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Development and Validation of the Teachers' Perceptions of Computers Survey

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## Development and Validation of the Teachers' Perceptions of Computers Survey

## Abstract

The purpose of this study was to validate the Teachers' Perceptions of Computers Survey that was used in the evaluation of the Teaching and Learning Summer Institutes staff development program. The participant responses from the Comfort and Confidence Using Technology section of the survey were validated using exploratory and confirmatory factor analysis. Internal consistency reliabilities of the scores from both the complete survey ( $\alpha = .98$ ) and the Confidence and Comfort Using Technology section ( $\alpha = .92$ ) were high. The survey is available from the researchers by request.

## Development and Validation of the Teachers' Perceptions of Computers Survey

## Purpose

Professional development is one of the essential conditions necessary for the integration of technology into the curriculum (Adelman, Donnelly, Dove, Tiffany-Morales, Wayne, & Zucker, 2002; Lemke, Wainer, & Haning, 2006; NETTS Project 2006; Ringstaff & Kelley, 2002; SETDA, 2006; TSSA Collaborative; 2001). Effective professional development includes evaluation to assure that the training is meeting the specific needs of the participants (Rodriguez, & Knuth, 2000). However, there is scant research that has measured teacher change from professional development (Dede, Breit, Ketelhut, McCloskey, & Whitehouse, 2005).

The *Perceptions of Computers Survey* is an instrument that was initially delivered in both a paper and web form in 2000 to examine how computers are used in the classrooms by teachers and students (Hogarty & Kromrey, 2000; Hogarty, Lang, & Kromrey, 2003; Lang, Raver, White, Hogarty, & Kromrey, 2000). This survey, in its web-based format, was recently used (with minor adaptations) to examine the changes in teachers' perceptions of technology before and after summer training sessions that were sponsored by the Florida Department of Education.

The purpose of this study is to validate the scores obtained from the *Perceptions of Computers Survey* instrument to assure accurate measurement of the constructs. This validation study is essential for policy makers and educators to make appropriate interpretations about the results obtained by using this instrument to measure the changes that occur among teachers who participate in professional development programs.

### Perspective(s) or Theoretical Framework

The state of Florida and the school districts have invested significant resources into supporting teachers to effectively integrate the latest technology into their current teaching practices. Many teachers have volunteered to participate in the Florida Digital Educators Program (which includes attending 4-day summer training sessions). Their investment includes not only their commitment to participate in the training sessions but also their continuation of this training as they integrate technology within their K-12 classrooms. Since both time and financial resources are limited, it is imperative to measure the effectiveness of the implementation of this staff development program. Accurately measuring changes in teachers' perceptions is crucial to the evaluation process.

### Research Methods

#### *Survey Design*

The survey was developed using recommended psychometric procedures (AERA/APA/NCME, 1999; Crocker & Algina, 1986; Dillman, 2000). First, researchers with expertise in the integration of technology into the curriculum, selected the constructs based on previous research studies and survey instruments used in the field (e.g., Becker & Anderson, 1998; Gardner, Discenza, & Dukes, 1993; Kernan & Howard, 1990; Sandholtz, Ringstaff, & Dwyer, 1996; Smerdon, Cronen, Lanahan, Anderson, Iannotti, & Angeles, 2000). Then items were developed and selected through an iterative process by a research team of members with expertise in instructional technology, measurement, evaluation, and research. The survey instrument was designed and pilot tested with graduate students. Feedback from the participants and psychometric results guided minor revisions to the final paper survey, which was composed of four pages containing demographic items and eight sections of perceptions of computers

items. The web instrument was developed to match the paper instrument following guidelines of Dillman (2000) and White, Carey, and Dailey (2001). Finally, the survey was sent for field testing to all of the teachers ( $N = 2156$ ) in a large urban southeastern school district.

Twenty percent of the teachers were sent the web survey, and the rest were sent paper surveys. Matched samples of schools by level, size, and free or reduced lunch status were randomly selected in order to compare the web-based delivery with the paper delivery. Separate exploratory factor analyses were conducted for each of the eight sections of the survey. Internal consistency reliability measured by Cronbach's alpha for the responses for each of these sections ranged between .74 and .92. At the time this field test was conducted, there were differences in the response rates for paper-based and web-based surveys (39% vs. 10%). Differences in the responses obtained by web-based and paper-based administration on the eleven subscales were significant for six of the subscales; however, they were small in absolute magnitude.

