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Editor-Invited Article
Teacher Educator Technology Competencies

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The U.S. National Educational Technology Plan recommends the need to have a common set of technology competencies specifically for teacher educators who prepare teacher candidates to teach with technology (U.S. Department of Education, Office of Educational Technology, 2017). This study facilitated the co-creation of the Teacher Educator Technology Competencies (TETCs). The TETCs define the competencies (knowledge, skills, and attitudes) *all* teacher educators need in order to support teacher candidates as they prepare to become technology-using teachers. The TETCs shed light on the roles and responsibilities of teacher educators who address technology within their courses. A highly collaborative research approach was used to develop the TETCs which involved the crowdsourcing of technology-related literature, a Delphi method for expert feedback, and an open call for public comment. As a result, 12 competencies with related criteria were identified. The TETCs should be viewed as a first step in a larger reform effort to better address technology integration in teacher preparation programs. The release of the TETCs provides future research opportunities including, but not limited to, implications for course design, relevant faculty development for teacher educators, and policy implications.

Keywords: crowdsourcing, Delphi method, teacher preparation, teacher educators, technology integration, teacher educator technology competencies, TETCs

[1] The first author served as project facilitator. All authors contributed equally to the research and writing process.

Note from the Editor-in-Chief

The main role of most peer-reviewed journals is to publish empirical and theoretical manuscripts related to its driving mission. A second, but equally important goal is to promote conversations around critical topics in the field. Naturally with the Journal of Technology and Teacher Education (JTATE), these goals often blend with the publication of the aforementioned manuscripts. In other cases, however, ideas and questions are raised regarding technology and teacher education that do not necessarily match manuscripts waiting to be published. The editor then has both the luxury and the responsibility to work with the Editorial Review Board and International Advisory Board to raise awareness of the questions and needs in the field (often leading to future publications on the topic). The Editor typically responds with editorials, calls for special issues, and/or editor-invited commentaries and articles.

Teacher educator technology competencies is one such topic that I believe deserves attention. To clarify and to state the obvious, this introduction is not to suggest that the field should immediately adopt competencies and/or adopt the competencies addressed in this article. The point, rather, is that teacher educator technology competencies is a topic of which the field should become keenly aware and energetically knowledgeable. When policymakers, practitioners, researchers, and educators hear about the issue, they should be able to join in an existing and rich conversation held by researchers using this journal medium. They should be able to seek and find answers to such questions as:

- What are competencies?
- What are the best methods for creating competencies?
- Should we adopt teacher educator technology competencies?
- What would these competencies look like in practice?
- How would these competencies translate to specific domains (i.e. content specialties) and existing competencies or standards those agencies and organizations might already recommend?
- Who will be responsible for monitoring the competencies?
- What research backs or refutes proposed competencies?
- What will be the process for reviewing and revising these competencies?
- How can we ensure such competencies will lead to change and/or high-quality instruction?

With any new idea, there are more questions than answers. We as a field can hesitate and wait for some other discipline to provide answers, or we can begin the experiment. My goal as Editor-in-Chief is to always strive to have the field use JTATE and our sibling journals as a forum for a vibrant exchange of cutting-edge ideas. Given that desire, Teresa, Kevin, Denise, and David initiated multiple meetings with me throughout the last few years to explore how to use JTATE as a forum to discuss this emerging issue. The first step was a commentary where they masterfully introduced the topic with its history, current context, and future needs (see JTATE 24:3; Foulger, Graziano, Slykhuis, and Schmidt-Crawford, 2016). The second step was this article. The authors submitted the manuscript and I, along with a few editorial board members, provided difficult questions for the authors (many of them in the list above). The resulting discussions across email, phone, and face-to-face conference meetings--and obviously their hard work in rewriting--resulted in this interesting, thought-provoking, and research-based article.

There is a third step. This process began with traditional peer review. After consultation with editorial review board members, I decided to bypass the traditional peer-review process and offer to publish this as an editor-invited article in order to expedite publication and get this information in front of readers. Now that we have this common ground, you, too, have the opportunity to ask and answer some of the same challenging questions we asked the authors. As a famous author once told me, 'I don't care if you agree or disagree with me, but I do care if you don't know enough to pick a side.' Whether you love the idea of competencies or have a different solution, we owe it to the field to have strong, research-based answers as to what works, what doesn't work, and how that will and should impact our current and future practice.

Respectfully, Richard E. Ferdig, JTATE Editor-in-Chief

Teacher Educator Technology Competencies

> *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... 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.* (U.S. Department of Education, Office of Educational Technology, 2017, p. 35-36)

Currently, in the majority of teacher preparation programs, a semester-long course is the approach used to help teacher candidates learn how to teach with technology, with the stand-alone technology integration course being the most prominent method (Gronseth et al., 2010; Kleiner, Thomas, & Lewis, 2007). However, when technology integration is taught as a subject matter in and of itself, alignment to content such as science, mathematics, literacy, or social studies is lacking, and technology often drives the curriculum (Foulger, Buss, Wetzel, & Lindsey, 2012). This is contrary to the idea of "integration." Additionally, the singular semester-long course approach is often misaligned with research which suggests a critical factor influencing new teachers' use of technology in classrooms relies both on the quality and quantity of technology experiences they encounter throughout their teacher preparation programs (Agyei & Voogt, 2011; Drent & Meelissen, 2008; Kay, 2006; Polly, Mims, Sheperd, & Inan, 2010). The ultimate goal for teacher preparation programs should be a technology infused program that provides a more concerted effort to address teaching with technology throughout the curriculum.

Some universities and colleges have implemented an alternative approach by addressing technology use and integration within subject-specific methodology courses (Dexter, Doering, & Riedel, 2006; Kisicki, 2012). Although this approach better addresses the need to teach about technology integration within the context of content specific curriculum, it still has limitations to the number of opportunities that teacher candidates have for teaching with technology in classrooms. Clearly, there is no "one-size-fits-all" approach for preparing teacher candidates to teach with technology. Teacher educators have often fallen short in their efforts to plan, model, and implement the right combination of technology experiences across the entire scope of a teacher preparation program. As the National Educational Technology Plan acknowledges:

> Teachers need to leave their teacher preparation programs with a solid understanding of how to use technology to support learning. Effective use of technology is not an optional add-on or a skill that we simply can expect teachers to pick up once they get into the classroom. Teachers need to know how to use technology to realize each state's learning standards from day one. (U.S. Department of Education, Office of Educational Technology, 2017, p. 35)

Underscoring this, beginning teachers continue to report feeling ill-prepared to use technology effectively when they enter classrooms (Sang, Valcke, van Braak, & Tondeur, 2010; Tearle & Golder, 2008). A key component that remains constant for effectively preparing teacher candidates to use technology is the involvement and influence of the teacher educator (Kay, 2006). A teacher educator is referred to as "someone [within institutions of teacher education] who provides instruction or who gives guidance and support to student teachers [teacher candidates], and who thus renders a substantial contribution to the development of students [teacher candidates] into competent teachers." (Koster, Brekelmans, Korthagen, & Wubbels, 2005, p. 157). Today's teacher educators must establish new roles for themselves and be held accountable for providing all teacher candidates with equitable, high-quality technology experiences in the courses they teach and the field experiences they supervise. However, teacher educators typically lack the necessary knowledge and skills needed to effectively model technology use and integration for teacher candidates (Goktas, Yildirim, & Yildirim, 2009; Tondeur et al., 2012).

The National Education Technology Plan boldly calls upon teacher preparation programs to rethink how teacher educators are using technology to transform learning while preparing new teachers for future classrooms. Specifically, the plan recommends for those in teacher preparation to "develop a common set of technology competency expectations for university professors and candidates exiting teacher preparation programs for teaching in technologically enabled schools and postsecondary education institutions" (U.S. Department of Education, Office of Educational Technology, 2017, p. 40). As teacher educators who are experts in teaching with technology themselves, the authors of this study, herein referred to as the research team, viewed this charge as merely a first step in a larger reform effort, with the intention to heighten awareness as to the changing roles and responsibilities of *all* teacher educators.

The purpose of this study was to develop a set of teacher educator technology competencies (TETCs) that comprise the knowledge, skills, and attitudes *all* teacher educators need in order to best support teacher candidates as they become technology-using teachers. The research question guiding the study was: What knowledge, skills, and attitudes do teacher educators need to support teacher candidates as they learn to teach with technology? Results from the study identified 12 competencies with related criteria for *all* teacher educators.

LITERATURE REVIEW

This literature review provides a brief summary of technology and teacher education research, with emphasis around the conceptual framework of Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006), as it relates to teacher educators and teacher preparation. A discussion of the professional standards and guidelines impacting teacher education, as well as technology standards situated within content area organizations follows.

