positive for preservice teachers and that led increased levels of self-efficacy. His study pointed out that prior to this research, prior studies had indicated that self-efficacy actually influenced how often a preservice teacher would use technology. This study showed that perhaps knowing more technology and how to integrate might indeed improve self-efficacy (Abbitt, 2011).

In addition, Chai, Koh and Tsai (2010) also used the survey for their study involving over 400 preservice teachers. Their findings were also very similar to Abbitt (2011) in that their preservice teachers had higher perceptions of their competencies based on TPACK after completing the technology integration course than they did prior to taking it. While the course didn't specifically address their content knowledge they did have to use it for the basis on some projects they were to do so it was implied.

Other studies have taken a different approach than simply using TPACK to evaluate programs or preservice teachers and have instead research the effectiveness of the various categories of TPACK itself. One such study looked at the actual paths to TPACK to determine which categories (TK, PK, CK, TCK, TPK, PCK) had the most impact or effect on TPACK (Koh, Chai & Tsai, 2011). Based on their study they found there to be little to no effect on TPACK in regards to content knowledge (CK) and pedagogical knowledge (PK). However, technological knowledge (TK) was found to have a positive influence on TPACK (Koh, Chai & Tsai, 2011). Technological knowledge (TK) was also found to have positive influences on TPK and TCK as well within the TPACK model. Thus, it appears that technology is possibly the most important factor in the TPACK model.

In a somewhat related study, Brantley-Dias and Ertmer (2013) conducted an extensive review of TPACK itself to try and educate others on how useful and appropriate it can be but also highlight how broad it is and how much is still unknown. They felt that TPACK as it is may be a bit too large or overwhelming to apply within a technology integration course. They point out that there really is no consistency of what technologies are utilized within various technology integration courses that could be associated with increasing TPACK within preservice teachers.

Herring, Thomas and Redmond (2014) conducted a review of climate of education based on the latest research and found that in order to be effective as a teacher education program, teacher education leaders must direct, lead and redesign their programs to embrace TPACK. This appears to be fundamental yet the formula for how to teach or help preservice teachers obtain these skills is still in question.

Methods

This study identified preservice teachers' knowledge of teaching and technology by utilizing a survey instrument that was adapted from the Technological Pedagogical Content

Knowledge (TPACK) model because of its reliability and validity. The internal consistency (alpha) ratings of the TPACK vary from .75 to .92 (Schmidt et al., 2010).

The survey utilized has been widely used to evaluate TPACK readiness within the educational technology community. It consists of the following areas: technology knowledge (TK), content knowledge (CT), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) and technology pedagogy and content knowledge (TPACK). The instrument is based on a 5-part pre/post survey (Schmidt et al., 2010). This study included students enrolled in both online and face-to-face formats.

Respondents were preservice teachers enrolled in a technology integration course within the teacher education program. The course involved the use of technology-based lesson plan writing to incorporate various Web 2.0 tools and technologies designed to help preservice teachers learn to integrate technology into their future classroom. Specific programs or tools included Promethean board, ActivInspire and Hyperstudio. Web 2.0 tools included, wiki, blogs, web-resources and apps. It also was designed to help teachers learn to use technology to improve standardized test scores. One of the main goals of the course was to teach students to learn to implement and integrate technology into their classroom to improve their students' acquisition of the content and blend it with their teaching philosophy. This is the foundation of TPACK. The face-to-face courses were taught in a traditional method but used Blackboard for informational purposes while the online courses were taught exclusively online through Blackboard. The same instructor taught the courses in the spring semester of 2015 at the same university. The face-to-face sections consisted of approximately 55-60 students while the online section will consist of approximately 20-25 students.

There were 73 total respondents to the survey. The 73 consisted of freshmen (26%), sophomores (46%), juniors (19%) and seniors (8%). There were more females (75%) than males (25%). They were from a variety of different area which consisted of: elementary (36%), middle school (7%), secondary (33%) and other (24%) which consists of agriculture, special education, health etc. Only 36% indicated that they had ever either observed or substituted in a regular classroom before, while 64% had not. Furthermore, only 24% had been admitted to the teacher education program at the time of the survey compared to 76% that had not yet been admitted.

