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Validation of a Teacher Educator Technology Competencies Survey

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The Teacher Educator Technology Competencies (TETCs) were created as a set of technology competencies specifically for teacher educators who prepare future teachers to teach with technology. A survey was developed based on the competencies and administered to 223 participants who reported they were teacher educators from North America, Europe, and the Asia/Pacific Region during 2018-2019. The purpose of this study was to assess the psychometric properties of the instrument. Factor analysis, multidimensional scaling, analysis of variance, and bivariate correlation procedures were used to confirm that the 12-item Likert-type instrument exhibited high internal consistency reliability (alpha = .95), and acceptable construct and criterion-related validity. The instrument's total scale score was effective in discriminating between respondents attending the Society for Information Technology and Teacher Education (SITE) annual conference, expected to be highly proficient, and teacher educators from other avenues of data acquisition. The identification of prospective subscale structures of the TETC Survey led the authors to conclude that the Teacher Educator Technology Competencies address a large portion of the teacher educator attributes required for proficiency in the preparation of future teachers to integrate technology. The TETC Survey is recommended for use in additional studies with teacher educators.

INTRODUCTION

A 2017 update to the 2016 United States Department of Education's National Educational Technology Plan focused on the role of technology in higher education pointed out the need to address competencies required of university teacher educators (U.S. Department of Education, Office of Educational Technology, 2017). In response to this call, teacher education researchers began a collaborative process of developing competencies for teacher educators (Foulger, Graziano, Schmidt-Crawford, & Slykhuis, 2017). The researchers began with a crowdsourcing of literature related to technology in education and then used a Delphi method plus open public comment for development of the Teacher Educator Technology Competencies (TETCs) (Schmidt-Crawford, Foulger, Graziano & Slykhuis, 2019). The final list of 12 competencies along with related criteria for each competency were published in a teacher education and technology journal as well as on the Society for Information Technology and Teacher Education's website (http://site.aace.org/tetc/). Foulger, Graziano, Schmidt-Crawford and Slykhuis (2017) fully described the process of development of the TETCs in their publication. The goals of the current study were to validate a new survey instrument focusing on the teacher educator competencies and recommend ways in which teacher education programs could use the instrument as a tool to guide teacher educator professional development focused on enhancing the integration of technology to prepare future teachers.

LITERATURE REVIEW

Classroom teachers are expected to integrate technology in their K-12 classrooms (Christensen & Knezek, 2017) and standards for these teachers have been recommended since 2000 (Thomas & Knezek, 2008). According to the recently released 2017 United States National Educational Technology Plan Update (U.S. Department of Education, Office of Educational Technology, 2017), schools should expect that teachers who recently completed a teacher preparation program should be prepared to use technology in meaningful ways. In fact, a United States Department of Education policy brief focused on technology in teacher preparation implied that schools are not able to rely on new teachers prepared in these programs to be prepared to use technology (U.S. Department of Education, Office of Educational Technology, 2016). Foulger et al. (2017) have made the case that today's teacher educators must provide and be held accountable for providing technology-rich experiences in their teacher preparation courses. However, according to research on teacher educators who prepare future teachers, there are few rich technology experiences throughout teacher preparation programs (Batik, 2015; Ertmer & Ottenbreit-Leftwich, 2010; Foulger, Wetzel, & Buss, 2019). While progress has been made, teacher education programs continue to struggle to implement and model technology integration best practices throughout their programs (Batik, 2016; Shaffer, Nash, & Ruis, 2015). Future educators not only need to know about the technologies available for education but need to have the technology modeled in their classrooms. The United States Department of Education's (2016) policy brief identified problems and solutions to the effective integration of technology in teacher education and provided guiding principles on how to move the field forward in this endeavor. The four guiding principles developed by the Office of Educational Technology are:

- Focus on the active use of technology to enable learning and teaching through creation, production, and problem-solving.
- Build sustainable, program-wide systems of professional learning for higher education instructors to strengthen and continually refresh their capacity to use technological tools to enable transformative learning and teaching.
- Ensure pre-service teachers' experiences with educational technology are program-deep and program-wide, rather than one-off courses separate from their methods courses.
- Align efforts with research-based standards, frameworks, and credentials recognized across the field. (U.S. Department of Education, Office of Educational Technology, 2016, p. 9)

The challenge is not a new one but as technology continues to change and become more ubiquitous in the lives of students and teachers, the need is becoming more urgent to prepare future teachers to effectively integrate technology in their teaching practices. As early as 1990 (Stowe, 1990), researchers surveyed teacher preparation institutions regarding their level of commitment for preparing future teachers to function in the information age. Stowe (1990) reported that the 282 colleges surveyed were implementing changes toward that goal. In fact, the Association for Educational Communications and Technology (AECT) published guidelines for the use of information technology in teacher preparation programs (AECT, 1989). These guidelines were intended to help programs produce technologically literate teachers for the 21st century (Faison, 1994). The guidelines included recommendations for research and instruction of information technology in five areas summarized as the operation of media equipment, the design of instruction to meet learner needs, and the selection, preparation and use of media and interactive technologies for instruction (AECT, 1989). Many universities responded by creating a technology course for future teachers, but rarely was technology used throughout their other courses (Foulger, Wetzel, & Buss, 2019; Judge & O'Bannon, 2008; Kolb, Kashef, Roberts, Terry, & Borthwick, 2018).

Between 1999 and 2001, the Preparing Tomorrow's Teachers to use Technology Program (PT3) of the United States Department of Education awarded $399 million toward the effort of producing five million new technology-infusing teachers for the United States (Carroll, 2005). While several programs reported successful implementation (Christensen & Knezek, 2007; Heinecke & Adamy, 2010; Mims, Polly, Shepherd, & Inan, 2006; Polly, Mims, Shepherd, & Inan, 2010; Whittier & Lara, 2006), it is unclear whether the programs remained in place as sustained or systemic after PT3 funding ended. More recently, in 2016, the United States Department of Education issued the challenge of integrating technology across the curriculum in teacher preparation programs to all educator programs (Iasevoli, 2016).

