

**Technology Integration and Teacher Preparation:  
The Development of Teacher Educator Technology Competencies**

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**Abstract:** Preservice teachers should be better prepared to teach with technology from day one when they enter the profession (U.S. Department of Education, Office of Educational Technology, 2017). Teacher preparation curricula along with teacher educators' use of technology for teaching and learning, impact preservice teachers' use of technology in future practice. Yet, there is no cohesive set of technology competencies to guide teacher educators in developing their own knowledge, skills and attitudes around technology when working with preservice teachers. This article discusses the development of a common set of technology competencies that will guide teacher educators in teaching *with* and *about* technology.

## **Introduction**

The 2017 National Educational Technology Plan (NETP) focuses on closing the digital use gap by assuring technology is used to engage PK-12 students in “creative, productive, life-long learning” (U.S. Department of Education, Office of Educational Technology, 2017, p. 21). The plan identifies a related concern for colleges of education, that preservice teachers need to be better prepared to teach with technology “from day one” when they enter the profession. As noted in the plan:

Schools should be able to rely on teacher preparation programs to ensure that new teachers come to them prepared to use technology in meaningful ways. No new teacher exiting a preparation program should require remediation by his or her hiring school or district. (p. 35-36)

In a meta-analysis of studies related to preservice teacher preparation and technology integration conducted by Tondeur et al. (2012), 12 critical variables impacted preservice teachers’ use of technology in their practice including role modeling, aligning theory and practice, and providing opportunities for reflecting on attitudes about technology. If teacher educators are charged with the need to prepare preservice teachers to use technology effectively, then teacher educators responsible for this charge must establish curriculum for teaching with technology, serve as role models in the use of technology in teaching, and provide support to preservice teachers to develop their ability to teach with technology.

With this in mind, the NETP explicitly calls on all faculty involved in a preservice teacher’s preparation to address educational technology curriculum stating, “This expertise does not come through the completion of one educational technology course separate from other methods courses but through the inclusion of experiences with educational technology in all courses modeled by the faculty in teacher preparation programs” (p. 33). As a result, a list of competencies were developed to guide teacher educators in preparing teachers who will use technology effectively for teaching and learning.

## **Literature Review**

Although current technologies, the Internet, and digital tools offer many possibilities for PK-12 teachers and students, newer teachers tend to limit their use of technology to developing instructional materials and communicating with others (Ertmer, Ottenbreit-Leftwich, & York, 2006); and teachers, in general, tend to limit their use of technology to writing, creating spreadsheets, managing student data, and making presentations (Gray, Thomas, & Lewis, 2010). For the most part, preservice teachers enter preparation programs knowing how to operate their personal devices, but need support in learning how to integrate technology in ways that are powerful, yet meaningful (Dexter, 2006).

The multifaceted nature of teachers’ work makes the process of integrating technology a challenging task. Not only do teachers need to know how to operate new technologies, they also need to know how to align these technologies with their pedagogy and content. The Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) identifies three interrelated knowledge bases, each of equal relevance, required for masterfully teaching with technology: technological knowledge, pedagogical knowledge, and content knowledge (see Figure 1).

Koehler and Mishra (2008) contend that technology integration has often been driven by an unclear goal to find appropriate technological solutions to pedagogical problems. This

problem involves multiple factors, with few hard and fast rules that apply across contexts and cases. For this reason, learning to integrate technology has been deemed a “wicked problem” (Koehler & Mishra, 2008; Niess, 2008), and one that requires time and practice to master (Foulger, Buss, Wetzel & Lindsey, 2015), and high levels of engagement and support over extended periods of time (e.g., Fullan, 2016; Rogers, 2003).