The *Perceptions of Computers Survey* currently includes 99 items to measure eight categories associated with teachers' perceptions about using computers for instruction: (1) Teacher Preparation for Technology Use, (2) Confidence and Comfort Using Technology, (3) General School Support, (4) Integration of the Computer into the Classroom, (5) Types of Software Used by Teachers to Complete School Related Activities, (6) Types of Software Used by Students to Complete School Related Activities, (7) Perceptions of Computers and Technology, and (8) Digital Educator Profile.

Before using the survey in the research study, the survey design, constructs, and items were examined by researchers with expertise in the integration of technology into the curriculum. Items were updated based on current research (e.g., Dede et al., 2005; O'Dwyer, Russell, & Bebell, 2005; SETDA, 2006). These items were then placed into the web interface, previewed by

the team, and then pilot tested by additional teachers. Feedback from the pilot tests were used to make final revisions before releasing the instrument.

The initial items on the deployed survey collected information about the participants' demographics, background teaching experiences and training, and current use of computers. The nine successive pages measured the seven constructs of interest. Participants were given a special Universal Resource Locator (URL) or web address to log into the system. They used their e-mail address as their username and created their own password. A fail safe was created for the participants who forgot the password so that the password could automatically be e-mailed to them at their e-mail address.

If the participants tried to progress to the next section or page, and they had not completed all items on the page, a pop-up alert requested them to complete the listed incomplete items. The participants could by-pass this alert by pressing OK to the alert and OK to the confirmation that verifies that they wanted to continue. Participants could stop the survey and then log back on at a different time to complete the survey. Participants could not begin the post-survey until after they had completed the pre-survey.

### *Participants*

Participants included 475 K-12 teachers, media specialists, instructional technology specialists and trainers, and administrators, who attended six different summer institutes that were offered in five Florida regions. Participants from nineteen school districts, representing urban, suburban, and rural areas took part in the institutes. Of the 19 districts, 11 were recipients of the Florida Department of Education EETT grants. The participants became involved with the institute in different ways. Districts that were awarded the grants were required to send a certain number of their staff to the summer institutes; as a result some of the participants were told by

their administrators or grant coordinators that they needed to attend, while other participants voluntarily attended. The participants had diverse backgrounds, representing a variety of positions within public schools at different grade levels and subject areas, as well as a full range of technical ability levels. Most participants were female (84%). Seventy-one percent were White/ Non-Hispanic, 20% African American, and 5% Hispanic. Most participants had a Bachelors Degree (53%) or Masters Degree (44%). Three percent had either a doctorate or Educational Specialist advanced degree. The pre-survey was taken by 398 Summer Institute participants. Three hundred forty-one completed the pre-survey, and two hundred twenty-seven participants began the post-survey.

#### *Data Analysis*

A selection of the items from the pre-survey was also included on the post-survey, which was released during the fourth day of training. These items were used to measure internal consistency reliability of the constructs. In addition, these items were used to measure any changes that occurred in participants' perceptions after attending the training sessions.

For this paper, only the results from the Confidence and Comfort Using Technology section are reported, because these items were identical on the pre and post-institute surveys. However, the total pre-survey with items and response options is available from the researchers by request.

Initially, the data collected with the web instrument had to be cleaned and prepared for analysis with the SPSS for Windows version 15.0 (SPSS, 2006) statistical software package. Descriptive statistics for the items were conducted to screen the data for anomalies such as outliers and violation of the normalcy assumption. Then, the sample of participants who

completed the pre-survey was randomly assigned to two groups with 199 participants in each group.

Validation of the survey was conducted in three major steps: (1) exploratory factor analysis and reliability analysis with the first sample group; (2) confirmatory factor analysis and reliability analysis with the second sample group; and (3) reliability analysis with the post-survey sample on the *Perceptions of Computers and Technology* category.

During the first step, the responses from the first sample group were used for exploratory factor analysis on each category to determine if there were any sub factors. Then the first sample was used to compute Cronbach's alphas for the scores from each factor in order to determine the internal consistency of the data. During the second step, confirmatory factor analysis was conducted with the responses from the second sample to confirm the model fit. Cronbach's alphas were computed for the scores of the items retained for each factor category with the responses from the second sample. During the last step, Cronbach alphas of internal consistency were computed for the scores from the *Perceptions of Computers and Technology* items on the post-survey to determine if the survey maintained its internal consistency over time.