If teacher preparation programs strive to be accredited, they must meet standards provided by their state and/or national accrediting agency and most of the criteria include a technology requirement. For example, the Council for the Accreditation of Educator Preparation (CAEP) standards include the requirement that teacher candidates are prepared to use and integrate technology in teaching and learning (CAEP, 2019). In addition, most teacher educator content organizations include technology as a key component in their standards or guidelines (Foulger et al., 2017). The Teacher Educator Technology Competencies (Foulger et al., 2017) were created to guide the community in a common language and common goals for addressing the need. Determining the level at which teacher educators are competent to integrate technology into their own teaching is an important step in improving the teacher preparation programs. While some studies have measured teacher educators regarding their use of technology, the surveys were largely technology skills based (Truesdell & Birch, 2013) or focused on attitudes toward computers (Gilmore, 1998) rather than a specific set of competencies. However, at the time of this study, there were no published instruments addressing the new set of teacher educator technology competencies. This article introduces a survey intended to be administered to teacher educators as a means of determining teachers' levels of self-efficacy (confidence in their competence) in using technology in their teacher preparation courses. This can aid self-diagnosis of areas of greatest needs, or targeted support for professional development.

RESEARCH QUESTIONS

At the time of this study, there were no instruments previously developed to determine the level of technology competencies for teacher educators. This study included the development of a valid and reliable instrument to assess the Teacher Educator Technology Competencies (Foulger et al., 2017). Four research questions guided the study:

1. To what extent does the TETC Survey instrument form a reliable and valid measure of the Teacher Educator Technology Competencies?
2. What constructs are measured by the instrument based on the 12 TETC competencies?
3. To what extent do TETC Survey total scale and subscales distinguish among relevant demographic and disaggregated data groups?
4. To what extent do TETC Survey total scale and subscales relate to other educator technology proficiency measures?

METHODS

Instrument Development

The Teacher Educator Technology Competencies Survey (TETC Survey) was developed by Knezek and Christensen based on the Teacher Educator Technology Competencies (TETCs) posted on the Society for Information Technology and Teacher Education (SITE) website (http://site.aace.org/tetc/) as of 2018 (Knezek & Christensen, 2019). Each of the twelve competencies agreed upon by the TETC development team was included as a Likert-type item to be rated on a 1 = strongly disagree to 5 = strongly agree scale. The instrument was designed as a self-efficacy (competence in one's confidence) self-appraisal measure, and therefore the posted competencies were slightly modified so the core concept part of the original wording became the target portion for each of twelve items that began with "I feel confident that I could …" Several demographic items as well as the self-efficacy presentation format were adopted from the Technology Proficiency Self-Assessment (TPSA) survey (Christensen & Knezek, 2017) that has been successfully used in related studies for many years. The complete TETC Survey is included in Appendix A. Note that these items are constructed from the 12 published teacher educator competencies and do not specifically refer to the in depth criteria written for each competency, since inclusion of all criteria would potentially have added 40 additional items, resulting in increased risk of poor data acquisition due to response fatigue (Ben-Nun, 2011). Also the order of the items has been modified slightly (compared to the original list of competencies) so the instrument begins with perceived easier items, as is recommended for psychometric instrument development (Thorndike & Hagen, 1977). The TETCs in their original order, with criteria for each, are listed as originally published (Foulger et al., 2017) in Appendix B.

Study Participants

Analyses were based on the completed surveys of 223 participants consisting of 83 respondents attending the 2018 Society for Information Technology and Teacher Education (SITE) annual conference plus 140 respondents from more than one dozen universities with teacher preparation programs, primarily located in the United States, Europe, and the Asian/Pacific Region. Data collection locations were targeted to represent a broad range of teacher educators and increase prospects for generalizability of the instrument across nations and cultures. All participants voluntarily completed the surveys, either through paper and pencil administration or through a Google form online submission system created by the research team. All respondents in the United States and Europe completed English language versions of the survey, but for one university in Japan ($n = 27$) the survey process was unique and included: a) translation to Japanese by one member of the research team, with translation fidelity verifications by one additional Japanese-English bilingual teacher educator and an elementary school teacher; b) administration via department representatives to subjects via paper and pencil survey; and c) data entry into an English-variable spreadsheet by a bilingual member of the research team.

SITE conference participants were recruited through a pseudo-random sampling technique that resulted in a convenience sample. Specifically, a member of the research team approached a round table of participants waiting for a keynote to begin, or a cluster formed in the conference atrium during coffee breaks, and asked the small group if they would be willing to complete a brief survey about the Teacher Educator Technology Competencies, for the purpose of validating a new survey instrument. Those who agreed completed a front and back one-page paper form, then returned the completed form to the distributing researcher located in the vicinity. Over three days of the conference 83 completed surveys were gathered in this manner.

The demographics of the subjects across all locations and forms of data acquisition were as follows. Respondents varied in age from 25 to 77 years old with a mean age of 46.4 years. The respondents included 64% female and 36% male participants. Ninety-four (94) percent of the respondents reported owning a smartphone. For the SITE conference attendees as a disaggregated subgroup of special interest in this study, respondents varied in age from 25 to 76 years old with a mean age of 45.1 years. SITE respondents were 61% female and 39% male, with ninety-nine (99) percent reporting smartphone ownership. Thus SITE respondents were slightly younger with a slightly greater percentage of males than the participants in this study as a whole. All but one of the 83 SITE respondents reported owning a smartphone.

RESULTS

Results from this study focused on testing the psychometric properties of the new TETC Survey instrument. Reliabilities for all TETC items from the total survey instrument as well as three separate subscales were examined. In addition, construct and criterion-related validity for the TETC Survey instrument's total scale (all 12 items) and subscales were analyzed.

Reliability

Internal consistency reliability (Cronbach's Alpha) was calculated to estimate the consistency of a scale produced from the 12 TETC Survey items. Cronbach's Alpha was found to be .95, with none of the items indicating weakness to the point that removing the item would strengthen the scale. This reliability is very good according to guidelines by DeVellis (1991).