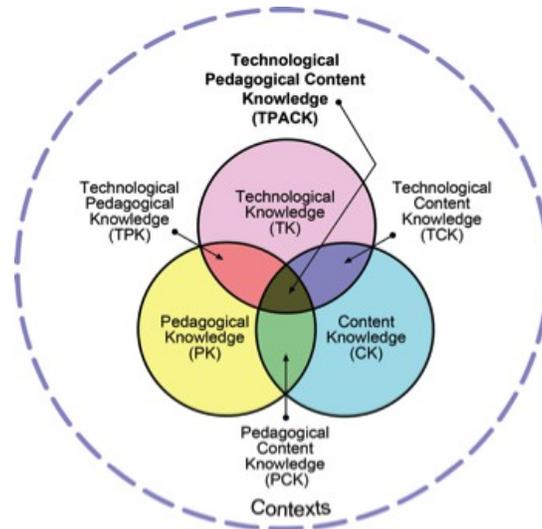


Figure 1. Technological Pedagogical Content Knowledge (TPACK) Framework. Reproduced by permission of the publisher, © 2012 by tpack.org

Circa 1999, the Preparing Tomorrow’s Teachers to Use Technology (PT3) grants afforded some 400 colleges of education the stimulus to provide faculty development in this area. This seminal effort was successful in restructuring courses in teacher preparation to include the use of technology, in changing policy related to certification, and in establishing collaborations across universities dedicated to developing and sharing resources and training materials (U.S. Department of Education, 2006). In more recent years, the original PT3 efforts have morphed into a variety of formulas in teacher preparation for addressing technology integration curriculum.

Some colleges of education address technology integration with their preservice teachers by providing a stand-alone educational technology course, taught by experts in educational technology (Kleiner, Thomas, Lewis & Greene, 2007; Lambert & Gong, 2010). But, evidence suggests that a one-shot approach, taught by educational technology faculty, may not provide an adequate opportunity to develop this aspect of a teacher’s practice (Kleiner, Thomas, Lewis & Greene, 2007; Lambert & Gong, 2010). In fact, research by Niess, Sadri, and Lee (2007) demonstrates that teaching with technology takes place in stages and is a developmental process, as an extension to Rogers’ work stemming from 1962 on a process individuals go through as they decide to adopt or reject an innovation (2003). This understanding has shifted some colleges toward a programmatic approach where technology is integrated across the curriculum (Doering, Hughes, & Huffman, 2003; Wetzel, Foulger, Buss & Lindsey, 2014). Teacher educators who facilitate hands-on activities in a collaborative and safe environment improve preservice teachers’ efficacy toward using technology and their interest in increasing their own technology use in classrooms even in environments where technology access is limited (Rosenfeld, 2008).

In addition to the *quantity* of experiences that might be provided by a programmatic, technology infusion model, the *quality* of technology experiences in courses has shown to play a critical role in shaping new teachers' use of technology in their practice (e.g., Tondeur, et al., 2012). A concern with the technology infusion model involves teacher educators who have content expertise (e.g., math methods), and see the infusion of technology as an additional and possibly separate curriculum in their course, in which case they have shown to be resistant. Their struggles stem from being underexposed to technology tools that support their curricular area, lack of technology literacy skills, and/or confidence in their ability to use technology and to support their students' use of technology (Buss, Wetzel, Foulger & Lindsey, 2015).

This research study answers the call from NETP for those involved in teacher preparation to develop a common set of technology competencies for faculty who support preservice teachers. The purpose of this article is to describe the development of a common set of technology competencies that will guide teacher educators in teaching *with* and *about* technology.

### Methods

Crowdsourcing and the Delphi method were used in this study with the goal of identifying technology competencies for teacher educators. Crowdsourcing involves “outsourcing” a task to a group of people in the form of an open call. The process allows for many individuals to participate in knowledge generation, and to participate based on their varied expertise and experience. The product of a crowdsourcing process is oftentimes shared freely, and has strong agreement due to the participation of many (Morris & McDuff, 2015).

A call for literature was sent out through social networks (e.g., LinkedIn, Twitter) and teacher educator networks that were available to the research team, which consisted of four educational technology faculty from various universities. Ninety-three articles were collected and uploaded to a web-based portal. Of the 93, 43 articles were deemed useful in identifying possible competencies. Each researcher was assigned 18-19 articles from which to identify and compile a master list of competencies. When writing the competencies, each researcher referred to a prepared checklist that included 11 evaluation criteria for writing an effective competency statement. The initial list of competencies was constructed by having each researcher write the competency, list any criteria aligned with the competency, and cite the article(s) from which the information was extracted. A list of 24 competencies were generated after the initial extensive review of literature.