The research survey consisted of a 5-point Likert scale with ordinal data not normally distributed, thus the Mann-Whitney U and Wilcoxon Rank Sum tests were used to analyze the pre and post survey data. Since the same group of participants took both the pre and post survey, the Wilcoxon rank sum test was used to determine if significant differences exist in pre and post survey results. The survey consisted of 50-60 items in which students identified their perceptions on technology-enhanced, learner centered instruction. The survey was based on a 5-Likert scale with the following responses: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree or 5 = strongly agree.

The hypothesis for the proposed study was that preservice teachers do not have any knowledge of TPACK or Web 2.0 tools prior to the technology integration course. Thus, they are not prepared to combine technology with pedagogy and content knowledge to substantially affect learning outcomes.

This research study sought to determine how much more prepared preservice teachers are to integrate Web 2.0 technology into their content after completing a technology integration course. It also investigated how prepared preservice teachers were to utilize technology in their content area and how prepared they felt to teach after completing a technology integration course. Lastly it sought to determine the degree to which preservice teachers understand how technology affects pedagogy.

Results

Seventy-three respondents took the pre-survey and 59 took the post-survey. Pre-surveys of those who did not complete either the pre or post surveys were not used to calculate significant differences between pre and post survey results. Of the 73 pre-survey results, only 59 completely answered the survey. Fifty-nine respondents completed the post-survey. Each respondent was assigned a numerical identifier so each pre and post survey could be correctly matched during analysis.

Each of the 32 Technological Pedagogical Content Knowledge (TPACK) questions was assigned a Likert scale value of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree or 5 = strongly agree. To determine if the results were normally distributed, a Shapiro-Wilk test of normality was conducted on all respondent's answers using SPSS statistical software (version 22). As expected, the Shapiro-Wilk tests yielded probability (p) values less than .05 for each question, indicating that the data set was not normally distributed. Clasen and Dormody (1994) indicate that Likert scale data is not normally distributed. Table 1 lists the Shapiro-Wilk values for each question.

Initially, two statistical tests were considered to test for significant differences between the students' pre and post surveys: *t*-test and Mann Whitney U-Wilcoxon Rank Sum (MWW). The results of the Shapiro-Wilk indicated that the respondent's answers were not normally distributed; therefore the use of the *t*-test was eliminated. The end result was to use the Mann Whitney U-Wilcoxon Rank Sum test. The Mann-Whitney U test is the non-parametric equivalent of the independent *t*-test, and is used to compare data collected in an experiment involving an independent groups design. The Wilcoxon test is the nonparametric equivalent of the paired *t*-test, and is used for data gathered in experiments involving repeated measures and matched pairs designs. This nonparametric test is used in preference to the equivalent *t*-tests when data are only of ordinal level of measurement or do not meet the other assumptions required for parametric tests. These combined tests (Mann-Whitney-Wilcoxon) were appropriate since the same group of participants took the same pre and post survey. Mann-Whitney-Wilcoxon has greater efficiency than the *t*-test on non-normal distributions, such as a mixture of normal distributions, and it is nearly as efficient as the *t*-test on normal distributions (Bergmann et al., 2000). SPSS software automatically combines the Mann-Whitney test with the Wilcox Rank Sum test during statistical analysis. Table 2 shows individual Mann-Whitney-Wilcoxon results for each pre and post survey question. P-values less than .05 indicate significant differences between respondents' pre and post survey responses.

The null hypothesis for this research study is that there will be no significant differences between the respondents' pre-survey and post-survey responses. The alternative hypothesis is that significant differences do exist between pre and post survey responses. Mann-Whitney-

Wilcoxon (MWW) probability (*p*) values less than .05 ($p < .05$) indicate significant differences between pre/post survey responses.

Table 1

Shapiro-Wilk tests of normality

Tests of Normality Shapiro-Wilk			
	Statistic	*df*	Sig.
TK – I know how to solve my own technical problems.	.883	109	.000
TK – I can learn technology easily.	.869	109	.000
TK- I keep up with important new technologies.	.825	109	.000
TK- I frequently play around with technology.	.799	109	.000
TK- I know about a lot of different technologies.	.868	109	.000
TK- I have the technical skills I need to use technology.	.847	109	.000
CK – I have sufficient knowledge of the content in my specialty area.	.848	109	.000
CK- Based on my specialty area, I can use a curriculum-based way of thinking.	.862	109	.000
CK- I have various ways and strategies of developing my understanding of my specialty area.	.847	109	.000
PK – I feel I know how to assess student performance in a classroom.	.868	109	.000
PK – I feel prepared to adapt my teaching based upon what students currently understand or do not understand.	.850	109	.000
PK – I feel I could adapt my teaching style to different learners.	.782	109	.000
PK- I feel I can use assess student learning in multiple ways.	.811	109	.000
PK – I feel I can use a wide range of teaching approaches in a classroom setting.	.841	109	.000
PK- I am familiar with common student understandings and misconceptions.	.871	109	.000
PK – I know how to organize and maintain classroom management.	.869	109	.000