Reported Levels of Competencies

Mean, standard deviation, and minimum-maximum responses for each item were examined to ensure that a wide range of proficiencies were reported in the validation data set. Listings of item response frequency distributions allowed confirmation that every possible response category (1-5) was used by respondents, for each of the 12 survey items. As shown in

Table 1, the average level of agreement with each of the twelve items on the TETC survey instrument ranged from a low of 3.83 for “use technology to connect globally with a variety of regions and cultures” (Survey Item 5/TETC 8) to a high of 4.32 for “use online tools to enhance teaching and learning” (Survey Item 1/TETC 4). In general the 223 respondents felt somewhat comfortable with the competencies being assessed by this instrument, as indicated by the lowest group mean ratings falling just below 4 = agree on a scale of 1 = strongly disagree to 5 = strongly agree. The mean value of survey items when combined into a single scale was 4.08, slightly above 4 = agree on the 1 to 5 rating scale. Note there is some variability in the number of subjects in the analyses in Table 1 and throughout this article, due to missing data on demographics and attitude items that contributed to scales.

Table 1

Descriptive Statistics for Level of Agreement with Twelve TETC Survey Items and Total Survey Scale

I feel confident that I could …	N	Mean	Std. Dev.
1. use online tools to enhance teaching and learning (TETC 4).	223	4.32	1.09
2. use technology to differentiate instruction to meet diverse learning needs (TETC 5).	223	4.09	1.02
3. use appropriate technology tools for assessment (TETC 6).	223	4.07	1.07
4. use effective strategies for teaching online and/or blended/hybrid learning environments (TETC 7).	223	4.02	1.16
5. use technology to connect globally with a variety of regions and cultures (TETC 8).	223	3.83	1.25
6. address the legal, ethical, and socially-responsible use of technology in education (TETC 9).	222	4.06	1.03
7. engage in ongoing professional development and networking activities to improve the integration of technology in teaching (TETC 10).	222	4.26	1.04
8. engage in leadership and advocacy for using technology (TETC 11).	222	3.98	1.14
9. apply basic troubleshooting skills to resolve technology issues (TETC 12).	222	4.08	1.00
10. design instruction that utilizes content-specific technologies to enhance teaching and learning (TETC 1).	222	4.13	1.05

I feel confident that I could …	N	Mean	Std. Dev.
11. incorporate pedagogical approaches that prepare teacher candidates to effectively use technology (TETC 2).	219	4.04	1.09
12. support the development of the knowledge, skills, and attitudes of teacher candidates as related to teaching with technology in their content area (TETC 3).	219	4.15	1.01
Total Survey (12 items combined).	223	4.08	.86

Note: Ratings were on 1 = strongly disagree to 5 = strongly agree scale.

Construct Validity through Factor Analysis: Single Factor Solution

Exploratory factor analysis (principal components, varimax rotation) was conducted with the data from the 223 respondents. Initial examination of the data matrix to determine suitability for running a factor analysis produced a Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) = .93, well above the .5 criteria often judged to be adequate (Yong & Pierce, 2013); and also produced a significance level of $p < .0005$ for Bartlett's Test of Sphericity (Chi-square = 2105.14, 66 *df*), far better than the $p < .05$ typical cutoff for confirming that the data sample contains pattern relationships capable of producing factors (Yong & Pierce, 2013). Using the default criterion of Eigenvalue > 1.0 for extraction of factors, the factor analysis procedure extracted one factor accounting for 64% of the common variance in the data (see Table 2). As shown in Table 3, all 12 survey items had Pearson-product moment correlations (factor loadings) of .69 or greater with the underlying construct we will refer to as Teacher Educator Technology Competency. Factor loadings were all well above the .5 cutoff criteria (.5 x .5 = 25% of the variance of an item in common with the construct) that is often used in exploratory factor analysis, with the additional consideration that .5 is the point at which factor loadings become rare by chance ($p < .05$) for sample sizes of 120 cases or greater (Hair, Tatham, Anderson, & Black, 1998).

Table 2
Total Variance Explained by Extraction of One Factor from TETC Survey Data

Extraction	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.712	64.263	64.263	7.712	64.263	64.263
2	.776	6.470	70.732			
3	.673	5.607	76.339			
4	.511	4.260	80.600			
5	.472	3.934	84.534			
6	.446	3.720	88.254			
7	.341	2.841	91.094			
8	.314	2.615	93.710			
9	.248	2.070	95.780			
10	.204	1.703	97.482			
11	.183	1.522	99.005			
12	.119	.995	100.000			

Note: Extraction Method: Principal Component Analysis, Eigenvalue > 1 Criterion.

Table 3
Factor Loadings: Correlation of Each Item with Underlying Construct of Teacher Educator Technology Competency

I feel confident that I could …	Factor Loading
11. incorporate pedagogical approaches that prepare teacher candidates to effectively use technology (TETC 2).	.860
10. design instruction that utilizes content-specific technologies to enhance teaching and learning (TETC 1).	.855
1. use online tools to enhance teaching and learning (TETC 4).	.847
8. engage in leadership and advocacy for using technology (TETC 11).	.842
4. use effective strategies for teaching online and/or blended/hybrid learning environments (TETC 7).	.828
7. engage in ongoing professional development and networking activities to improve the integration of technology in teaching (TETC 10).	.821
3. use appropriate technology tools for assessment (TETC 6).	.816

2. use technology to differentiate instruction to meet diverse learning needs (TETC 5).	.802
12. support the development of the knowledge, skills, and attitudes of teacher candidates as related to teaching with technology in their content area (TETC 3).	.789
5. use technology to connect globally with a variety of regions and cultures (TETC 8).	.741
6. address the legal, ethical, and socially-responsible use of technology in education (TETC 9).	.705
9. apply basic troubleshooting skills to resolve technology issues (TETC 12).	.691

As shown in Table 3, the individual items having strongest association with the underlying construct were: *I feel confident that I could…*

- (Survey Item 11/ TETC 2) incorporate pedagogical approaches that prepare teacher candidates to effectively use technology,
- (Survey Item 10/TETC 1) design instruction that utilizes content-specific technologies to enhance teaching and learning, and
- (Survey Item 1/TETC 4) use online tools to enhance teaching and learning.