To identify participants for the component of the study using the Delphi method, the research team developed a “Request to be a Delphi Participant” application, and emailed it to the International Society for Technology in Education (ISTE) and the Society for Information Technology and Teacher Education (SITE) listservs. The Delphi method involves experts who are carefully selected to provide their opinions on ideas (Skulmoski, Hartman, & Krahn, 2007). The process is iterative in order to build a reliable consensus, determine suitability, and ultimately yield consensus (Linstone & Turoff, 2002). The Delphi application was a virtual form that included demographic questions and additional questions related to three qualification criteria: 1) Expertise (e.g., Do you have expertise related to teaching with technology in teacher preparation?); 2) Impact (e.g., Do you have products and synergistic activities that have benefitted the field of educational technology in teacher preparation?); and 3) Availability (e.g., Are you available to participate in multiple rounds of the Delphi process?).

Initially, 44 participants applied to be part of the Delphi study. A list of variables (i.e., country, grade level, subject, size of university/college, professional affiliation, online/hybrid

teaching experience, professional development in teacher preparation experience) were created and used to select a diverse group of Delphi participants. In the end, 18 participants were selected for the study. Of those 18 participants, 17 committed to participate in the study and signed the IRB consent agreement.

The 17 participants received an email about the Delphi methodology and their involvement in the study. It was made clear to them that round one was the first of several rounds (3-6), whereby they would be asked to provide expert opinion on the technology competencies. The email explained that each round would end with the research team synthesizing the input from all participants to create an updated version of the competencies for use in the next round. Participants were also informed that through several rounds there would be close agreement on the final list of competencies.

Round one of the Delphi process focused on the competency level. It included four questions used to evaluate each of the 24 competencies, and included both quantitative and qualitative measures.

1. Which of the following needs does this competency address?
2. How well written is this competency?
3. To what extent is this competency important for teacher educators who support preservice teachers as they learn to integrate technology?
4. How would you rewrite or revise this competency to better address the knowledge, skills, and attitudes required of teacher educators who support preservice teachers in learning how to teach with technology?

For all rounds of the Delphi process, participants were asked to submit their responses through a Google Form and were given approximately a two-week deadline for each round. Of the 17 initial participants, 16 provided responses during round one.

In between round one and round two of the Delphi process, the research team met with educational leaders at the National Technology Leadership Summit (NTLS) in Washington, D.C. This group consists of presidents and leaders from educational content associations such as the Association for Science Teacher Education (ASTE), College and University Faculty Assembly (CUFA) of the National Council for Social Studies (NCSS), the Conference on English Education (CEE) of the National Council of Teachers of English (NCTE), as well as representatives from the Association of American Colleges of Teacher Education (AACTE), the International Society of Technology Education Teacher Education Network (ISTE-TEN), and the Society for Information Technology and Teacher Education (SITE). NTLS attendees were presented with a draft copy of the competencies based on round one feedback from Delphi participants. They were asked to consider:

1. How can the competencies be improved to meet the needs of their constituencies?
2. What competencies are missing?
3. How could the competencies be combined and grouped?
4. What advice would you give to the Delphi participants?
5. How can you and your organization support the competencies?

The overall result of these discussions was very positive. Attendees supported the project and methodology being used to create the competencies. This group experienced the same difficulty as many of the Delphi participants, that is, remembering that the competencies will be designed for teacher education faculty members and not outcomes for teacher education candidates. The discussions at NTLS helped to inform round two of the Delphi process.

During round two of the Delphi process, participants were reminded that the competencies are for teacher educators in a broad sense, not just those housed in traditional colleges of education, and that the competencies should represent all aspects of TPACK. Participants were asked to think about what makes the competencies unique from other standards such as those from ISTE, and to think of the competencies not as individual items but under a larger structure and how they could be nested as categories-competencies-criteria.