Technology and Teacher Education

Researchers in teacher education continue to state that teacher candidates are ill-prepared to teach with technology when they enter classrooms (Angeli & Valanides, 2009; Ertmer & Ottenbreit-Leftwich, 2010; Kay, 2006; Sang et al., 2010; Tondeur, Roblin, van Braak, Fisser, & Voogt, 2013), and that teacher candidates graduate from preparation programs with little or no knowledge about how to use technology to facilitate PK-12 student learning (Angeli & Valanides, 2009; Ertmer & Ottenbreit-Leftwich, 2010). Teacher candidates are often required to design technology-based lessons in their coursework, but very few actually teach those lessons in classrooms with students (Voogt, Fisser, Roblin, Tondeur, & van Braak, 2012). Moreover, technology-rich field experiences where teacher candidates work side-by-side with experienced technology-using teachers in classrooms are difficult to find and support (Polly et al., 2010).

For the past 10 years, researchers in teacher education have used the conceptual framework of Technological Pedagogical Content Knowledge (TPACK) to guide their understanding of the knowledge teachers require to effectively teach with technology (Mishra & Koehler, 2006). Results reported from this large body of research (e.g., http://tpack.org) conclude that teacher preparation programs should foster the development of teachers' TPACK throughout an entire preparation program, and especially in content-specific courses (Polly et al., 2010; Tondeur et al., 2013; Voogt et al., 2012; Wetzel, Buss, Foulger, & Lindsey, 2014). In fact, specific instructional models have been designed around the TPACK framework to assist content-area teachers while planning instruction (Hammond & Manfra, 2009; Harris & Hofer, 2009; Hutchison & Colwell, 2015; Niess, 2011; Shettel & Bower, 2013). While the vision seems clear, teacher educators typically lack the necessary technology skills (i.e., TPACK) needed to effectively integrate technology into the curriculum they teach (Borthwick & Hansen, 2017; Tondeur et al., 2013). In general, teacher educators must model appropriate technology integration strategies for teacher candidates in courses, so the candidates in turn can effectively teach with technology in PK-12 classrooms (Goktas et al., 2009; Tondeur et al., 2012).

Most teacher educators need additional support structures to assist them with technology integration efforts (Barton & Haydn, 2006; Goktas et al., 2009; Polly et al., 2010; Thompson, Schmidt, & Davis, 2003). Others conclude that teacher educators need more professional development that focuses specifically on TPACK and its relevance to content area learning (Kay, 2006; Tondeur et al., 2013). The fact is, teacher educators who choose to address TPACK in their courses require varied levels of support in an ongoing manner to assist them in making this major transformation to their teaching (Foulger, Buss, Wetzel, & Lindsey, 2015; Wetzel et al., 2014). Yet, it is extremely difficult to determine exactly what teacher educators need to know related to technology, and then design and guide professional development efforts to assist them (Borthwick & Hansen, 2017). An examination of the professional standards impacting teacher education and the role technology plays within those standards might shed insight on this complex task.

Role of Standards in Teacher Education

In the United States, most teacher preparation programs align their program standards to either the set of Model Core Teacher Standards offered by the Chief State School Officers (CCSSO) in collaboration with its Interstate Teacher Assessment and Support Consortium (InTASC), or to the standards aligned with educator preparation accreditation from the Council for the Accreditation of Educator Preparation (CAEP). Teacher preparation programs in the U.S. follow a rigorous accreditation process that requires external peer review to guarantee quality assurance. The 10 InTASC standards are grouped into four categories (i.e., Learner and Learning, Content, Instructional Practice, Professional Responsibility) and "outline the common principles and foundations of teaching practice that cut across all subject areas and grade levels" (Council of Chief State School Officers, 2011, p. 3) for which teachers should be prepared to know and apply in PK-12 classrooms and learning contexts. The five CAEP standards focus specifically on educator preparation accreditation and a program's ability to address: 1) candidate content and pedagogical knowledge, 2) clinical partnerships and practices, 3) candidate quality, recruitment and selectivity, 4) program impact, and 5) quality assurance (Council for the Accreditation of Educator Preparation, 2016). Both sets of standards hold teacher educators accountable for preparing teacher candidates who acquire the knowledge and skills necessary to ensure the academic and social development of PK-12 students.

The InTASC and CAEP standards both make reference throughout their requirements that teacher candidates must be prepared to use and integrate technology within teaching and learning. For example, CAEP's Standard 1 focuses on a candidate's development of content and pedagogical knowledge. Provider responsibilities (i.e., teacher preparation programs) listed for Standard 1 include ensuring that candidates "model and apply technology standards as they design, implement and assess learning experiences to engage students and improve learning; and enrich professional practice" (Council for the Accreditation of Educator Preparation, 2016, ¶ 5). Technology is also included in CAEP's Standard 2 which details the need for providing effective clinical partnerships and practice experiences for teacher candidates. Such phrases as "technology-based collaborations," "appropriate technology-based applications", and "technology-enhanced learning opportunities" (Council for the Accreditation of Educator Preparation, 2016, ¶ 2) are found throughout Standard 2, and illustrate the emphasis CAEP places on the key role technology plays in the preparation of future teachers.

Technology is also mentioned frequently in the InTASC Standards. The InTASC Content Standards state (Council of Chief State School Officers, 2011), "Today's teachers make content knowledge accessible to learners by using multiple means of communication, including digital media and information technology" (p. 8), while the InTASC Instructional Practice Standard states that instructional planning should incorporate a variety of instructional strategies and "...incorporate new technologies to maximize and individualize learning" (p. 9). Program standards, like InTASC and CAEP, play a critical role in outlining what teacher candidates need to know and be able to do as a result of completing their teacher preparation programs. As such, CAEP asks teacher preparation institutions seeking endorsement to "present multiple forms of evidence to indicate candidates' developing content knowledge, pedagogical content knowledge, pedagogical skills, and the integration of technology in all these domains" (Council of Chief State School Officers, 2011, p. 9). Many teacher educators also rely on specific content area standards to guide the content they teach and the learning experiences they provide in their preparation courses.

Many content-specific professional organizations associated with PK-12 and teacher education have developed their own set of standards. Organizations like the Association of Mathematics Teacher Educators (AMTE), National Council of Teachers of English (NCTE), International Literacy Association (ILA), National Council for the Social Studies (NCSS), National Science Teachers Association (NSTA), Teaching English to Speakers of Other Languages (TESOL) International Association, and the Council for Exceptional Children (CEC) have developed standard frameworks that typically represent the content knowledge and related skills students and/or teachers need. Once again, technology is a key component found in many of these content-specific standards or guidelines. For example, the NSTA Preservice Science Standards for content knowledge and content pedagogy state that teacher candidates will "understand the central concepts of the supporting disciplines and the supporting role of science-specific technology" (National Science Teachers Association, 2012, p. 1) and will include "science-specific technology...in the lessons when appropriate" (National Science Teachers Association, 2012, p. 1). One specific indicator in the Standards for Preparing Teachers of Mathematics states that well-prepared beginning teachers of mathematics will "use mathematical tools and technology" (Association of Mathematics Teacher Educators, 2017, p. 11) to support learning mathematical concepts and procedures. These examples illustrate how content-specific professional organizations have taken steps to include technology as a key component of preparing teachers. These content-specific standards also begin to unpack the technology knowledge, skills, and attitudes that teacher educators need (i.e., competencies) for preparing teachers in their discipline area, but these standards lack direction and details related to the selection and implementation of content specific technologies that are needed for teacher educators.

The International Society of Technology in Education (ISTE) has been involved for many years in developing technology standards (Thomas &

Knezek, 2008; Thomas, Porter, Taylor, & Kelly, 2002). The National Educational Technology Standards for Students (NETS•S) were created by ISTE and first released in 1998. Then in 2000, ISTE released the National Educational Technology Standards for Teachers (NETS•T) as a way to help teachers support the NETS•S in classrooms. Since ISTE maintains the position that technology is dynamic and ever-changing, and so are educational learning environments, the standards periodically go through a refresh process. The current revisions have been retitled as the ISTE Standards and provide frameworks and specific guidelines for the technology skills, knowledge, and approaches needed by educators who seek to transform teaching and learning (International Society for Technology in Education, 2017). ISTE has separate standards for students, teachers, administrators, (technology) coaches, and computer science educators. These standards are typically used by educators to inform lesson development, curriculum planning, and professional development. Still, ISTE has not yet developed a set of technology standards specifically for teacher educators.