These topics appear to lie close to the core of Teacher Educator Technology Competency as a psychological construct, by virtue of their sharing between 72% (.847 x .847) and 74% (.860 x .860) of their variance in common with the underlying construct. Conversely, the following items appear to be in a role more supportive to the core of Teacher Educator Technology Competency viewed as a single construct: *I feel confident that I could…*

- (Survey Item 9/TETC 12) apply basic troubleshooting skills to resolve technology issues,
- (Survey Item 6/TETC 9) address the legal, ethical, and socially-responsible use of technology in education, and
- (Survey Item 5/TETC 8) use technology to connect globally with a variety of regions and cultures.

These three items share between 48% (.691 x .691) and 55% (.741 x .741) of their variance in common with the underlying construct.

The narrative of the previous paragraph enables us to answer research question 1, “To what extent does the TETC Survey instrument form a reliable and valid measure of the Teacher Educator Technology Competencies?” The answer is that the TETC Survey is a reliable (alpha = .95) and valid instrument based on construct validity established through factor analysis in the current study.

Construct Validity for Prospective Subscales of the TETC Survey

Due to the high internal consistency reliability of the 12-item TETC Survey, the researchers sought to determine whether two or more subscales with acceptable reliabilities might exist among the TETC items. Factor analyses were run specifying two factors without a simple structure (Cattell, 1973) emerging, but when three factors were specified, the procedure was able to account for 76% of the common variance in the data (see Table 4) and the simple structure shown in Table 5 emerged. This approach extracted three subscale factors with factor 1 centered around technology-infused Instructional Practices (Survey Items 1, 3, 2, 4, 7/ TETCs 4, 6, 5, 7, 10) while factor 2 focused on preservice Teacher Preparation for teaching and learning with technology (Survey Items 12, 11, 9, 10/TETCs 3, 2, 12, 1). Factor 3 focused on Appropriate Uses of technology, including digital citizenship (Survey Items 6, 5, 8/TETCs 9, 8, 11). These extractions are listed in Table 5.

Table 4
Total Variance Explained by Extraction of Three Factors from TETC Survey Data

Extraction	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.712	64.263	64.263	7.712	64.263	64.263
2	.776	6.470	70.732	.776	6.470	70.732
3	.673	5.607	76.339	.673	5.607	76.339
4	.511	4.260	80.600			
5	.472	3.934	84.534			
6	.446	3.720	88.254			
7	.341	2.841	91.094			
8	.314	2.615	93.710			
9	.248	2.070	95.780			
10	.204	1.703	97.482			
11	.183	1.522	99.005			
12	.119	.995	100.000			

Table 5
Rotated Factor Loadings for TETC Survey Three Factor Solution: Correlation of Each Survey Item with Underlying Subscale Concept on the TETC Survey

	Rotated Component Matrix		
I feel confident that I could …	1	2	3
Factor 1: Instructional Practices			
1: use online tools to enhance teaching and learning (TETC 4).	.827		
3: use appropriate technology tools for assessment (TETC 6).	.797		
2: use technology to differentiate instruction to meet diverse learning needs TETC 5).	.779		
4: use effective strategies for teaching online and/or blended/hybrid learning environments TETC 7).	.699		
7: engage in ongoing professional development and networking activities to improve the integration of technology in teaching (TETC 10).	.601		
Factor 2: Teacher Preparation			
12: support the development of the knowledge, skills, and attitudes of teacher candidates as related to teaching with technology in their content area TETC 3).		.765	
11: incorporate pedagogical approaches that prepare teacher candidates to effectively use technology (TETC 2).		.758	
9: apply basic troubleshooting skills to resolve technology issues (TETC 12).		.728	
10: design instruction that utilizes content-specific technologies to enhance teaching and learning (TETC 1).	.551	.564	
Factor 3: Appropriate Uses			
6: address the legal, ethical, and socially-responsible use of technology in education (TETC 9).			.814
5: use technology to connect globally with a variety of regions and cultures (TETC 8).			.717
8: engage in leadership and advocacy for using technology (TETC 11).			.630

Note: Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 5 iterations, Loadings < .5 suppressed.

Reliabilities for Subscale Solutions

As shown in Table 6, internal consistency reliabilities for the subscales of the TETC Survey range from alpha = .83 to alpha = .92. These reliabilities are very good (.80 - .90) according to guidelines provided by DeVellis (1991). Two of the three subscales have very high internal consistency reliabilities, comparable to the 12-item total scale score of alpha = .95. These high reliability values indicate that little measurement precision is lost by examining indices at the subscale level. For each subscale, all of the items were positive contributors. That is, for none of the three subscales would deletion of an item make the scale stronger. Note that Survey Item 10: design instruction that utilizes content-specific technologies to enhance teaching and learning (TETC 1) is cross-loaded between Factor 1: Instructional Practices and Factor 2: Teacher Preparation. Because the factor loading (correlation with the underlying construct) was slightly stronger with Teacher Preparation, this item was assigned to the Teacher Preparation subscale.

Table 6

Internal Consistency Reliabilities for TETC Subscales on Instructional Practices (F1), Teacher Preparation (F2), and Appropriate Uses (F3), in addition to TETC Total Scale Score

Scale	No. of Items	N	Alpha
Factor 1. Instructional Practices	5	222	.916
Factor 2. Teacher Preparation	4	219	.888
Factor 3. Appropriate Uses	3	222	.828
Total Scale Score: Entire Survey	12	219	.949

Note: There were no items that if deleted would make a scale stronger; All were positive contributors.

Revalidation of Subscales

Multidimensional scaling, which can produce a visual representation of distances or similarities between objects (Dunn-Rankin, Knezek, Wallace, & Zhang, 2004), provided a second validation of the primary constructs derived through factor analysis. The goal of this multidimensional scaling procedure was to determine the minimum number of dimensions necessary to accurately represent the distances among the survey items. A two-dimensional solution using the procedure ALSCAL (Euclidean distance, interval level measures) accounted for 76% (RSQ = .76) of the distances between the 12 survey items. As shown in Figure 1, the cluster that includes survey items 1, 2, 3, 4 and 7 corresponds to Factor 1 in Table 5. The cluster that includes survey items 10, 11 and 12 – if joined by survey item 9 – corresponds to Factor 2 in Table 5. The remaining survey items of 5, 6 and 8 can be assigned to a third cluster that corresponds to factor 3 in Table 5. As shown in Figure 2, if the ALSCAL procedure is restricted to its best representation in one dimension (along a straight line), then the items collapse along the Y axis shown in Figure 1. The one-dimensional ALSCAL solution accounts for just 54% of the psychometric distances between the 12 survey items, in contrast to the two-dimensional solution shown in Figure 1 that accounts for 76% of the distances.