The questions for round two of the Delphi process asked:

1. To what extent is this competency important for all faculty in teacher education?
2. Should this competency be modified to make it more applicable to all faculty in teacher education? If yes, explain.
3. Should this competency be combined with one or more other competencies? If so, which one(s)?
4. If you suggested combining this competency with another/others, please write a competency that represents this suggestion.
5. After reading all the competencies, what other competencies for faculty in teacher education are missing?

Round two of the Delphi process allowed participants to combine duplicate ideas/competencies and add new competencies to the list that did not show up in the literature. Nine of the original competencies from round two remained as is, while 15 of the competencies were combined as seven, and three new competencies were added. Of the 17 initial participants, 16 provided responses during round two.

As round three of the Delphi process began, 19 competencies carried over from round two. Round three was similar to round two in that participants were asked to examine the combined and new competencies. The questions for round three of the Delphi process asked:

1. To what extent is this competency important for all faculty in teacher education?
2. Should this competency be combined with one or more other competencies? If so, which one(s)?
3. If you suggested combining this competency with another/others, please write a competency that represents this suggestion.

Of the 17 initial participants, 15 provided responses during round three.

At the beginning of round four, participants were asked to position their thoughts in teaching at the higher education level, and in how competencies and criteria for faculty might support preservice teachers' development of TPACK. Participants were reminded of our working definition of a competency, and were reminded on how the final list of competencies will be different from K-12 ISTE standards.

We also shared with participants that the research team was invited to participate in the U.S. Department of Education, Office of Technology Summit for Innovation in Higher Education. The competencies were presented at the symposium. Teacher educators from across the nation were present. Our goal was to stimulate a national conversation about how the 2017 National Educational Technology Plan and the teacher educator technology competencies can provide guidance to higher education faculty who promote technology integration.

In round four of the Delphi process, participants were asked to provide feedback on the criteria for each competency that emerged from round three. After combining several competencies and adding new ones in round three, 13 competencies were identified for round four. The research team mapped these competencies back to the round one literature, which had associated criteria. Participants were asked to analyze the criteria from the literature for fit, and

to provide expert opinions on criteria that were missing from each competency. A list of components on how to write well-written criteria was provided to participants.

The questions for round four of the Delphi process asked:

1. The following criteria for this competency were gleaned from the literature review that informed this competency. Of those criteria, in your opinion which one(s) are a good fit for this competency?
2. List additional criteria needed in order to develop this competency for all faculty who support preservice teachers.

Of the 17 initial participants, 14 provided responses during round four.

During round five of the Delphi process, the research team noticed there were overlap and redundancies between some of the competencies. As the research team made edits to the competencies and criteria based on feedback from the participants, we were able to merge one competency with another competency, which left us with 12 competencies for round five. Round five was an opportunity for participants to reexamine the revisions to the criteria for each competency. Participants were asked to review the criteria resulting from round four, suggest edits to the criteria, and note any additional criteria that were needed in order to complete the list of knowledge, skills, and behaviors for teacher educators within that competency.

The questions for round five of the Delphi process asked:

1. The following criteria were compiled based on the Delphi participant suggestions for edits and additions during the round four survey. Of the revised criteria listed below, in your opinion which one(s) are a good fit for this competency?
2. Of the criteria you marked above, please provide any slight edits that will help the criteria better apply to this competency.
3. List any additional criteria needed in order to develop this competency for all faculty who support preservice teachers.

Of the 17 initial participants, 15 provided responses during round five. To date, five rounds of the Delphi study have been administered.

### **Data Analysis**

Data from round one of the Delphi survey were analyzed by the research team to improve how the competencies were written. First, team members were assigned to analyze data on each competency. At least two team members analyzed the responses for each competency. The assigned competencies were staggered to assure it was not always the same two team members reviewing a competency. The first review of the data was quantitative. Two Likert-style questions were converted to values, with five being highest and one being lowest, and the mean and range was calculated for each question. The mean and range were held as comparison points with round two of the Delphi process to determine if the competency, when rewritten, is still deemed as important to the experts.