Since teaching with technology is complicated, multi-faceted, and a developmental process, it must be addressed and integrated throughout our teacher preparation programs. Overall, many of the standards or guidelines that influence our work and preparation in teacher education make reference to the use and integration of technology for PK-12 teachers and students, but there are no technology guidelines that exist specifically for teacher educators to operationalize these aforementioned initiatives. The aim of this study was to identify the technology competencies (knowledge, skills, and attitudes) *all* teacher educators need in order to prepare teacher candidates to teach with technology in their future classrooms.

METHODOLOGY

The research team involved in this study realized in order for the TETCs to be broadly accepted, the process for developing the TETCs would need to be crafted in such a way that would produce insightful conversations about the roles and responsibilities of teacher educators, and embrace policy and procedure adjustments. As a way to begin a broad-based movement and a set of TETCs that were agreed upon by those involved, the research team facilitated a process that was highly collaborative. With the intent to have the resulting TETCs apply to the variety of individuals and organizations who support teacher educators and teacher preparation, the research team intentionally sought to include diverse perspectives from teacher educators, worldwide, in the development process.

An advisory group was established to consistently inform the research team and the research methodology. Two members of the research team met once a month with the advisory group throughout the development of the TETCs. Membership on the advisory group consisted of representation from each organization that had written a letter of support for the development of the TETCs including: the U.S. Department of Education Office of Educational Technology, the Council for the Accreditation of Educator Programs (CAEP), the National Technology Leadership Coalition, the Society for Information Technology and Teacher Education (SITE), the Teacher Education Network of the International Society for Technology in Education (ISTE-TEN), and the American Association of College for Teacher Education (AACTE). The advisory group provided insight on how to broaden the awareness of the development process of the TETCs. The advisory group did not provide input or feedback on the TETCs themselves. While the advisory group met monthly, the research team facilitated three phases of data collection and analysis.

These three phases included crowdsourcing of related literature, a Delphi method, and open public comment. These methods were used to assure the findings (the resulting TETCs and related criteria) would be usable by teacher educators and colleges/schools with teacher preparation programs. Phase I of data collection involved the crowdsourcing of literature related to technology and teacher education.

Phase I: Crowdsourcing

Data collection. 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). Crowdsourcing was used in this study to locate articles that address the competencies needed by teacher educators who support the development of teacher candidates as they learn to teach with technology. A call for literature was sent out through various teacher educator networks (i.e., SITE, ISTE), and included social networks (e.g., LinkedIn, Twitter). Educational technology faculty who were familiar with such literature submitted articles to a web-based portal. To assure comprehensive review of literature, the research team searched for additional articles. Keywords used in the search for literature included words such as: competencies, technology, and higher education faculty; technology skills and teacher educators; and technology and teacher education faculty.

Analysis and outcomes. At the end of the Phase I data collection, the crowdsourcing of literature combined with the review of literature produced 93 articles. In a review of the articles, it was evident that some of the articles submitted were not specific to teacher educators and were eliminated. In the end, 43 articles were deemed as appropriate because they addressed a technology skill or behavior related to teacher educators. Next, the research team worked together to compose competencies stemming from the articles' findings. The research team utilized 11 guidelines for writing an effective competency statement (European Commission: Education and Training, 2013; Sturgis, 2012; University of Texas School of Public Health, 2012). The initial list of competencies was constructed by writing the competency, listing any criteria aligned with the competency, and citing the article(s) from which the information was obtained. This initial list included 31 competencies extracted from the crowdsourced literature.

The research team then reviewed and revised the initial list of 31 competencies with a focus on relevancy, duplication, and wording. Several competencies were merged, while others were revised. Then slight revisions were made to assure each competency was well written according to 11 guidelines used for writing an effective competency. As a result, a list of 24 TETCs were extracted from the collection of crowdsourced literature. These 24 competencies were later revised and merged through the Delphi method described below. Appendix A outlines the literature that resulted from Phase I crowdsourcing. Next, Phase II of data collection involved using a Delphi method to assist with the identification and further development of the competencies.

Phase II: Delphi Method

The Delphi method is an approach used in research to validate and refine ideas because it "is designed to both obtain and identify areas of consensus and divergence of opinion" (Nworie, 2011, p. 29). This method allows "a group of individuals, as a whole, to deal with a complex problem" (Linstone & Turoff, 2002, p. 3), and involves experts who are carefully selected to provide their opinions on ideas (Skulmoski, Hartman, & Krahn, 2007). This collaborative research method is iterative in order to build a reliable consensus, determine suitability, and ultimately yield agreement (Linstone & Turoff, 2002). This section includes details about participant selection and the data collected and analyzed during the six Delphi rounds.

Participant solicitation and selection. To identify participants who were experts in educational technology for the Delphi component of the study, the research team developed a “Request to be a Delphi Participant” application. The application was an online form that included questions about participants’ educational organization affiliation, department or college affiliation, role in preparing PK-12 teachers, and country of residence. Criteria for participant involvement included:

- Expertise: Individual has expertise related to teaching with technology in teacher preparation (e.g., model teaching with technology); is an expert in teaching with technology in teacher preparation (e.g., concerned with curriculum related to teaching with technology).
- Impact: Individual has products (e.g., publications, culminations, etc.) and synergistic activities that have benefited the field of technology in teacher preparation.
- Time availability: Individual was available to participate in the study.
- Diversity: Collectively, individuals represented a wide range of content areas, associations, geographic regions, and institution types.

Forty-six applicants responded to the call for Delphi participants. All individuals who responded met the criteria to participate in the study. Nworie (2011) recommends selecting divergent experts to help account for future developments in technology, the rapid expansion of pedagogy due to technology use, and any potential or probable changes in policy. The research team created a list of variables (i.e., country, responsibility with regard to teacher preparation, subject-matter expertise, size of university/college, professional associations, online/hybrid teaching experience, experience with professional development in teacher preparation) to ensure the greatest diversity among the Delphi participants. Eighteen participants were selected and asked to participate in the study and 17 participants agreed to participate and signed the Institutional Review Board (IRB) agreement.

The Delphi participants (11 females and 6 males) collaborated with one another and functioned as a team by providing feedback on revisions to the TETCs through six rounds of survey-driven data collection. Each participant provided their individual feedback to the research team but not to each other. This process allowed participants to share their views and opinions without ever having direct communication with one another. In fact, they were not aware of the identity of the other participants throughout data collection. For a complete list of Delphi participants with their affiliations, locations, and subject area specializations, see Appendix B.

Data collection & analysis: Delphi method rounds 1-3. A Delphi method is designed to build consensus. In this research study, building consensus involved two parts, (1) building consensus on the competencies and (2) building consensus on the criteria that defined each competency. The first three rounds of the Delphi method focused specifically on the development of the competencies. In each Delphi round, participants viewed a draft version of the competencies and rated the extent to which each competency was important for all teacher educators on a 1-5 Likert scale with five being the highest. They also recommended changes to the competencies. During round 1, participants received the same list of 11 guidelines of a well-written competency to determine if indeed each competency was well written. During rounds 2 and 3, participants combined similar competencies and added any missing competencies.

After each Delphi round, the research team integrated the participants' feedback into the competencies, creating a revised draft of the TETCs. Each new draft provided the basis for the next round. Thus, the TETCs presented to the Delphi participants were different for each round. Participants consistently rated each competency as important (4) to very important (5) for all teacher educators during rounds 1-3 (see Figure 2).

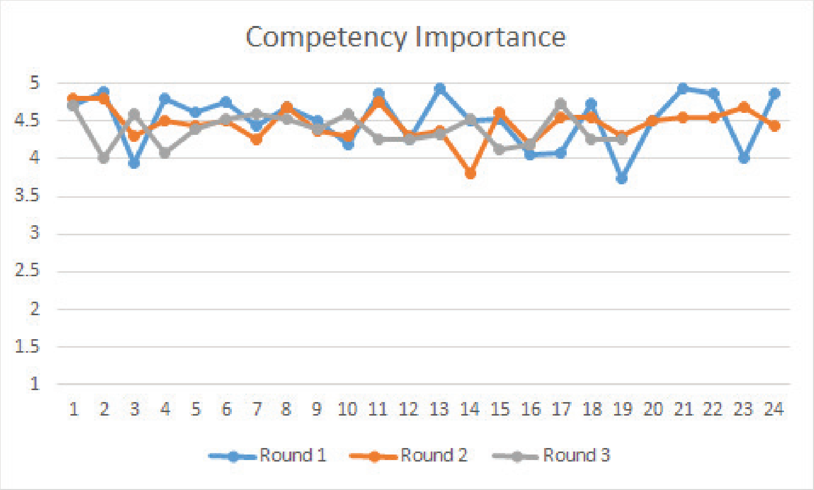

Figure 2. Importance of each competency for all teacher educators.