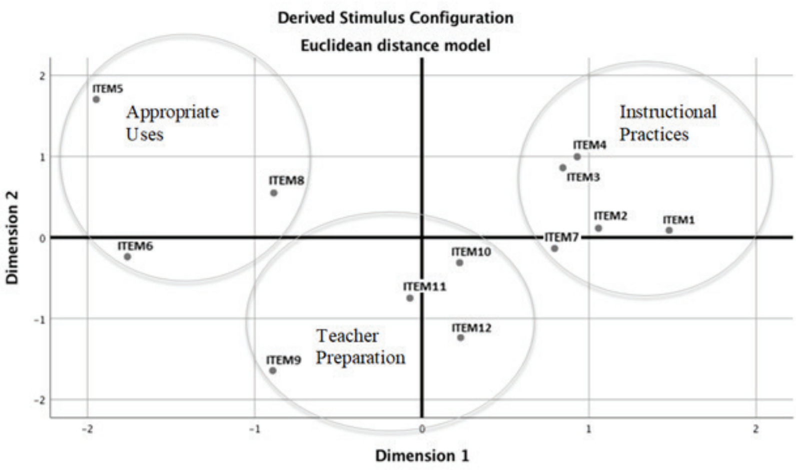

Figure 1. Dispersion among 12 TETC Survey items in two dimensions (RSQ = .76).

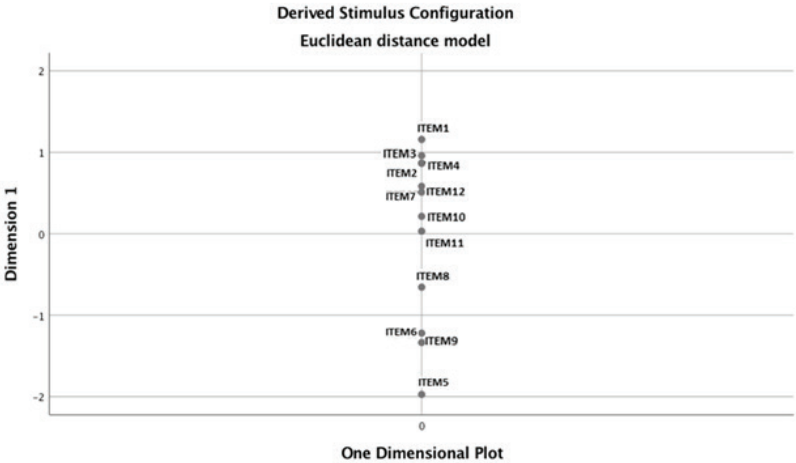

Figure 2. Dispersion among 12 TETC Survey items in one dimension (RSQ = .54).

Based on analyses presented in Tables 2-6 and Figures 1 and 2, the answer to research question 2, summarized as "What constructs are measured by the instrument?" is that 1-3 constructs appear to be measured by the TETC Survey. The total scale score and subscales 1, 2, 3 are reasonably well developed and credibly assessed by the instrument in its current form.

Criterion-Related Validity: What Can the TETC Survey Instrument Measure?

A TETC total survey score for each individual respondent was produced by averaging the 1 = strongly disagree to 5 = strongly agree ratings for each item on the TETC Survey. The same procedure was followed to average each person's responses to survey items 1, 2, 3, 4 and 7 to produce a subscale score for Instructional Practices (F1); with survey items 9, 10, 11 and 12 to produce a subscale score for Teacher Preparation (F2); and with survey items 5, 6 and 8 to produce a subscale score for Appropriate Uses (F3). The TETC total scale score and subscale scores were then used to assess the extent of associations with other demographic and teaching with technology attributes.

Gender Contrasts

As shown in Table 8, when the 12 TETC Survey items were viewed as a single unidimensional scale, male and female ratings were significantly (p < .05) different from each other, with females being higher. The effect size (Cohen's d) for the total scale score was .30. This magnitude of effect for gender is small to moderate according to guidelines by Cohen (1988) and educationally meaningful according to established research criteria (Bialo & Sivin-Kachala, 1998). Among the participants in this study, the self-reported level of competencies was higher for females than for males.

Table 8
ANOVA for TETC Total Scale Score by Gender

		N	Mean	Std. Deviation	Sig.	Effect Size
TETC Scale	Male	78	3.94	.98		
	Female	139	4.19	.76		
	Total	217	4.10	.85	.037	.30

As previously discussed (see Tables 6 and 7), three subscales with good to very good reliabilities were able to be produced from the 12 survey items. An analysis of variance by gender was completed for these subscales. As shown in Table 9, the analysis of subscales by gender revealed that for this data set gender differences were primarily in Subscale 1: Instructional Practices. The effect size of .43 for Instructional Practices would be considered in the realm of moderate according to guidelines by Cohen (1988). The effect size of .17 for Subscale 2: Teacher Preparation, and the effect size of .14 for Appropriate Uses, would be considered small by the same standard. Gender differences were not found to be significant ($p < .05$) for the subscales focusing on Teacher Preparation or Appropriate Uses. Apparently gender differences in the Teacher Educator Technology Competencies primarily reside in Instructional Practices.