PCK- I feel I can select effective teaching approaches to guide student thinking and learning in my specialty area.	.858	109	.000
TCK- I know about technologies that I can use understanding and learning my specialty area.	.863	109	.000
TPK – I feel I can choose technologies that enhance the teaching approaches for a lesson.	.869	109	.000
TPK – I feel I can choose technologies that enhance students' learning for a lesson.	.858	109	.000
TPK – My teacher education program technology course has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom	.841	109	.000
TPK – I am thinking critically about how to use technology in my classroom.	.820	109	.000
TPK – I feel I can adapt the use of the technologies that I am learning about to different things.	.831	109	.000
TPK – I feel I can select technologies to use in my future classroom that enhance what I teach, how I teach and what students learn.	.854	109	.000
TPK – I can use strategies that combine content, technologies and teaching approaches that I learned about in my technology course in my classroom.	.863	109	.000
TPK – I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my future school and/or district.	.846	109	.000
TPK I can choose technologies that enhance the content for a lesson.	.834	109	.000
TPACK – I can teach lesson that appropriately combine my specialty area, technologies and teaching approaches.	.857	109	.000
Models of TPACK (Faculty) – My specialty area education professors appropriately model combing content, technologies and teaching approaches in their teaching.	.838	109	.000
Models of TPACK (Faculty) – My technology integration professor(s) appropriately models combining content, technologies and teaching	.804	109	.000

approaches in their teaching.			
Models of TPACK (Faculty) – In general, approximately what percentage of your teacher education professors have provided an effective model of combining content, technologies and teaching approaches in their teaching?	.867	109	.000
Models of TPACK (Faculty) – In general, approximately what percentage of your professors outside teacher education have provided an effective model of combing content, technologies and teaching approaches in their teaching?	.907	109	.000
A significance (p) of .000 (p < 0.05) signifies that the data is not normally distributed. As a result, a t-test cannot be conducted on the survey data. The Mann-Whitney test, a non-parametric statistical test was used to analyze the survey data.			

Table 2

Mann-Whitney U and Wilcoxon Test Statistics (Grouping Variable: Pre or Post Survey

Grouping Variable: Pre or Post Survey	Mann-Whitney *U*	Wilcoxon *W*	Sig. *p*
TK (Technology Knowledge) – I know how to solve my own technical problems.	105.000	1816.000	.000
TK (Technology Knowledge) – I can learn technology easily.	103.000	1814.000	.000
TK (Technology Knowledge) - I keep up with important new technologies.	555.500	2766.000	.000
TK (Technology Knowledge) - I frequently play around with technology.	1388.000	2766.000	.516
TK (Technology Knowledge) - I know about a lot of different technologies.	567.000	1945.000	.000
TK (Technology Knowledge) - I have the technical skills I need to use technology.	1158.000	2536.000	.032
CK (Content Knowledge) – I have sufficient knowledge of the content in my specialty area.	981.000	2359.000	.001
CK (Content Knowledge) - Based on my specialty area, I can use a curriculum-based way of thinking.	976.000	2354.000	.001