To determine if the competencies should be reviewed for combination, one-fourth of the Delphi participants had to recommend the combination.

One-fourth was chosen as it was a natural breaking point in the data and the research team agreed, given the diversity of the Delphi participants, a consensus of one-fourth was meaningful. In some cases, a single competency was suggested to be combined with several other competencies. In these cases, the combination with the most suggestions were coded green, the second most suggestions were coded yellow, and the third most suggestions were coded red (see Figure 3). The cells in the table were then checked for internal consistency. For example, if competency 2 was marked as needing to be combined with competency 14, then 14 also needed to be marked to be combined with competency 2. This process resulted in some competencies being combined more than once and some competencies being combined with more than one other competency. From the 24 competencies reviewed by participants in round 2, competencies 2, 7, 8, 11, and 13 were combined to a single competency, as were competencies 4 and 18, 5 and 12, 6 and 8, 9 and 15, 11 and 14, and 17 and 23.

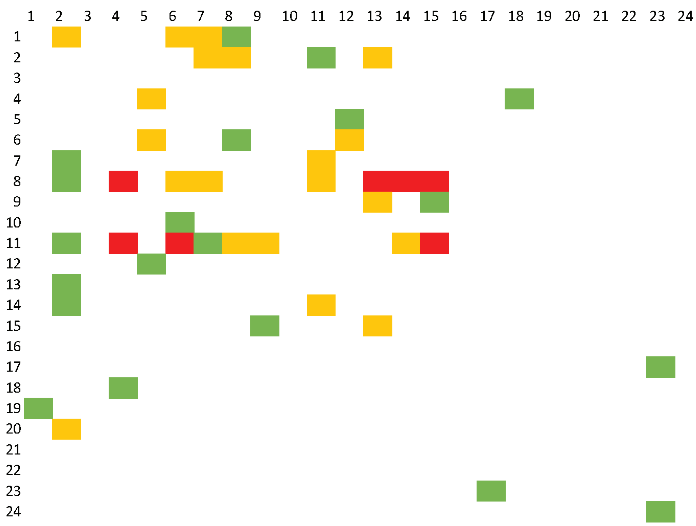

Figure 3. Round 2 coded competency combination suggestions.

In between rounds 1 and 2 of the Delphi method, members of the research team met with educational leaders at the National Technology Leadership Summit (NTLS) in Washington, D.C. NTLS involves 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). This group reviewed the draft of the TETCs that resulted from the feedback received in round 1. The research team shared thoughts put forth by the NTLS participants with the Delphi participants for consideration during their round 2 feedback: to keep in mind the definition of teacher educators, to conceptualize the competencies using the TPACK framework, to keep in mind the distinction between teacher educator competencies and the standards required of PK-12 teachers (e.g., ISTE Standards for Educators).

The round 2 survey also asked participants to suggest competencies they felt were not included in the list of 24 competencies provided during that round's draft. After reviewing participants' suggestions, three additional competencies were added to address differentiated instruction, being advocates and leaders, and social media. At the end of round 2, nine original competencies remained intact, 15 of the original competencies had been combined to form seven new competencies, and three new competencies were added, which changed the total number of competencies from 24 to 19.

Again in round 3, one-fourth of the Delphi participants had to recommend competencies for combination for the research team to consider writing a new combined competency. As can be seen when comparing Figures 3 and 4, the decrease in highlighted cells indicated the competencies were getting closer to consensus (see Figure 4). Based on the suggestions from participants during round 3, competencies 13, 14 and 15 were combined into a single competency as were 1 and 5, 1 and 13, 2 and 17, 7 and 19, 9 and 16, 10 and 14, and 11 and 12. As a result, the total number of competencies changed from 19 to 13 at the end of round 3.

Data collection & analysis: Delphi method rounds 4-6. Rounds 4 and 5 with the Delphi participants focused on writing appropriate criteria for each of the 13 competencies. In round 4, Delphi participants provided edits, additions, and deletions to the criteria. Based on participants' feedback, the research team made edits to the criteria and presented the revised lists of criteria to participants in round 5. Again in round 5, Delphi participants suggested edits, additions, and deletions to the criteria and the research team made the appropriate revisions. During round 5, it became clear to the research team that two competencies had criteria that were very similar so the research team combined two competencies, which brought the final number of TETCs to 12.

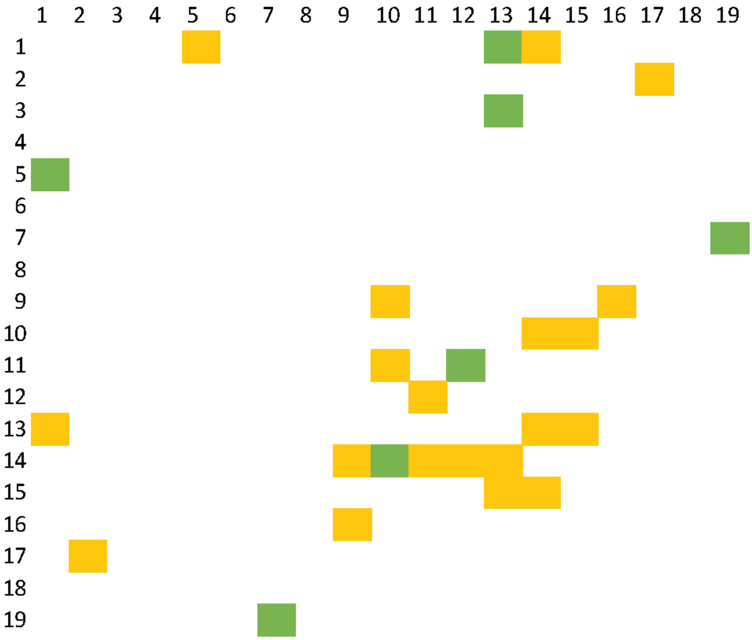

Figure 4. Round 3 coded competency combination suggestions.

The sixth and final round of the Delphi method focused on finding a logical order for the competencies by asking participants to order the competencies and to provide the logic for their decision. In examining these results from the Delphi participants, first, a simple average was calculated for each competency and the competencies were placed in numerical order. The averages had a reasonable spread, from three to ten, so this indicated some consensus among participants as to the order since the averages did not all cluster around six. Upon examination of the competencies in average order, one competency did not appear to fit. Participants consistently ranked this competency near the beginning or at the end in their individual rankings. The research team decided to move that competency to the end of the list, and decided to flip the order of two competencies to place them near more similar competencies. The Delphi participants agreed to the two small changes, and the 12 competencies with related criteria were now in a logical order.

One common problem with the Delphi method is having a high attrition rate of the Delphi experts throughout the process (Nworie, 2011). Despite having six intensive rounds over a nine-month period, there was no Delphi participant attrition. While not all Delphi participants participated in all six rounds, no participant dropped out of the study. When a participant was absent from a round, they participated in the subsequent round (See Figure 5).

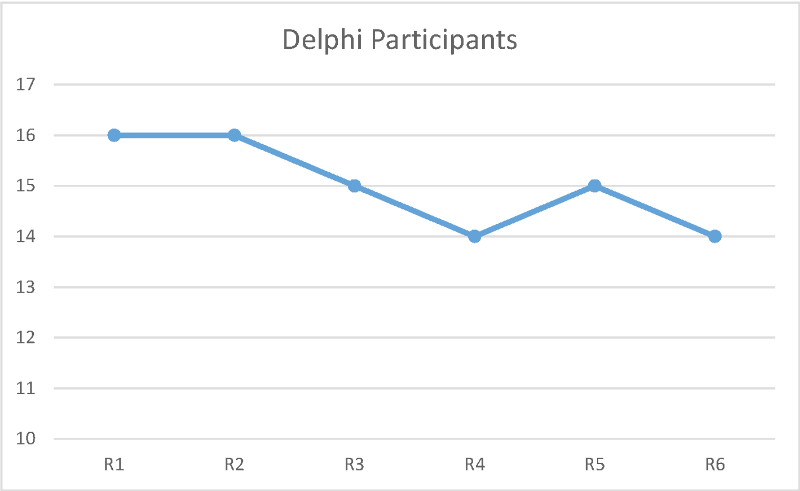

Figure 5. Number of Delphi participants (out of 17 possible) by round.

Phase III: Public Comment

Data collection. Following a presentation during the 2017 SITE conference, where the round 6 draft of the TETCs was discussed, the research team sought broad-based public comment. An online survey, available for a one-month period, was shared with SITE attendees, and emailed to a variety of organizations and individuals. As well, the online survey was posted on a variety of social media platforms. The survey consisted of four brief questions. The first question asked, what aspects of the TETCs are most useful? The second question asked how others would use the TETCs? The third question allowed for the inclusion of concerns about TETCs, and the last question asked for additional comments. The responses submitted represented all geographic regions of the United States as well as Australia.