Table 9

Analysis of Variance by Gender for Three Subscales of the TETC Survey

		N	Mean	Std. Deviation	Sig.	Effect Size
F1 Instructional Practices	Male	78	3.92	1.12		
	Female	139	4.31	.75		
	Total	217	4.17	.91	.002	.43
F2 Teacher Preparation	Male	78	4.01	.95		
	Female	138	4.17	.86		
	Total	216	4.11	.89	.219	.17
F3 Appropriate Uses	Male	78	3.87	1.05		
	Female	139	4.01	.96		
	Total	217	3.96	.99	.326	.14

Contrasts Based on Age

The median age of the respondents who ranged from 25 to 77 years old was 45. The median age was used to dichotomize age and create a new variable for each person, coded either 1 = low or 2 = high. As shown in Table 10, analysis of variance for TETC Total Scale Score by Age (low vs. high) uncovered no significant ($p < .05$) differences between younger and older survey respondents on the TETC total scale score (12 items) nor on any of the three subscales (not shown). The TETC total scale score effect size for younger versus older was Cohen's $d = -.16$ (older tended to be a bit lower) which would be considered small according to guidelines by Cohen (1988) and not educationally meaningful as it fell well below the ES = .3 criterion for the point at which an effect is sufficient in magnitude to be considered educationally meaningful (Bialo & Sivin-Kachala, 1996). A Pearson Product Moment Correlation computed between age as a continuous variable and TETC total scale score produced an $r = -.09$ (NS), which would also be considered small according to the guidelines for Pearson r by Cohen (1988). No meaningful differences in teacher educator technology competencies based on age were found in this study.

Table 10
ANOVA for TETC Survey Total Scale Score by Age

Age	N	Mean	Std. Dev.	Sig.	Effect Size
<45	99	4.15	.73		
>=45	113	4.02	.95		
Total	212	4.08	.86	.249 (NS)	-.16

Contrasts Based on Smartphone Ownership

Each respondent was requested to answer “no” or “yes” to the demographic question, “Do you own a smartphone?” This demographic item was included as the 21st Century counterpart of the single item (Do you have a computer at home?) the authors had found in the late 1990s to be the best indicator of high versus low technology integrating teachers (Christensen & Knezek, 2003). As shown in Table 11, when the 12 TETC Survey items were viewed as a single unidimensional scale, those who owned smartphones were significantly ($p < .05$) higher. The effect size (Cohen’s d) for the total scale score was 1.37. This magnitude of effect for smartphone ownership is classified as very large, based on the guidelines by Cohen (1988). It is well beyond the ES = .3 point at which an effect is sufficient in magnitude to be considered educationally meaningful (Bialo & Sivin-Kachala, 1996). Each of the three subscales of the TETC Survey (not shown) were also found to be significantly ($p < .05$) different based on smartphone ownership, with effect sizes that were moderate to large (F1 ES = 1.75 , F2 ES = .88, F3 ES = .98). Lack of smartphone ownership can be considered to be a good indicator of probable lower teacher educator technology competencies, in the 21st Century. Note that the research design that produced this finding does not allow determination of whether the lack of a smartphone produced lower competencies, or lower competencies caused respondents not to own a smartphone, or possibly some other circumstance caused both.

Table 11
ANOVA for TETC Survey Total Scale Score by Smartphone Ownership

	N	Mean	Std. Dev.	Sig.	Effect Size
No	12	3.00	1.35		
Yes	205	4.17	.77		
Total	217	4.10	.85	.0005	1.37

Based on the outcomes of the analysis of variance procedures presented in this section, we can address research question 3, "To what extent do TETC Survey total scale and subscales distinguish among relevant demographic and disaggregated data groups?" The answer is that the instrument indicated a moderate to large effect on lack of ownership of a smartphone as an indicator of lower proficiency in Teacher Educator Technology Competencies, and a small to moderate effect of gender with females being higher, especially on the subscale of Instructional Practices. There was a small but not significant ($p < .05$) effect of age also possibly indicated, with older respondents tending to report slightly lower competencies. The TETC Survey total scale score and subscales appear to be capable of distinguishing among relevant demographic groups.

Contrasts Based on SITE Conference Attendance

Researchers conjectured that responses to the TETC Survey instrument for the Society for Information Technology and Teacher Education (SITE) annual conference attendees might differ from responses provided by the teacher educator community as a whole. This was conjectured because teacher educator technology competencies are core to the purpose of SITE as a professional society. As shown in Table 12, group mean averages for SITE conference attendees were significantly ($p < .05$) different from other study participants on the TETC Survey total scale score. SITE participants were moderately higher (ES = .55) (Cohen, 1988) than the collective group of respondents providing data from other sources. SITE conference attendees were also higher on each of the TETC Survey subscales, with effect sizes of Cohen's d = .50 for Instructional Practices, .49 for Teacher Preparation, and .50 for Appropriate Uses.

Table 12
ANOVA for TETC Survey Total Score by
SITE Annual Conference Attendee vs. Other

	N	Mean	Std. Dev.	Sig.	Effect Size
SITE	83	4.38	.65		
Other	140	3.91	.92		
Total	223	4.08	.86	.0005	.55

Alignment of TETC Survey Scale Score and Subscales with Established Measure of Technology Integration Proficiency

Sixty-eight (68) respondents who completed the TETC Survey online also completed a self-report measure of Stages of Adoption of Technology (Christensen, 2002; Christensen & Knezek, 1999). This instrument has previously been used in several studies and has been shown to align well with other long established measures of levels of development in technology integration proficiency. For example, Hancock, Knezek and Christensen (2007) found that when used together, Stages of Adoption of Technology (Christensen, 2002; Christensen & Knezek, 1999), the Concerns-Based Adoption Model Levels of Use (CBAM LoU) (Griffin & Christensen, 1999) and Apple Classrooms of Tomorrow (ACOT) (Dwyer, 1994) teacher stages produced an internal consistency reliability coefficient of alpha = .84. Stages of Adoption of Technology was included in the current study to assess the alignment of the new TETC Survey with an established measure of technology proficiency. A linear regression (not shown) predicting Stages from 12 competencies confirmed a high level of association, with competencies overall, accounting for 69% (RSQ = .685, $p < .0005$) of Stages of Adoption. In the next paragraph we examine the association between Stages and subscales as well as total scale score for the TETC Survey instrument.

As shown in Table 13, the correlations between Stages of Adoption of Technology and the three TETC Survey subscales as well as TETC Survey total scale score ranged from $r = .636$ to $r = .712$. All are significant at the $p < .01$ level and all fall in the range of large effects (strong associations) according to guidelines by Cohen (1988). All four indices are of sufficient magnitude to be classified as in the zone of desired effects according to modern psychometric guidelines (Lenhard & Lenhard, 2016). Therefore the answer to research question 4, “To what extent do TETC Survey total scale and subscales relate to other educator technology proficiency measures?” is that they relate to a large extent. There is a strong association between the derived TETC Survey subscales and Stages of Adoption of Technology as a criterion measure. The strongest association with 51% of the variance in common (.712 x .712 = .51) was found between Stages of Adoption and Teacher Preparation (Subscale 2). However, the association between Stages of Adoption and the total scale score for TETC Survey was found to be almost as strong, with 50% (.710 x .710 = .50) of the variance in common.