## Results

### *Limitations*

The results of this validation study must be interpreted with consideration for its limitations. First, a convenience sample was used for the study. In addition, the results of the survey were not available from every participant. The survey was long and many did not complete the pre-survey, and more did not complete the post-survey. Second, the method of assessment is through self-report, and some of the participants may not have answered truthfully.

Furthermore, some of the participants were administrators and technology specialists, so their responses may not reflect the perceptions of teachers who work within the classroom.

*Descriptive statistics*

Before conducting the statistical analyses, the data were visually screened for anomalies such as outliers. Items with uninterruptible responses (e.g. “mucho” where a number was to be entered or an impossible number response) were deleted from the data. The participants were randomly assigned to two groups using SAS 9.13. Then descriptive statistics were conducted to compare these two groups (see Table 1). The two groups were considered similar enough in demographics to conduct the study.

Table 1

*Pre-Survey Participant Demographics*

	Sample 1		Sample 2	
	Frequency	Percent	Frequency	Percent
<b>Gender</b>				
Male	29	15	32	16
Female	158	79	156	78
Missing	12	6	11	6
Total	199	100	199	100
<b>Ethnicity</b>				
African American	42	21	34	17
Asian/Pacific Islander	2	1	1	1
Hispanic	7	4	12	6
Native American/American Indian	1	1	1	1
White/Non-Hispanic	132	66	135	68
Other	3	2	4	2
Missing	12	6	12	6
Total	199	100	199	100
<b>Highest Degree</b>				
Bachelors	103	52	96	48
Masters	77	39	87	44
Doctorate	2	1	4	2
Specialist (Ed.S)	4	2	1	1
Other	1	1	---	---
Total	187	94	188	94
Missing	12	6	11	6
Total	199	100	199	100

Next, the descriptive statistics (minimum, maximum, mean, standard deviation, skewness, and kurtosis) of the responses of the two groups to the items were compared. The responses of the two groups were determined to be similar enough to conduct exploratory factor analysis with the first group and confirmatory factor analysis with the second group.

#### *Factor Structure*

After listwise deletion to treat missing data, the responses from 126 participants from sample 1 were used for exploratory factor analysis. A Spearman Correlation analysis was conducted to determine if the items on the survey were correlated. Since many items were correlated, a series of exploratory factor analyses were conducted using principal axis factoring for orthogonal solution with promax rotation. Exploratory factor analysis was conducted separately with the items from each of the categories designated on the survey. Kaiser's Rule was used to extract the number of factors. Examination of the skree plot verified the number of factors that were extracted.

The Confidence and Comfort Using Technology category had items that loaded on two factors, which explained 67.8% of the variance, (1) comfort level and (2) beliefs about the benefits of technology. There were no items identified with lower than .300 loadings (see Table 2).

Table 2

*Exploratory Factor Analysis: Rotated Factor Pattern and Structure Matrices for Confidence and Comfort Using Technology*

Factor and Item	Pattern Matrix		Structure Matrix	
	Factor		Factor	
	1	2	1	2
<b>Comfort Level</b>				
I feel prepared to guide other teachers in planning and implementing lessons that incorporate technology	1.017	-0.157	0.913	0.515
I feel prepared to use laptop computers in my classroom	0.882	0.041	0.909	0.624
I have had adequate training in technology use	0.779	-0.061	0.875	0.671
I feel comfortable using computers for classroom instruction	0.767	0.164	0.808	0.645
I feel prepared to create rubrics to assess multimedia projects	0.760	-0.030	0.756	0.614
I feel comfortable assigning multimedia projects to my students	0.678	0.196	0.740	0.472
I use computers effectively in my classroom	0.622	0.203	0.739	0.454
<b>Beliefs about the Benefits of Technology</b>				
I believe that my use of technology enhances student performance	-0.079	0.942	0.543	0.889
I believe that technology enhances my teaching	0.110	0.750	0.605	0.822
I believe that student use of technology enhances student performance	-0.018	0.705	0.448	0.693

*Internal Consistency Reliability*

Cronbach's alpha was computed for the internal consistency reliability of the total survey ( $\alpha = .978, CI_{95} .972 \text{ to } .983$ ) and for the Confidence and Comfort Using Technology section ( $\alpha = .921, CI_{95} .903 \text{ to } .938$ ). The Item-Total Statistics were examined for each factor to find items that were not functioning well, because removing the items improved the reliability of the scale. The following item was identified for review and possible revision or replacement from the

Confidence and Comfort Using Technology: *I believe that student use of technology enhances student performance.*

Exploratory factor analysis of the scores on the pre-survey and the scores on the post-survey for Confidence and Comfort Using Technology factors revealed the same underlying construct with two sub factors for comfort level and beliefs.