Responses to the public comment included thoughts about possible organizational implications of the TETCs and helped form the basis for the implications section of this article. Additionally, some of the feedback from the concerns and additional comments questions prompted the research team to make minor revisions to the TETCs that did not change content or meaning. Specifically, modifications included adding a uniform stem to each of the competencies and more precise use of evaluative terms such as ‘appropriate’ and ‘effective’ or elimination of these terms.

FINDINGS

The research question guiding this study was: What knowledge, skills, and attitudes related to technology do all teacher educators need? Delphi participants reached a consensus and identified 12 TETCs. Additional public feedback (colleagues from professional networks and organizations) provided favorable comments on the competencies. Table 1 contains the 12 TETCs and related criteria aligned with each competency.

The TETCs encourage teacher educators to design instruction that utilizes content-specific technologies to enhance teaching and learning; incorporate pedagogical approaches that prepare teacher candidates to effectively use technology; and support the development of the knowledge, skills, and attitudes of teacher candidates as related to teaching how technology is used by learners in their content area. The TETCs support teacher educators’ use of technology to enhance teaching and learning; differentiate instruction to meet diverse learning needs; assess learners; connect globally with a variety of regions and cultures; teach online and/or blended/hybrid learning environments; and address the legal, ethical, and socially-responsible use of technology in education. The TETCs encourage teacher educators to engage in ongoing professional development and networking activities to improve the integration of technology in their teaching, engage in leadership and advocacy for using technology, and apply basic troubleshooting skills to resolve technology issues.

IMPLICATIONS FOR TEACHER EDUCATORS

Responses from public comments and individuals who viewed the TETCs at professional meetings (e.g. 2017 SITE conference, 2017 ISTE conference, 2017 NTLS, and the 2017 Innovation in Higher Education Summit co-sponsored by the U.S. Department of Education Office of Educational Technology and the White House) yielded positive, enthusiastic attitudes towards the TETCs. Individuals shared their thoughts about usability for teacher educators as well as implications of the TETCs within their organizations.

Table 1

Teacher Educator Technology Competencies (TETCs) with related criteria

1. Teacher educators will design instruction that utilizes content-specific technologies to enhance teaching and learning.	
	a) Evaluate content-specific technology for teaching and learning.
	b) Align content with pedagogical approaches and appropriate technology.
	c) Model approaches for aligning the content being taught with appropriate pedagogy and content.
2. Teacher educators will incorporate pedagogical approaches that prepare teacher candidates to effectively use technology.	
	a) Model using technology for accessing, analyzing, creating, and evaluating information.
	b) Assist teacher candidates with evaluating the affordances of content-specific technologies to support student learning.
	c) Assist teacher candidates with the selection and use of content-specific technologies to support student learning.
	d) Facilitate opportunities for teacher candidates to practice teaching with technology.
3. Teacher educators will support the development of the knowledge, skills, and attitudes of teacher candidates as related to teaching with technology in their content area.	
	a) Support teacher candidates' alignment of content with pedagogy and appropriate technology.
	b) Provide opportunities for teacher candidates to reflect on their attitudes about using technology for teaching and for their own learning.
	c) Provide opportunities to develop teacher candidates' efficacy about using technology in teaching.
4. Teacher educators will use online tools to enhance teaching and learning.	
	a) Communicate using online tools.
	b) Collaborate using online tools.
	c) Design instruction using online tools.
	d) Assess teacher candidates using online tools.
5. Teacher educators will use technology to differentiate instruction to meet diverse learning needs.	
	a) Design instruction using technology to meet the needs of diverse learners.
	b) Demonstrate using assistive technologies to maximize learning for individual student needs.
	c) Model using technology to differentiate learning in teaching and learning.
	d) Provide opportunities for teacher candidates to create learning activities using technology to differentiate instruction.
6. Teacher educators will use appropriate technology tools for assessment.	
	a) Use technology to assess teacher candidates' competence and knowledge.
	b) Model a variety of assessment practices that use technology.
	c) Provide opportunities for teacher candidates to use appropriate technology for assessment.

7. Teacher educators will use effective strategies for teaching online and/or blended/hybrid learning environments.	
	a) Model online and blended learning methods and strategies. b) Provide opportunities for teacher candidates to practice teaching online and/or in blended/hybrid learning environments.
8. Teacher educators will use technology to connect globally with a variety of regions and cultures.	
	a) Model global engagement using technologies to connect teacher candidates with other cultures and locations. b) Design instruction in which teacher candidates use technology to collaborate with learners from a variety of backgrounds and cultures. c) Address strategies needed for cultures and regions having different levels of technological connectivity.
9. Teacher educators will address the legal, ethical, and socially-responsible use of technology in education.	
	a) Model the legal, ethical, and socially-responsible use of technology for teaching and learning. b) Guide teacher candidates' use of technology in legal, ethical, and socially-responsible ways. c) Provide opportunities for teacher candidates to design curriculum following legal, ethical, and socially-responsible uses of technology.
10. Teacher educators will engage in ongoing professional development and networking activities to improve the integration of technology in teaching.	
	a) Define goals for personal growth in using technology. b) Engage in continuous professional development and networking activities promoting technology knowledge and skills. c) Support teacher candidates' continuous participation in networking activities to increase their knowledge of technology.
11. Teacher educators will engage in leadership and advocacy for using technology.	
	a) Share a vision for teaching and learning with technology. b) Engage with professional organizations that advocate technology use in education. c) Seek to influence the opinions and decisions of others regarding technology integration. d) Assist teacher candidates in becoming advocates for using technology to enhance teaching and learning. e) Support teacher candidates in understanding local, state, and national technology policies in education.
12. Teacher educators will apply basic troubleshooting skills to resolve technology issues.	
	a) Configure digital devices for teaching. b) Operate digital devices during teaching. c) Model basic troubleshooting skills during teaching. d) Find solutions to problems related to technology using a variety of resources.

Note: List of current Teacher Educator Technology Competencies (TETCs) can be found at http://site.aace.org/tetc

Individuals felt the TETCs could be useful for transforming teacher educators' course goals as well as course design, and noted the adoption of the TETCs could guide effective, transformational pedagogical practices. Comments included suggestions on using the TETCs to develop a self-assessment tool for teacher educators in colleges and schools of education. Other comments included the need for the TETCs to be incentivized and integrated into yearly performance evaluations (standards of academe) and promotion and tenure guidelines. Several comments included thoughts on providing teacher educators with free or borrowed tablets or other technology devices if they incorporate the TETCs into their curriculum.

Individuals also recommended using digital badging as a tool to track and monitor teacher educators' mastery of the TETCs. In an exploratory study on digital badging within a teacher professional development program, Gamrat, Zimmerman, Dudek and Peck (2014) defined digital badges as microcredentials and explained,

> Digital badges are online representations of learning experiences and activities that tell a story about the learner's education and skills. Frequently represented by a graphic or icon, badges offer a socially constructed and valued encapsulation of experiences through a variety of stored metadata. Through this rich metadata, digital badges offer transparency and depth into the learning and achievements of the learners, which can then be reviewed by others. (p. 1136)

Nearly all individuals noted the TETCs could be an appropriate frame to plan for faculty development. Individuals mentioned professional development and modeling the use of the TETCs could involve one-on-one mentoring as well as group workshops (Kay, 2006; Polly et al., 2010). One individual noted the value of modeling (Kay, 2006; Thomas, Herring, Redmond, & Smaldino, 2013; Tondeur et al., 2013) and stated, "I like that modeling the use of technology is a part of how teacher educators are meant to support preservice teachers in thinking about the integration of technology. This seems crucial to me."

Many individuals viewed the TETCs from an organizational perspective, and noted the TETCs would inspire conversations among their administrators in their university surrounding new aspirations; however, individuals from every meeting where the TETCs were shared agreed organizational growth, change, leadership, and promotion would be necessary for the TETCs to thrive within a college or school. Several individuals passionately argued the "TETCs will not become the norm in teacher preparation programs unless deans and top administrators support and require them of teacher educators." Others shared their views and suggested changes in accreditation may be helpful and timely. One individual stated, "Professional organizations such as CAEP must support the competencies and hold colleges accountable."

In addition to public comments, the research team recommends posting a wealth of related TETCs information on department or college/school of education websites such as online tutorials, webcasts, vodcasts, and use-case examples with lessons and rubrics. This would support learning and achievements using the TETCs, and allow teacher educators to access related resources quickly that allow them to enhance their understanding and use of the TETCs.