The question, "Is the competency well written?," prompted further actions by the research team. If the competency had a mean response of 2.99 or lower the research team examined the suggested revisions by the Delphi participants. Since two members of the research team were assigned to each competency, two revisions were suggested. The research team then met as a group to discuss the suggested revisions for each competency and agreed on revisions. If the analysis of question two yielded a mean of 3.0 or higher, the reviewers had the option of deciding if revisions were needed to the competency based on the suggestions from the Delphi participants. If revisions were suggested, the research team discussed them before being accepted.

Analysis of round two of the data followed some of the same procedures as round one. The answers to the question about the importance of the competency were converted from the Likert answers to numerical data with five being the highest and one the lowest. Competencies with means of 2.99 or lower were again edited as suggested by the Delphi participants. This round also asked the Delphi participants to identify competencies that should be combined.

To evaluate this data, a chart was constructed with all the competencies listed across the top and side (see Figure 1). Tally marks recorded for each instance of a suggestion of competencies to be combined. These were then coded green, yellow, red or not applicable. Green code indicated a combination was suggested at least four times and it was the highest combination suggested for that competency. Yellow code indicated a combination was suggested at least four times and it was the second most suggested combination for a competency. Red code indicated a combination was suggested at least four times and it was the third most suggested combination for a competency.

The competencies that were suggested for combination both ways at least at the red level were examined by the research group to be combined. With this process, 17 competencies were combined to seven (some were combined more than once). Lastly, suggestions for additional competencies by the Delphi participants were examined for themes to determine if additional competencies were needed. One additional competency was added.

Competen	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1		xxxx	xxx		xxx	xxxx	xxxx	xxxx	xxx	xx	xx	xxx	xx	xx	xxx	xx	xx	x	xx		x	xx	x	
2	xx		xx	x	xx	xxxx	xxxx	xxxx	xx	xx	xxxxxx	x	xxxx	xxx	xxx	xx	xx	xxxx	xxx	x	x	xx	xx	xxx
3	xx	x		x	x		x	xxx		x	x	x		xxx	x	xx	x	xxx	x	x	xx	xx	x	xxx
4	xx	xx			xxxx	xx	x	x		x	x	x	xx	x	xxx	x	xxxx	xxxxxxx		x	xx	xx	x	xxx
5	x	xx	x	xxx		x	x	x	x		xxxxxxx	xxx	x	x		x	x			x	x	x	x	x
6	xxxx	xxx	x	xxx	xxxx		xxxxxxxx	xxx	xx	xxx	xxxx	xx	xx	x	x	x	x	xx	xxx	xxx	x	x	x	x
7	x	xxxxxx	x	xx	xx	x		x	x	xxx	xxxx	xxx	xxx	x	x	x	xx	xxx	x	xx	xx	x	xx	xx
8	xxxx	xxxxxxxx	x	xxx	xxx	xxxx	xxxx	xxxx	x	xxx	xxxx	xxx	xxx	xxx	xxx	x	x	x	xxx	xxx	x	x	xx	xx
9	xxx	x	x	x	x	x	x	xx	x	xx	xx	xxx	xxx	xxx	xxxx	x	xx	xx	x	xx	x	xx	xx	xxx
10	xx	x	x	xxx	xxx	xxxxxx	xxx	xxx		x	x	x	xx	x	xxx	x	x	xx	x	xx	x	xx	x	xxx
11	xx	xxxxxx	xxx	xxx	xx	xxxx	xxxxxx	xxxx	xx	xxx	xxx	xxx	xxx	xxxx	xxx	x	xxx	x	xxx	x	xxx	x	x	x
12	xx	xxx	x	xx	xxxxxxxx	x		x	x	xxx	xxx	xx	x	x	xx	x	xx		xx	x	xxx	xx	xx	x
13	xx	xxxx	x	x	x		xx	xx	xxx		xxx	xxx	x	xxx								xx	x	xx
14	xxx	xxxx	xx		x	xx	xx	xx	xx	xxxx	xxx	xxx	xxx	x	x	x	x	x	xx		x	x	x	x
15	x	xx	x	x		x	x	xx	xxxx		x	xxx	xxxx	xxx					x					x
16	x		x	x	x		x	x		x	x	xx	x	xx		x	xx							x
17	x	x	x	x	x		xx	x	x		x	x					x			x	x	xx	xxxx	xxx
18	xx	xxx	x	xxxx	xx		xx	xx		xxx	x	x	x	xx			x		x	x	x	xx	xx	xx
19	xxxx	xx	x	x		x		x		x	x	x						x				xx	x	xx
20	xxx	xxxx	xx	x	x		x	xx		xxx	x	x	x					x	x		x	xx	x	x
21	x	xx								x	x	x	x			x	x	x		x		x	xxx	xx
22	x	x	x	x		x	x	x		x	x	x										x	x	x
23	x	x	x	x		xx	x	x		x	x						xxxxxx	x	x	x	x	xx	xx	xxx
24	x	xx		x	x		x	x	x		x		xx		x		xxx	xx		x	x	xxx	xxxx	xxx