Table 13
Correlations Between TETC Scale/Subscale Scores and Stages of Adoption of Technology

		Stage of Adoption
TETC Total Scale Score	Pearson Correlation	.710**
	Sig. (2-tailed)	.0005
	N	68
TETC Subscale 1: Instructional	Pearson Correlation	.644**
Practices	Sig. (2-tailed)	.0005
	N	68
TETC Subscale 2: Teacher Preparation	Pearson Correlation	.712**
	Sig. (2-tailed)	.0005
	N	68
TETC Subscale 3: Appropriate	Pearson Correlation	.636**
Uses	Sig. (2-tailed)	.0005
	N	68

Note. **. Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

While competencies (confidence in their competence) are an important component for teacher educators in their quest to integrate technology throughout the educator preparation programs, there are additional elements needed to fully implement technology integration. This is implied by the correlations listed in Table 13, where even the strong association of the TETC Survey total scale score with Stages of Adoption of Technology, with the two sharing 50% of their variance in common leaves half of a typical teacher educator's level of proficiency in technology integration (Stages) to be accounted for from other sources. Research on classroom teachers for the past two decades has shown that there must be the willingness to teach with technology, the skill to use and model technology, access to the tools needed, and support to integrate technology to enhance learning (Agyei & Voogt, 2011; Knezek, Christensen, Hancock, & Shoho, 2000; Petko, 2012). A focus has also been evolving in the area of pedagogy for the integration of technology into teaching and learning practices (Knezek & Christensen, 2016; Niess, 2005; Mishra & Koehler, 2006; Petko, 2012). Earlier studies in this area are relevant to current considerations for teacher educator technology competencies, if we assume that teacher educators (who teach preservice teachers) are similar to K-12 classroom teachers (who teach students) in that they have similar characteristics and requirements in their quest to model and integrate technology for preservice students.

One examination of the Preparing Tomorrow's Teachers to Use Technology (PT3) project outcomes found it was necessary for teacher preparation programs to address multiple facets. These included curriculum redesign in all education courses, and development of teacher educators' technology integration skills with personalized support and opportunities for integrating technology into clinical teaching experiences (Mims et al., 2006). Many teacher education programs have focused on this issue by making program-wide changes. For example, the University of Michigan integrated the components of a technology course into their four-semester program. The program begins with the philosophical framework related to teaching with technology and ends with the student teachers integrating technology into their clinical experiences (U.S. Department of Education, Office of Educational Technology, 2016). The program-wide and program-deep implementation includes the preparation needed for teacher educators to be successful in technology implementation with their students. Another educator preparation program has instituted a successful model using a three-tiered approach (Truesdell & Birch, 2013). The program includes a literacy component to establish a level of knowledge among teacher educators, the augmentation of the required courses that include modeling and tools allowing faculty to model the use of instructional technology, and finally the transformation of the program in which the activities in the courses could only be accomplished through the leveraging of technology (Truesdell & Birch, 2013). In addition, the program provides a technology facilitator to support and guide the implementation of the program. These sample scenarios indicate there are many successful ways to implement technology integration into teacher education programs. Pierson and Borthwick (2010) have developed an Effective Technology Professional Development (ETPD) model that could aid programs wishing to transform themselves, in the systematic assessment and evaluation of progress toward their goals. The ETPD model includes an approach to strengthen the evaluation of professional development and includes what, where and how components (Pierson & Borthwick, 2010). The what component uses the TPACK framework to guide the development of professional development (Pierson & Borthwick, 2010). The where component incorporates the context of the use of technology and the supporting environment for teachers during and after professional development (Pierson & Borthwick, 2010). The how component involves the research design of the evaluation from the beginning and includes teachers as research partners in the loop of data collection and interpretation of the data to improve teaching with technology (Pierson & Borthwick, 2010).

One theme emerging throughout the current discussion of ways to successfully infuse technology into teacher education programs is the need for teacher educators themselves to be proactive in advancing their own skills, and in moving the field forward. The researchers observed when gathering data for this study that attendees at the Society for Information Technology and Teacher Education (SITE) annual conference frequently engaged in discussion about the competencies immediately after completing the survey. The researchers expected these attendees as a group ($n = 83$) would be measurably different and possibly higher than the other teacher educator respondents ($n = 140$). Indeed, as shown in Table 12, the SITE attendees were significantly ($p < .05$) different from other respondents as a group, and rated their competencies higher. The effect of being a SITE conference participant on TETC total survey score was Cohen's $d = .55$, which would be considered moderate according to guidelines by Cohen (1988). The SITE attendees were significantly ($p < .05$) higher on each of the three subscales of the TETC Survey as well. This organization would likely be poised to keep the momentum moving forward.

LIMITATIONS

There were several limitations to this study. The participants who completed the survey were not given a systematic background about the competencies. As one specific example, while the survey included each of the 12 competencies, the criteria for each of the competencies (see Appendix B) were not included in the survey. This could have led to a lack of clear understanding of what was being asked with each survey item, on the part of respondents. However, many of the SITE participants ($n = 83$) were familiar with the competencies and criteria as there were presentations and announcements about the competencies at the conference. For the purposes of this instrument validation study, there is evidence that the desirable sampling goal of having a wide range perceived proficiency levels among the respondents (Thorndike & Hagen, 1977) was achieved. The stable factor structures (Cattell, 1973) and high reliabilities (DeVellis, 1991) that emerged attest to a common recognition of meaning and consistency of ratings on the part of most study participants.

Having approximately one-third of the study participants sampled while attending the Society for Information Technology and Teacher Education annual conference could have also led to another imperfection in the data. SITE attendees could be expected to be relatively high in these competencies, since the TETCs are mainstream to the purpose of this professional society. Reliabilities for this group could be somewhat inflated due to a ceiling effect resulting from high scores. A spot check of internal consistency reliabilities for all SITE attendees (alpha = .936) versus all others (alpha = .947) indicated that both disaggregated subgroups were almost equally high in their reliabilities so there was no evidence of inflated reliabilities among those attending SITE.