CK (Content Knowledge) - I have various ways and strategies of developing my understanding of my specialty area.	809.500	2187.500	.000
PK (Pedagogical Knowledge) – I feel I know how to assess student performance in a classroom.	684.500	2062.500	.000
PK (Pedagogical Knowledge) – I feel prepared to adapt my teaching based upon what students currently understand or do not understand.	646.500	2024.500	.000
PK (Pedagogical Knowledge) – I feel I could adapt my teaching style to different learners.	924.500	2302.500	.000
PK (Pedagogical Knowledge) - I feel I can use assess student learning in multiple ways.	1002.000	2380.500	.001
PK (Pedagogical Knowledge) – I feel I can use a wide range of teaching approaches in a classroom setting.	1025.000	2403.000	.003
PK (Pedagogical Knowledge) - I am familiar with common student understandings and misconceptions.	649.500	2027.500	.000
PK (Pedagogical Knowledge) – I know how to organize and maintain classroom management.	770.000	2148.000	.000
PCK (Pedagogical Content Knowledge) - I feel I can select effective teaching approaches to guide student thinking and learning in my specialty area.	743.500	2121.500	.000
TCK (Technological Content Knowledge) - I know about technologies that I can use understanding and learning my specialty area.	854.500	2232.500	.000
TPK (Technological Pedagogical Knowledge) – I feel I can choose technologies that enhance the teaching approaches for a lesson.	817.500	2195.500	.000
TPK (Technological Pedagogical Knowledge) – I feel I can choose technologies that enhance students' learning for a lesson.	691.000	2069.000	.000

TPK (Technological Pedagogical Knowledge) – My teacher education program technology course has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom	884.000	2262.000	.000
TPK (Technological Pedagogical Knowledge) – I am thinking critically about how to use technology in my classroom.	976.500	2354.500	.001
TPK (Technological Pedagogical Knowledge) – I feel I can adapt the use of the technologies that I am learning about to different things.	863.500	2241.500	.000
TPK (Technological Pedagogical Knowledge) – I feel I can select technologies to use in my future classroom that enhance what I teach, how I teach and what students learn.	841.000	2219.000	.000
TPK (Technological Pedagogical Knowledge) – I can use strategies that combine content, technologies and teaching approaches that I learned about in my technology course in my classroom.	812.000	2190.000	.000
TPK (Technological Pedagogical Knowledge) – I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my future school and/or district.	844.500	2222.500	.000
TPK (Technological Pedagogical Knowledge) - I can choose technologies that enhance the content for a lesson.	912.000	2290.000	.000
TPACK (Technological Pedagogy and Content Knowledge) – I can teach lesson that appropriately combine my specialty area, technologies and teaching approaches.	742.500	2120.500	.000
Models of TPACK (Faculty) – My specialty area education professors appropriately model combing content, technologies and teaching approaches in their teaching.	788.000	2166.000	.000
Models of TPACK (Faculty) – My	987.000	2365.000	.001

technology integration professor(s) appropriately models combining content, technologies and teaching approaches in their teaching.			
Models of TPACK (Faculty) – In general, approximately what percentage of your teacher education professors have provided an effective model of combining content, technologies and teaching approaches in their teaching?	317.000	1695.000	.000
Models of TPACK (Faculty) – In general, approximately what percentage of your professors outside teacher education have provided an effective model of combing content, technologies and teaching approaches in their teaching?	433.500	1811.500	.000

α = 0.05

Discussion

According to Herring, Thomas and Redmond (2014), preservice teachers must have a concrete understanding of the TPACK model and how the various parts work in diverse settings in order to effectively benefit teaching with technology. Abbitt (2011), echoed this by saying that the TPACK model is crucial to the success of teacher preparation programs and more specifically in how technology helps create new possibilities.

As shown in the results section, this study found significant differences among all survey items except one, "*TK (Technology Knowledge) - I frequently play around with technology.*" The findings are significant to the field of technology integration. This indicates that the technology integration course, that was standards-based and utilized Web 2.0 tools, did indeed change various aspects of their technology and integration skills and how these things relate to their specific content areas significantly. As shown in the tables, there were five questions concerning their technology knowledge (TK) that changed significantly from the beginning to the end of the course. Based on the results, preservice teachers felt they could better solve their own technical problems and also could learn technology more easily. They also felt that after the course they also kept up with important new technologies more often. Furthermore, they also felt they know more about many different technologies and have the technical skills they need to use technology. These findings were consistent with other research that found that the perception of TK has a positive effect on TPACK (Koh, Chai & Tsai, 2011).

They also had significant differences in regards to every area of content knowledge (CK). For example, they now feel they have a sufficient knowledge of the content in their specialty area and they now can use a curriculum-based way of thinking. They also now feel they have various ways and strategies of developing their understanding of their specialty area. Significant gains in CK is important as research shows CK to be foundational in preservice teachers' understanding of TPACK overall (Chai, Koh & Tsai, 2010).