#### *Confirmatory Factor Analysis*

The next step in the validation process was to use confirmatory factor analysis with maximum likelihood estimation method on the scores of the sample 2 group using MPlus Version 3.0 (Muthen & Muthen, 2004). Confirmatory factor analysis also allows the examination of correlations among the factors and among the residuals.

A first-order confirmatory factor analysis was used to confirm the fit of the proposed model for each separate category in the survey. The models assumed that sub-factors were correlated and all errors were uncorrelated. The responses were analyzed using Maximum Likelihood estimation method. Significant parameter estimates were determined by using the EST/ S.E. ratio of greater than 2. All factor loadings were significant for the sub factors and items. The evaluation of the overall fit of the apriori model was determined using Chi Square Test of Model Fit. The Model Modification Indices were used to determine if any of the items were not functioning well and should be revised or removed from the model. Model Modification Indices provide improvement measures for the model fit from identifying items that load on more than one factor, those that are correlated with items on different sub factors, and those that have correlated errors. Then the Chi Square Test of Model Fit for the updated model was compared with the statistic from the original model to determine the degree of improvement.

The standardized parameter estimates for the loadings of each item on its sub factor and the parameter estimates of each sub factor with other sub factors are depicted on the factor diagram for the final model (see Figure 1). Also, all standardized residual variances of the final model are reported on the diagram for each category. In addition, all unstandardized and standardized parameters and variance estimates and their significance in the final model are included in Table 3.

Table 3

*Confirmatory Factor Analysis: Unstandardized and Standardized Parameter Estimates for Confidence and Comfort Using Technology*

Factor and Items	Parameter Estimates		
	Unstandardized	Standardized	Est./S.E.*
<b>Comfort</b>			
I use computers effectively in my classroom	1	0.732	0
I feel prepared to use laptop computers in my classroom	1.258	0.806	10.916
I feel prepared to create rubrics to assess multimedia projects	1.224	0.764	10.299
I feel prepared to guide other teachers in planning and implementing lessons that incorporate technology	1.559	0.875	11.908
I feel comfortable using computers for classroom instruction	1.117	0.852	11.575
I feel comfortable assigning multimedia projects to my students	1.483	0.898	12.237
<b>Belief</b>			
I believe that technology enhances my teaching	1	0.886	0
I believe that student use of technology enhances student performance	0.851	0.812	12.795
I believe that my use of technology enhances student performance	1.005	0.808	12.726
Belief with Comfort	0.274	0.627	5.925
<b>Variances</b>			
Comfort	0.505	1	5.623
Belief	0.378	1	7.171
<b>Residual Variances</b>			
I use computers effectively in my classroom	0.437	0.464	8.772
I believe that technology enhances my teaching	0.104	0.215	4.864
I believe that student use of technology enhances student performance	0.142	0.341	6.97
I believe that my use of technology enhances student performance	0.203	0.347	7.044

Table 3

*Confirmatory Factor Analysis: Unstandardized and Standardized Parameter Estimates for Confidence and Comfort Using Technology*

Factor and Items	Parameter Estimates		
	Unstandardized	Standardized	Est./S.E.*
I feel prepared to use laptop computers in my classroom	0.43	0.35	8.313
I feel prepared to create rubrics to assess multimedia projects	0.541	0.417	8.613
I feel prepared to guide other teachers in planning and implementing lessons that incorporate technology	0.377	0.235	7.388
I feel comfortable using computers for classroom instruction	0.239	0.275	7.796
I feel comfortable assigning multimedia projects to my students	0.268	0.194	6.807