Nevertheless, lack of certainty of equivalent meanings for items and rating scales among the myriad of different geographic locations and cultural contexts within which TETC Surveys were completed is a limitation of any study of this nature. Most of the participants from Asia completed a survey that was translated from English to their local language, and some nuances may have been lost in translation. Conversely but equally important, participants from Europe completed the survey in English but European respondents had varying levels of mastery of English, given that for most it was not their native language.

One more area of limitations is important to mention. This instrument validation study is one of the earliest empirical studies touching on the question of: "How many different constructs are really represented among the twelve competencies created through a Delphi technique (Foulger et al., 2017)?" Based on the findings of this study, the answer appears to be one main construct that can be represented in more detail through three subscales. More research is needed to determine if these same subscale representations emerge when the instrument is used in different contexts including additional nations and cultures. Cross-validation with other instruments based on the TETCs is also warranted, since this study used just one form of an instrument based on the 12 competencies of the Teacher Educator Technology Competencies (Foulger et al., 2017).

IMPLICATIONS FOR TEACHER EDUCATION

Validation of acceptable performance for this new TETC Survey instrument opens up the prospect for contributing to the field of teacher education in several ways. One prospect is that the instrument could be used to determine areas in which professional development might be needed in order for deans and others to support teacher educators in their use of technology in their teacher preparation courses. The instrument could also be used by an individual faculty member for self-appraisal, perhaps to help choose courses to teach that align with the faculty member's self-verified strengths. Conversely, the survey could also be used to self-identify an individual's areas that need strengthening, especially if future versions of the survey could be expanded to include additional items to develop subscales in areas such as ethics or advocacy and leadership. Although the reliability of the current version of the TETC Survey instrument has been shown in this study to be very high (alpha > .9), the precision and clarity of meaning of future versions of TETC Surveys might be improved by including brief bulleted criteria from the original competency write-ups (Foulger et al., 2017) as part of the item stem for each of the 12 competencies. This could be implemented as a click point, pop-up, "more info?" button in a web-based system, and would have the effect of more fully describing each competency for a survey participant unfamiliar with the foundational literature in the Teacher Educator Technology Competencies realm.

The quick administration time of the TETC Survey instrument implies that it could be easily combined with other instruments to form a battery of measures addressing other essential needs for teacher educators, such access to technology tools, time for learning new systems and technologies, and alternative paths for upgrading their own skills in teacher preparation pedagogies.

CONCLUSION

Analysis of the TETC Survey based on data from 223 participants has confirmed that the instrument possesses respectable psychometric properties and is worthy of use in further studies. The instrument has shown very high internal consistency reliability (alpha = .95 for 12 items) and credible construct validity as a unidimensional scale. The instrument has also shown to have acceptable internal consistency reliability for three subscales related to Instructional Practices (alpha = .92, 5 items), Teacher Preparation (alpha = .89, 4 items) and Appropriate Uses (alpha = .83, 3 items). The use of this instrument is recommended for establishing a baseline measure of how confident teacher educators are for modeling and using technology with their teacher candidates.

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APPENDIX A.

Teacher Educator Technology Survey

University: ____
College or Department: ______________________________
Gender: ① Male ② Female **Age:** ____
University Rank Position: ______________________________________
Level taught:

① Pre-service
② Graduate
③ Administrator
④ Don't teach
⑤ Other: Specify__________

What content area do you teach?

① Science
② English/LA
③ Mathematics
④ Social Studies
⑤ Technology
⑥ Arts
⑦ Other: Specify_______________

Work Location (Country): ________________
Do you own a smart phone? ① No ② Yes

Instructions: Select one level of agreement for each statement to indicate how you feel.
SD = Strongly Disagree, D = Disagree, U = Undecided, A = Agree, SA = Strongly Agree

	I feel confident that I could...	**SD**	**D**	**U**	**A**	**SA**
1.	use online tools to enhance teaching and learning (TETC 4).	①	②	③	④	⑤
2.	use technology to differentiate instruction to meet diverse learning needs (TETC 5).	①	②	③	④	⑤
3.	use appropriate technology tools for assessment (TETC 6).	①	②	③	④	⑤
4.	use effective strategies for teaching online and/or blended/hybrid learning environments (TETC 7).	①	②	③	④	⑤
5.	use technology to connect globally with a variety of regions and cultures (TETC 8).	①	②	③	④	⑤

6.	address the legal, ethical, and socially-responsible use of technology in education (TETC 9).	①	②	③	④	⑤
7.	engage in ongoing professional development and networking activities to improve the integration of technology in teaching (TETC 10).	①	②	③	④	⑤
8.	engage in leadership and advocacy for using technology (TETC 11).	①	②	③	④	⑤
9.	apply basic troubleshooting skills to resolve technology issues (TETC 12).	①	②	③	④	⑤
10.	design instruction that utilizes content-specific technologies to enhance teaching and learning (TETC 1).	①	②	③	④	⑤
11.	incorporate pedagogical approaches that prepare teacher candidates to effectively use technology (TETC 2).	①	②	③	④	⑤
12.	support the development of the knowledge, skills, and attitudes of teacher candidates as related to teaching with technology in their content area (TETC 3).	①	②	③	④	⑤

TETC Survey by G. Knezek & R. Christensen 2/2018 based on Teacher Educator Technology Competencies (TETCs) 2017 by T. Foulger, K. Graziano, D. Schmidt-Crawford, & D. Slykhuis https://www.learntechlib.org/p/181966/.
For annotated listing see http://site.aace.org/tetc/.

APPENDIX B.

Teacher Educator Technology Competencies*

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 technology.

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 on line and/or blended/hybrid learning environments.
a) Model online and blended leaning 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

* Source: Foulger, T.S., Graziano, K. J., Schmidt-Crawford, D., & Slykhuis, D. (2017). Teacher Educator Technology Competencies. *Journal of Technology and Teacher Education, 25*(4), 413-448.