The results also showed their pedagogical knowledge (PK) was enhanced from the course. They no felt they could better assess student performance, better adapt their teaching to students understanding and also adapt their teaching style to different learners. They also indicated they better understood how to assess students in multiple ways, use a wide range of teaching approaches, and are better familiar with student understanding and misconceptions. Additionally they felt better prepared to organize and maintain classroom management. This too is a very important finding since research also shows PK to have the strongest impact on TPACK with regards to preservice teachers (Chai, Koh & Tsai, 2010).

When combining pedagogy and content knowledge (PCK), preservice teachers felt they could better select effective teaching approaches to guide their student thinking and learning in their specialty areas. There were many areas that were improved upon within the area of technological, pedagogical knowledge (TPK). For example, preservice teachers learned about the various technologies available and that can enhance their students' learning in their content areas. They felt the technology course helped them think deeper about how the technology will influence their teaching approaches. They now think critically about how to use technology in their classroom. They feel they can now better adapt the use of technologies and also select technologies that better enhance what they teach. They also now have a better understanding of strategies that combine content, technologies and teaching approaches that they learned in the course. They furthermore feel they now can provide leadership in helping others coordinate the use of content, technologies and teaching approaches at their future schools. All of these findings are very similar to that of other research that also found that using technology based approaches with preservice teachers does in fact enhance preservice teachers' perceptions of their abilities (Chai, Koh & Tsai, 2010). It furthermore supports other studies that also found that when using technology integration course preservice teachers also improved technology and pedagogical knowledge (Chai, Koh & Tsai, 2010). This is important as it also supports other research findings that TPK and TCK have significantly higher effects on TPACK than do TK and PK alone (Koh, Chai & Tsai, 2013).

The last area was combining all areas of technology, pedagogy and content knowledge (TPACK). After completing the course, preservice teachers indicated that they now could teach a lesson that appropriately combined their specialty area, technologies and teaching approaches. They felt their specialty area education professors and technology integration professor did appropriately model this for them which has been shown to be an important piece to properly learning to integrate (Adamy, & Boulmetis, 2006; Koch, 2009).

One major finding of this study is the fact that preservice teachers did indeed learn to use the Web 2.0 tools to better enhance their own specialty areas. They found many ways to integrate those tools within their own areas of emphasis. This is especially useful since a previous study found that many students lack the knowledge of how to relate the Web 2.0 tools to their own content areas (Kale, 2014).

Conclusion

As discussed previously, Schmidt et al. (2010) developed the TPACK assessment instrument utilized in this study. In their report they emphasized that the survey should be modified and used to evaluate preservice students' pre/post changes as they go through a technology integration course (Schmidt et al., 2010). This study did modify the survey slightly but did utilize it as it was designed to be used by evaluating pre/post survey results of preservice teachers. Chai, Koh and Tsai (2010) indicated that there is indeed a need to evaluate how a technology integration course can raise preservice teachers' TPACK, which supports this study as well. The fact that the design activities utilized in the technology integration course from this study helped support and raise TPACK among preservice teachers is supported in similar research (Koh & Divaharan, 2013).

This research expands previous research concerning the use of the TPACK model and also addresses future research recommendations of prior research in the area of TPACK. For example, Abbitt (2011) identified the need to better understand how technology fits into preservice teacher education as a suggestion for further research. This study addressed that by looking at how preservice teachers' technology and integration skills develop over time while enrolled in a Web 2.0 based technology integration course. This study also attempted to address the suggestions for future research given by Brantley-Dias and Ertmer (2013). They suggested that at the core, the goal of teacher education or technology integration should be to help preservice teachers identify what type of technologies best fit their content areas to best enhance learning of their students. This study looked specifically at preservice teachers' pre/post skills according the TPACK standards and to determine whether they are obtaining these skills throughout the course.

Other research supported these same ideas but also stated that preservice teachers' technology integration training must involve a deeper understanding of TPACK (Hofer & Grandgenett, 2012). This study also determined that the preservice teachers are indeed obtaining this understanding of TPACK as taught using Web 2.0 tools. The question is exactly what Web 2.0 tools are the most influential or most widely used. Kale (2014) found that the specific Web 2.0 tools used in either their program or placement schools are the ones they choose to use the most often. Kale (2014) also indicated that certain Web 2.0 tools such as 3D-Exploring tools, helped preservice teachers better understand the relationship between technology and pedagogy (TPK).

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