\*All Est./S.E. was significant >2.0

The results from the confirmatory factor analysis of the Confidence and Comfort Using Technology category had a Chi Square that indicated a significant lack of fit,  $\chi^2 (N = 34, 181) = 92.632, p < .000$ ; however, since this usually occurs with large sample sizes, the results were also verified using other methods of evaluating the Model Fit. The Comparative Fit Index (CFI) = 0.95, and the Tucker Lewis Index (TLI) = 0.94 are close to standard of 0.95 also indicating Model Fit. The Root Mean Square Error of Approximation (RMSEA) = 0.072 (CI<sub>90</sub> = 0.074, 0.192) indicated model fit because the confidence interval included 0.08. The Standardized Root Mean Square Residual (SRMR) = 0.052 indicated lack of fit because it was over 0.05. Thus, some indicators indicate that the model needed adjustments. The item (*I have had adequate training in technology use*) was removed from the analysis and the Model Fit improved to  $\chi^2 (N = 26, 181) = 50.384, p = .0028$ . Although this Chi Square still indicated significant lack of fit, other indicators were examined to see if there was improvement. The Comparative Fit Index (CFI) = 0.98, and the Tucker Lewis Index (TLI) = 0.97 indicated a better model fit. The Root Mean Square Error of Approximation (RMSEA) = 0.072 (CI<sub>90</sub> = 0.041, 0.102) indicated model

fit because the confidence interval included 0.08. The Standardized Root Mean Square Residual (SRMR) = 0.038 indicated good fit because it was under 0.05. Thus, six items were included in the Comfort Factor and three items were retained in the Belief Factor of the final model (see Table 4 and Figure 1).

Table 4

*Items identified for review and potential revision for Confidence and Comfort Using Technology Factor.*

Factor and Items	Identified for review
Confidence and Comfort Using Technology	
I have had adequate training in technology use	**
I use computers effectively in my classroom	
I believe that technology enhances my teaching	
I believe that student use of technology enhances student performance	*
I believe that my use of technology enhances student performance	
I feel prepared to use laptop computers in my classroom	
I feel prepared to create rubrics to assess multimedia projects	
I feel prepared to guide other teachers in planning and implementing lessons that incorporate technology	
I feel comfortable using computers for classroom instruction	
I feel comfortable assigning multimedia projects to my students	

Note:

\* Identified by reliability analysis with sample 1.

\*\* Identified by confirmatory factor analysis with sample 2.

\*\*\* Identified by reliability analysis with sample 2.