The research team also believes reciprocal mentoring can serve as a form of professional development and become a valuable outlet to discuss and unpack the TETCs (Foulger & Gerard, 2009). Mary Deane Sorcinelli, Associate Provost for faculty development and Director of the Center for Teaching and Faculty Development at the University of Massachusetts Amherst, discusses mutual mentoring as the replacement of one-on-one, top-down mentoring with encouragement and involvement of faculty who initiate mentoring partnerships with each other that work for them (Briggs, 2013).

Teacher educators and teacher education administrators can influence professional organizations to align their standards with the TETCs. This may require a national team effort from members of the TETCs advisory group and other supporters. In the meantime, teacher education administrators operating under a transformational leadership framework (Leithwood, Begley, & Cousins, 1994) may assist in the implementation of the TETCs within their schools and colleges of education**.** To establish a shared vision, educational leaders should consider following a transformational leadership framework to redesign their organizations and support work towards the vision. Hallinger (2010) writes,

> Transformational leadership focuses on developing the organization's capacity to innovate. It [transformational leadership] seeks to build the organization's capacity to select its purposes and to support the development of changes to practices of teaching and learning. Transformational leadership may be viewed as distributed in that it focuses on developing a shared vision and shared commitment to school change. (p. 4)

The TPACK leadership diagnostic tool (Graziano, Herring, Carpenter, Smaldino, & Finsness, 2017) may assist educational leaders in the process of developing a shared vision and commitment to change and implementation of the TETCs within teacher preparation programs. The TPACK leadership diagnostic tool is designed for self-reflection and guidance for teacher education leaders as they develop vision and plans for developing a technology rich model for teacher candidates to become 21st century educators. The diagnostic tool serves as an opportunity to examine current practices and to help develop realistic goals for program development related to TPACK.

At the foundation of the TETCs is that technology integration should be infused into all courses in teacher preparation programs (Polly et al., 2010; Tondeur et al., 2013; Voogt et al., 2012; Foulger, Buss, Wetzel, Lindsey, & Pasquel, 2015), and that content area experts would be instrumental in the adoption of the TETCs. This suggests a need for teacher educators to partner with content area professional organizations such as the Association of Mathematics Teacher Educators, the National Council of Teachers of English, the National Council for the Social Studies, the National Academy of Science, the TESOL International Association, and the Council of Exceptional Children to examine whether the TETCs align with their professional standards or guidelines for PK-12 teachers and students.

CONCLUSION

All teacher candidates should have equitable, high-quality technology experiences throughout their teacher preparation programs. In the National Educational Technology Plan, the U.S. Department of Education, Office of Educational Technology (2017), called on teacher preparation programs to develop a set of competencies to help guide teacher educators in understanding what knowledge, skills, and attitudes are needed to use and integrate technology throughout a teacher preparation program. The TETCs and related criteria, which emerged from this study, shed light on the breadth and depth of knowledge, skills, and attitudes *all* teacher educators need for addressing technology within the courses they teach and throughout the preparation programs where they work.

The TETCs should not be viewed as a solution-oriented approach to technology integration for teacher preparation; rather, they are merely a first step in a larger reform of technology integration within teacher preparation programs. The end goal of the TETCs is to positively impact teacher candidates graduating from teacher preparation programs and teacher educators who teach within those programs, and to initiate conversations across institutions about larger reform issues surrounding the movement towards technology integration across the curriculum. Collectively, *all* teacher educators are responsible for preparing teacher candidates who enter future classrooms with the skills needed to use and integrate technology appropriately for teaching and learning.

References

Agyei, D. D., & Voogt, J. M. (2011). Exploring the potential of the will, skill, tool model in Ghana: predicting prospective and practicing teachers' use of technology. *Computers & Education*, *56*, 91–100.

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education*, *52*(1), 154-168.

Association of Mathematics Teacher Educators. (2017). Standards for preparing teachers of mathematics. Retrieved from https://amte.net/standards

Barton, R., & Haydn, T. (2006). Trainee teachers' views on what helps them to use information and communication technology effectively in their subject teaching. *Journal of Computer Assisted Learning*, *22*, 257–272.

Borthwick, A. C., & Hansen, R. (2017). Digital Literacy in Teacher Education: Are Teacher Educators Competent? *Journal of Digital Learning in Teacher Education*, *33*(2), 46-48.

Briggs, L. L. (2013). 5 keys to engaging faculty with IT. *Campus Technology*. Retrieved from https://campustechnology.com/Articles/2013/06/06/5-Keys-to-Engaging-Faculty-With-IT.aspx?Page=3

Council of Chief State School Officers. (2011). Interstate Teacher Assessment and Support Consortium (InTASC) model core teaching standards: A resource for state dialogue. Washington, DC: Council of Chief State School Officers.

Council for the Accreditation of Educator Preparation. (2016). *2013 CAEP Standards*. Retrieved from https://caepnet.org

Dexter, S., Doering, A. H., & Riedel, E. S. (2006). Content area specific technology integration: A model for educating teachers. *Journal of Technology and Teacher Education*, *14*(2), 325.

Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education*, *51*, 187–199.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, *42*(3), 255-284.

European Commission: Education and Training. (2013). *Supporting teacher competence and development for better learning outcomes*. Retrieved from http://ec.europa.eu/education/policy/school/teacher-training_en.htm on April 12, 2017.

Foulger, T. S., Buss, R. R., Wetzel, K., & Lindsey, L. (2015). Instructors' growth in TPACK: Teaching technology-infused methods courses to preservice teachers. *Journal of Digital Learning in Teacher Education*, *31*(4), 134-147.

Foulger, T. S., Buss, R., Wetzel, K., Lindsey, L. & Pasquel, S. (2015). Nudging tech Infusion into student teaching: Determining institutional readiness for large-scale, site-based, professional development. In D. Rutledge & D. Slykhuis (Eds.), *Proceedings of SITE 2015--Society for Information Technology & Teacher Education International Conference* (pp. 27-32). Las Vegas, NV, United States: Association for the Advancement of Computing in Education (AACE). Retrieved October 25, 2017 from https://www.learntechlib.org/p/149962/

Foulger, T. S., Buss, R. R., Wetzel, K., & Lindsey, L. (2012). Preservice teacher education benchmarking a standalone ed tech course in preparation for change. *Journal of Digital Learning in Teacher Education*, *29*(2), 48-58.

Foulger, T. S., Gerard, M. (2009, July). *Making the ideal real: Reciprocal mentoring for technology integration in preservice education*. Paper presented at the International Society for Technology in Education's National Educational Computing Conference, Washington, D.C.

Gamrat, C., Zimmerman, H. T., Dudek. J., & Peck, K. (2014). Personalized workplace learning: An exploratory study on digital badging within a teacher professional development program. *British Journal of Educational Technology*, *45*(6), 1136-1148.

Goktas, Y., Yildirim, S., & Yildirim, Z. (2009). Main barriers and possible enablers of ICTs integration into pre-service teacher education programs. *Educational Technology & Society*, *12*(1), 193–204.

Graziano, K. J., Herring, M., Carpenter, J., Smaldino, S., Finsness, E. (2017). A TPACK diagnostic tool for teacher education leaders. *TechTrends*, *61*(4), 372-379.

Gronseth, S., Brush, T., Ottenbreit-Leftwich, A., Strycker, J., Abaci, S., Easterling, W., & Leusen, P. V. (2010). Equipping the next generation of teachers: Technology preparation and practice. *Journal of Digital Learning in Teacher Education, 27*(1), 30-36.

Hallinger, P. (2010). Leading educational change: reflections on the practice of instructional and transformational leadership. In A. Walker & P. Hallinger (Eds.), Gateways to leading learning: leading educational change (pp. 2–37). Hong Kong: Hong Kong Institute of Education.

Hammond, T. C., & Manfra, M. M. (2009). Giving, prompting, making: Aligning technology and pedagogy within TPACK for social studies instruction. *Contemporary Issues in Technology and Teacher Education*, *9*(2), 160-185.

Harris, J., & Hofer, M. J. (2009). *Instructional planning activity types as vehicles for curriculum-based TPACK development*. Society for Information Technology and Teacher Education.

Hutchison, A. & Colwell, J. (2015). *Bridging Technology and Literacy: Developing Digital Reading and Writing Practices in Grades K-6*. New York: Rowman & Littlefield.

International Society for Technology in Education. (2017). *ISTE Standards*. Retrieved from https://www.iste.org/standards/standards

Kay, R. H. (2006). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. *Journal of Research on Technology in Education*, *38*(4), 383-408.

Kisicki, T. (2012). *Comparing Graduate Courses Taught By The Same Instructor Using Competing Approaches: Traditional Vs. Technology-Infused*. Arizona State University.