Figure 1. Round 2 coded combination suggestions

Round three of the Delphi process sought to seek consensus on the competencies. Once again the question about the importance of the competency was converted to numerical data, and the means were calculated. The participants were asked which competencies should be combined and they were coded similar to round two (see Figure 2). Based on the suggestions from participants, 17 competencies were combined to eight (some were combined more than once). Delphi participants were asked once again if there were any missing competencies. On this round, no patterns emerged indicating the need to write an additional competency.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1		x	x	xx	xxxx	xxx				xxx			xxxxx	xxxx		x	x		
2						x					xx		x	x	x		xxxx		
3	xx			xxx	x	xx		x	x	x			xxxxxxx	x		xx	x		x
4	x		x				x			x	x	xx	x	x	x	x			xxx
5	xxxxx							x		x	x		x	x	x	x			
6		x								x	x		xx	x	xxx		x	x	
7				x				x					x			xx		x	xxxxxx
8	xx			x	xx	x			x		x	xx						xx	x
9	x									xxxx	xx	x		xx	x	xxxx		x	
10									x		xxx	xxx	xxx	xxxx	xxxx	xxxx	xx		
11									xxx	xxxx	xxx	xxxxx	xx	xxx	xxx	x	x		
12									x	xxx	xxxx		xx	xx	x				x
13	xxxx		x								xx	xx		xxxx	xxxx	x	x		
14	xx				x				xxxx	xxxxxxx	xxxx	xxxx	xxxx	xxxx	xxxx		x		
15	x		xx			x			x	xx	xxx	xx	xxxx	xxxx					
16							xx			xxxx									xxx
17		xxxx	x	xx							x	x	x	x	xx			x	
18								xx										x	
19				x			xxxxx		x							x	x	x	

Figure 2. Round 3 coded combination suggestions.

Round four data analysis involved developing criteria based on the agreed upon competencies. In this case, the Delphi participants were asked which of the criteria originally identified from the literature were appropriate for the new revised and combined competencies. The analysis of this question entailed tallying all of the criteria suggested as still relevant. If three fourths of the Delphi participants agreed on the criteria, it was kept. Participants were also asked to suggest additional criteria that may be appropriate. The research team looked for patterns in the suggestions and added criteria as necessary. During this process, it became apparent two of the competencies had similar criteria that needed to be combined. This combination of the two competencies and their associated criteria resulted in 12 competencies and criteria moving forward. To date, data analysis on four rounds of data are complete.

### Next Steps and Significance of the Study

We are seeking input from SITE conference attendees on the usability of the competencies. We anticipate publishing a final list of the competencies and criteria soon. The final Teacher Educator Technology Competencies (TETCs) are available via the project web site at <http://teacheredtechcompetencies.net>. Establishing a set of clear and useful competencies that apply to all teacher educators, regardless of their content focus, will help colleges of education move forward in the effort to develop preservice teachers' ability to teach with technology. We envision the competencies to be used as the basis for colleges of education to more systematically address technology integration curriculum throughout a program, for faculty goal setting and professional development, and as a basis for credentialing decisions (Foulger, Graziano, Slykhuis, Schmidt-Crawford, & Trust, 2016).

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