Kleiner, B., Thomas, N., & Lewis, L. (2007). Educational technology in teacher education programs for initial licensure. *Statistical Analysis Report*. NCES 2008-040. National Center for Education Statistics.

Koster, B., Brekelmans, M., Korthagen, F., & Wubbels, T. (2005). Quality requirements for teacher educators. *Teaching and Teacher Education, 21,* 157-176.

Leithwood, K, Begley, P. T, & Cousins, J.B. (1994). *Developing expert leadership for future schools*. London: Falmer.

Linstone, H. A., & Turoff, M. (2002). *The Delphi method: Techniques and applications*. Newark, NJ: New Jersey Institute of Technology. Retrieved from web.njit.edu/~turoff/pubs/delphibook/delphibook.pdf.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017-1054.

Morris, R.R. & McDuff, D. (2015). Crowdsourcing techniques for affective computing. In Calvo, R. A., D'Mello, S. K., Gratch, J., & Kappas, A. (Eds.), *The Oxford handbook of affective computing* (pp 384-395). New York, NY: Oxford University Press.

National Science Teachers Association. (2012). *2012 NSTA Standards for Science Teacher Preparation*. Retrieved from http://www.nsta.org/preservice/

Niess, M. L. (2011). Investigating TPACK: Knowledge growth in teaching with technology. *Journal of Educational Computing Research*, *44*(3), 299-317.

Nworie, J. (2011). Using the Delphi technique in educational technology research. *TechTrends*, *55*(5), 24-30.

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

Sang, G., Valcke, M., van Braak, J., & Tondeur, J. (2010). Student teachers' thinking processes and ICT integration: Predictors of prospective teaching behaviors with educational technology. *Computers & Education*, *54*(1), 103-112.

Shettel, J. W., & Bower, K. (2013). Infusing technology into the balanced literacy classroom. *e-Journal of Balanced Reading Instruction*, *1*(2), 3-11.

Skulmoski, G. J., Hartman, F. T., & Krahn, J. (2007). The Delphi method for graduate research. *Journal of Information Technology Education, 6,* 1-21.

Sturgis, C. 2012. The art and science of designing competencies. A Competency Works Issue Brief, *International Association for K-12 Online Learning*. Available at https://eric.ed.gov/?id=ED566877

Tearle, P., & Golder, G. (2008). The use of ICT in the teaching and learning of physical education in compulsory education: how do we prepare the workforce of the future? *European Journal of Teacher Education*, *31*(1), 55-72.

Thomas, L. G., & Knezek, D. G. (2008). Information, communications, and educational technology standards for students, teachers, and school leaders. *International Handbook of Information Technology in Primary and Secondary Education*, 333-348.

Thomas, L., Porter, D., Taylor, H. & Kelly, P. (2002). *Revised Standards for ISTE/NCATE Accreditation and National Recognition*. In D. Willis, J. Price & N. Davis (Eds.), Proceedings of SITE 2002--Society for Information Technology & Teacher Education International Conference (p. 1797). Nashville, Tennessee, USA: Association for the Advancement of Computing in Education (AACE).

Thomas, T., Herring, M., Redmond, P., & Smaldino, S. (2013). Leading change and innovation in teacher preparation: A blueprint for developing TPACK ready teacher candidates. *TechTrends*, *57*(5), 55-63.

Thompson, A. D., Schmidt, D. A., & Davis, N. E. (2003). Technology collaboratives for simultaneous renewal in teacher education. *Educational Technology Research and Development*, *51*(1), 73-89.

Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012). Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education*, *59*(1), 134-144.

Tondeur, J., Roblin, N. P., van Braak, J., Fisser, P., & Voogt, J. (2013). Technological pedagogical content knowledge in teacher education: In search of a new curriculum. *Educational Studies*, *39*(2), 239-243.

University of Texas School of Public Health (2012). *Competencies and learning objectives*. Retrieved from https://sph.uth.edu/content/uploads/2012/01/Competencies-and-Learning-Objectives.pdf on September 4, 2016.

U.S. Department of Education, Office of Educational Technology, (2017). *Reimagining the Role of Technology in Education: 2017 National Education Technology Plan Update*, Washington, D.C.

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2012). Technological pedagogical content knowledge–a review of the literature. *Journal of Computer Assisted Learning*, *29*(2), 109-121.

Wetzel, K., Buss, R., Foulger, T. S., & Lindsey, L. (2014). Infusing educational technology in teaching methods courses: Successes and dilemmas. *Journal of Digital Learning in Teacher Education*, *30*(3), 89-103.

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Note

List of current Teacher Educator Technology Competencies (TETCs) can be found at http://site.aace.org/tetc

APPENDIX A

Literature that resulted from Phase I crowdsourcing

- Alayyar, G., Fisser, P., & Voogt, J. (2012). Developing technological pedagogical content knowledge in pre-service science teachers: The potential of blended support for learning. *Australasian Journal of Educational Technology, 28*(8), 1298-1316.

- Alghazo, I. M. (2006). Computer competencies of the faculty members of the college of education at the United Arab Emirates university. *International Journal of Instructional Media*, *33*(3), 327-335.

- Alvarez, I., Guasch, T., & Espasa, A. (2009). University teacher roles and competencies in online learning environments: A theoretical analysis of teaching and learning practices. *European Journal of Teacher Education, 32*(3), 321-336.

- Albee, J. J. (2003). A study of preservice elementary teachers' technology skill preparedness and examples of how it can be increased. *Journal of Technology & Teacher Education, 11*(1), 53-71.

- Anderson, S. E., Groulx, J. G., & Maninger, R. M. (2011). Relationships among preservice teachers' technology-related abilities, beliefs, and intentions to use technology in their future classrooms. *Journal of Educational Computing Research*, *45*(3), 321-338.

- Angeli, C., & Valanides, N. (2013). Technology mapping: An approach for developing technological pedagogical content knowledge. *Journal of Educational Computing Research, 48*(2), 199-221.

- Aubteen Darabi, A. Sikorski, E. G. and Harvey, R. B. (2006). Validated Competencies for Distance. *Distance Education, 27*(1),105–122.

- Barton R. & Haydn T. (2006) Trainee teachers' views on what helps them to use information and communication technology effectively in their subject teaching. *Journal of Computer Assisted Learning, 22*(4), 257–272.

- Banister S. & Vannatta R. (2006). Beginning with a baseline: Insuring productive technology integration in teacher education. *Journal of Technology and Teacher Education, 14*(1), 209-235.

- Bastedo, K. & Vargas, J. (2014). Assistive technology and distance learning: Making content accessible. In B. DaCosta & S. Seok (Eds.), *Assistive technology research, theory, and practice*, 233-251. Hershey, PA: IGI Global Publishing.

- Boix Mansilla, V., & Jackson, A. (2011). Educating for Global Competence: Preparing Our Youth to Engage the World. Council of Chief State School Officers' EdSteps Initiative & Asia Society Partnership for Global Learning Engage the World. Retrieved from https://asiasociety.org/files/book-globalcompetence.pdf

- Bower M. (2011) Synchronous collaboration competencies in web-conferencing environments – their impact on the learning process. *Distance Education, 32*(1), 63–83.

- Carroll, J. B., & Morrell, P. D. (2006). A comparison of teacher education faculty and preservice teacher technology competence. *Journal of Computing in Teacher Education, 23*(1), 5-10.

- Cullen, T. A., & Greene, B. A. (2011). Preservice teachers' beliefs, attitudes, and motivation about technology integration. *Journal of Educational Computing Research, 45*(1), 29-47.

- Courduff, J., Duncan, A., & Gilbreath, J. (2014). Teacher education and principals of effective assistive technology implementation. In B. DaCosta & S. Seok (Eds.), *Assistive technology research, theory, and practice*, 192-206. Hershey, PA: IGI Global Publishing.

- Delfino, M. & Persico, D. (2007). Online or face-to-face?: Experimenting with different techniques in teacher training. *Journal of Computer-Assisted Learning*, *23*(5), 351-365.

- Fleming, L., Motamedi, V., & May, L. (2007). Predicting preservice teacher competence in computer technology: Modeling and application in training environments. *Journal of Technology and Teacher Education, 15*(2), 207-231.

- Foulger, T. S., Ewbank, A. D., Kay, A., Osborn Popp, S., & Carter, H. L. (2009). Moral spaces in MySpace: Preservice teachers' perspectives about ethical issues in social networking. *Journal of Research on Technology in Education, 42*(1), 1-28.

- *Global competence is a 21st century imperative* (2010). NEA Policy Brief. NEA Education Policy and Practice Department, Center for Great Public Schools Retrieved from http://www.nea.org/assets/docs/HE/PB28A_Global_Competence11.pdf.

- Greenhalgh, S. P., & Koehler, M. J. (2015). "Pretty good practices" for the design of teacher portfolio courses. In M. L. Niess & H. Gillow-Wiles (Eds.), *Handbook of Research on Teacher Education in the Digital Age*, 256-280. IGI Global.

- Hodges, C. B., & Cowan, S. F. (2012). Preservice teachers' views of instructor presence in online courses. *Journal of Digital Learning in Teacher Education, 28*(4), 139-145.

- Hung, H. T., & Yuen, S. C. Y. (2010). Educational use of social networking technology in higher education. *Teaching in Higher Education, 15*(6), 703-714.

- Hunter, J. L. (2015). High possibility classrooms: A new model for technology integration. In M. L. Neiss & H. Gillow-Wiles (Eds.), *Handbook of Research on Teacher Education in the Digital Age*, 466-492. IGI Global.

- Kafyulilo, A., Fisser, P., Pieters, J., & Voogt, J. (2015). ICT use in science and mathematics teacher education in Tanzania: developing technological pedagogical content knowledge. *Australasian Journal of Educational Technology, 31*(4), 381-394.

- Kang, Y. & Ritzhaupt, A. D. (2015). A job announcement analysis of educational technology professional positions: Knowledge, skills, and abilities. *Journal of Educational Technology Systems, 43*(3), 231-256.

- Kiraz, E. & Ozdemir, D. (2006). The relationship between educational ideologies and technology acceptance in pre-service teachers. *Educational Technology & Society, 9*(2), 152-165.

- Kemp, L., Engan-Barker, D., Lewis, J., Coursol, D., Dercy, D., Nelson, A., Krohn, S., & Moore, S. (2000). Technology competencies in teacher education. An evaluation to guide implementation of beginning teacher technology standards. Mankato, Minnesota: Minnesota State Colleges & Universities. Retrieved from https://eric.ed.gov/?id=ED442797

- Kim, K., Jain, S., Westhoff, G., Rezabek, L. (2008). A quantitative exploration of preservice teachers' intent to use computer-based technology. *Journal of instructional Psychology, 35*(3), 275-287.

- Krumsvik, R. J. (2014). Teacher educators' digital competence. *Scandinavian Journal of Educational Research, 58*(3), 269 – 280.

- McKenney, S. E., Kali, Y., Markuskauskaite, L., & Voogt, J. (2015). Teacher design knowledge for technology enhanced learning: An ecological framework for investigating assets and needs. *Instructional Science, 43*, 181–202.

- Milman, N. (2005). Web-based digital teaching portfolios: Fostering reflection and technology competence in preservice teacher education students. Journal of Technology and Teacher Educatio*n, 13*(3), 373-396.

- Niess, M. L. (2013). Central component descriptors for levels of technological pedagogical content knowledge. Special issue on Technological Pedagogical Content Knowledge. *Journal of Educational Computing Research, 48*(2), 173-198.

- Ottenbreit-Leftwich, A., & Cullen, T. A. (2006). Preserving the legacy of PT3 tools, strategies & resources: Knowledge capture artifacts. *TechTrends, 50*(3), 46-53.

- Rosenfeld, B. (2008). The challenges of teaching with technology: From computer idiocy to computer competence. *International Journal of Instructional Media, 35*(2), 157-167.

- Smith, D. W., Kelley, P., Maushak, N. J., Griffin-Shirley, N., & Lan, W. Y. (2009). Assistive technology competencies for teachers of students with visual impairments. *Journal of Visual Impairment & Blindness, 103*(8), 457.

- Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreitt-Leftwich, A. (2012), Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education, 59*(1), 134-144.

- Tondeur, J., Pareja Roblin, N., van Braak, J., Voogt, J., & Prestridge, S. (2016). Preparing beginning teachers for technology integration in education: Ready for take-off? *Technology, Pedagogy and Education, 26*(2), 157-177.

- Veletsianos, G. (2012). Higher education scholars' participation and practices on Twitter. *Journal of Computer Assisted Learning, 28*(4), 336-349.

- Vu, P., & Fadde, P. (2014). A snapshot of technology integration training in teacher education programs. *International Journal of Psychology: A Biopsychosocial Approach, 14,* 139-150.

- Wetzel, K., Foulger, T. S., Buss, R., & Lindsey, L. (2014). Infusing educational technology in teaching methods courses: Success and dilemmas. *Journal of Digital Learning in Teacher Education, 30*(3), 89-103.

- Wojcik, B. W., Peterson-Karlan, G., Watts, E. H., & Parette, P. (2004). Assistive technology outcomes in a teacher education curriculum. *Assistive Technology Outcomes And Benefits, 1*(1), 21-32.

- Yurdakul, K. & Coklart, A.N. (2014). Modeling preservice teachers' TPACK competencies based on ICT usage. *Journal of Computer Assisted Learning, 30*(4), 363-376.

- Zhou, L., Ajuwon, P. M., Smith, D. W., Griffin-Shirley, N., Parker, A. T., & Okungu, P. (2012). Assistive technology competencies for teachers of students with visual impairments: A national study. *Journal of Visual Impairment & Blindness, 106*(10), 656-665.

APPENDIX B

List of Delphi participants

Name	Affiliation	Title	Professional Associations	Subject Specialization
Albion, Peter	University of Southern Queensland, Toowoomba, Australia	Professor (Educational Technology)	SITE, ISTE, ASCILITE, ACCE, QSITE	Technology, Math & Science
Blankenship, Rebecca	Florida Agricultural and Mechanical University, Tallahassee, Florida, United States	Assistant Professor (PreK-Elementary Education/TESOL Program Director/Teacher Candidate Field Supervisor)	AERA, SITE, NAME, KDP, NEA, FEA, AACTE, ATE	Second Language Acquisition, Instructional Technology, Social Studies, and TESOL
Burke, Diane	Keuka College, Keuka Park, New York, United States	Professor Emeritus	ISTE, ILA, NYSATE	Social Studies & Literacy
Cox, Suzy	Utah Valley University, Orem, Utah, United States	Associate Professor (Instructional Psychology & Technology)	ISTE, AERA, UATE, NRMERA, AECT	Secondary Education
Crompton, Helen	Old Dominion University, Norfolk, Virginia, United States	Assistant Professor (Instructional Technology)	ISTE, NCTM, AERA, AESA	Educational Technology, Math
Cunningham, Ann	Wake Forest University, Winston-Salem, North Carolina, United States	Associate Professor	ISTE, SITE	Global Ed, Instructional Design, Educational Technology
Dawson, Kara	University of Florida, Gainesville, Florida, United States	Professor (Educational Technology)	SITE, ISTE, AERA, AACE	Educational Technology
Hansen, Randy	University of Maryland University College, Adelphi, Maryland, United States	Professor (Learning, Design & Technology)	ISTE, ICE, MSET, AACTE	Learning Design & Technology

Name	Affiliation	Title	Professional Associations	Subject Specialization
Hervey, Lisa	North Carolina University, Raleigh, North Carolina, United States	Teaching Assistant Professor (Instructional Technology)	ISTE, LRA, AERA, AACE, ILA, ASCD, CEC, SITE	Literacy
Lee, John	North Carolina University, Raleigh, North Carolina, United States	Professor (Social Studies Education)	SITE, CUFA	Social Studies
McPherson, Sarah	New York Institute of Technology, New York City, New York, United States	Educational Consultant Retired Associate Professor (Instructional Technology & Leadership)	ISTE SITE AEA	Educational Technology STEM Assistive technology
Poyo, Susan	Franciscan University of Steubenville, Steubenville, Ohio, United States	Assistant Professor (Education)	ILA, NCTM, OCTEO, ISTE, AACE	Math and Literacy
Redmond, Pamela	Touro University California, Vallejo, CA, United States	Professor (Innovative Learning & Leadership; Education); Chair of Graduate Studies	ISTE, AACE, CEC, CCTE, WACRA	Innovative Learning & Leadership; Special Education
Sheffield, Rachel	Curtin University, Perth, Australia	Senior Lecturer (Science Education)	ISTE, HERDSA, AARE, ASTA, SHEA, ASERA	Math & Science
Stoloff, David	Eastern Connecticut State University, Willimantic, Connecticut, United States	Professor (Educational Technology)	ISTE	Educational Technology, Social Foundations of Education
Thomas, Kevin	Bellarmine University, Louisville, Kentucky, United States	Associate Professor (Education)	ISTE, AACE, KySTE	Education Technology
West, Richard	Brigham Young University, Provo, Utah, United States	Associate Professor (Instructional Psychology and Technology)	AECT, PIDT, AERA, AEA, AACE	Instructional Design & Technology