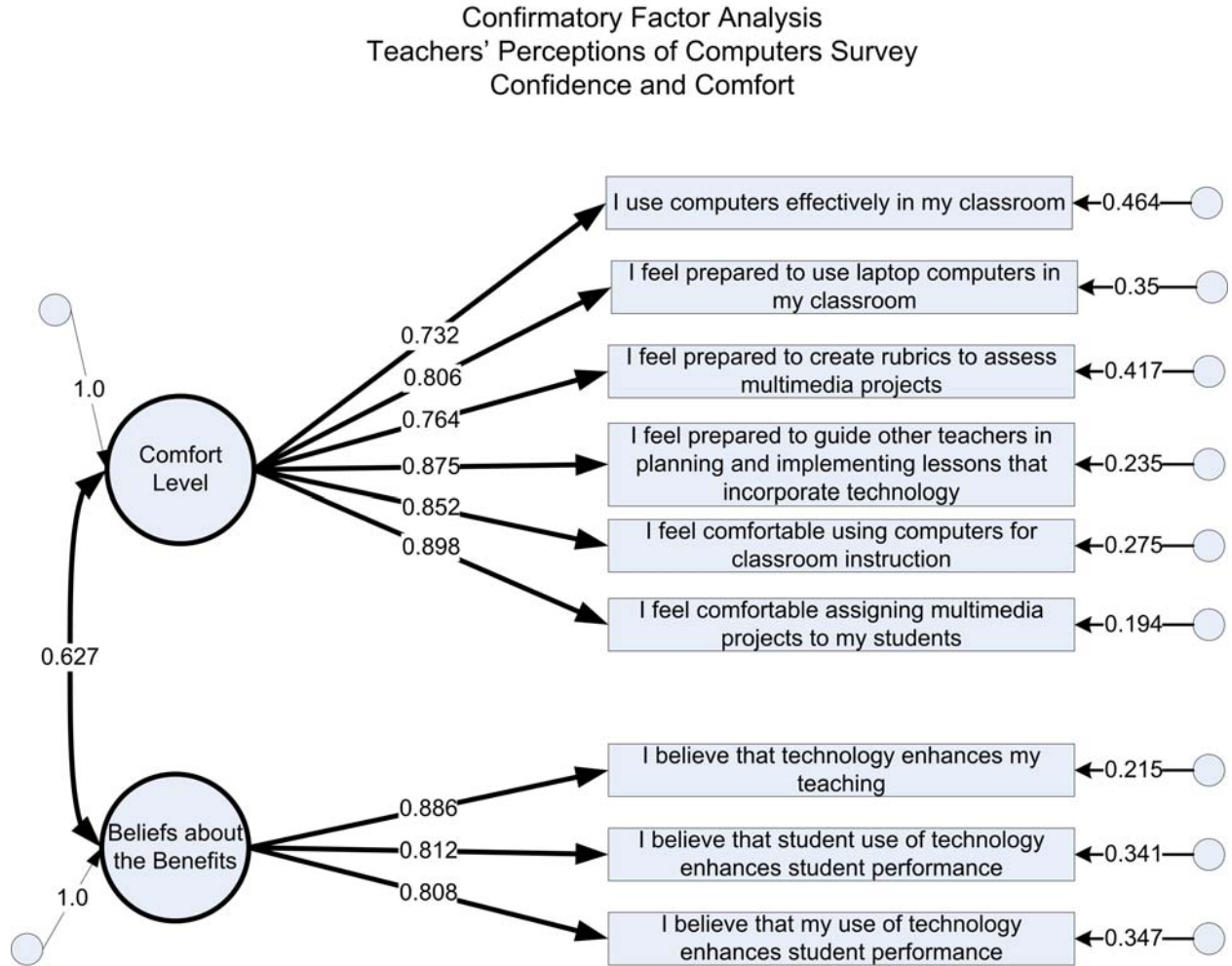


Figure 1. Standardized parameter estimates of the Comfort and Confidence Category determined through confirmatory factor analysis.

The scores of participants in the sample 2 group were used to compute Cronbach's alphas for each latent variable to determine if the internal consistency of the scores had been improved by the deletion of variables in the final latent variable models. Results indicated that the internal consistency reliability of the total survey had decreased ( $\alpha = .967, CI_{95} .958 \text{ to } .975$ ). This was to be expected because reliability is improved when additional items are used to measure a construct. Although there were 18 fewer items in the whole survey, the survey still had Cronbach's alpha greater than .90. Cronbach's alphas were also computed for the category Confidence and Comfort Using Technology ( $\alpha = .916, CI_{95} .896 \text{ to } .933$ ) The scores of the items

retained for this factor added to the reliability as measured by Cronbach's alpha, so no additional items were removed.

#### *Reliability Analysis with the Post-survey*

Further statistical analysis was conducted to investigate internal consistency of the Confidence and Comfort Using Technology factor over two points of time. Since one item on the pre-survey, *I use computers effectively in my classroom*, was changed on the post-survey to *I feel prepared to effectively integrate technology into the curriculum in my classroom*, the scores of the 217 participants on the nine items that remained the same were used in both of the analyses. Cronbach's alpha for the scores of the nine items in the Confidence and Comfort Using Technology factor for the group during the pre-survey was  $\alpha = .915$ ,  $CI_{95} .897$  to  $.931$  and for the scores of the nine items in the Confidence and Comfort Using Technology factor for the group during the post-survey at the end of the Summer Institute training was  $\alpha = .914$ ,  $CI_{95} .896$  to  $.930$ .

#### *Discussion*

The scores of the sample 1 group from the Confidence and Comfort Using Technology was found to have high reliability as measured via Cronbach's alpha ( $\alpha = .921$ ,  $CI_{95} .903$  to  $.938$ ), while the scores of the sample 2 group for the same section remained high ( $\alpha = .916$ ,  $CI_{95} .896$  to  $.933$ ). Although wording of items had changed since 2000, this is consistent with the results of Hogarty et al. (2000) who reported  $\alpha = .91$ . Exploratory factor analysis of the scores of sample 1 group yielded two factors, Comfort and Belief, which explained 67.8% of the variance. This finding was different than previous results, which indicated that all items loaded on one factor, which accounted for 99% of the common variance (Hogarty et al., 2000). Again this change in structure may be due to the revisions made to the wording of the items. Additional

issues were identified by the Model Modification Index during the confirmatory factor analysis of this study, and the item (*I have had adequate training in technology use*) was removed from the analysis. It is recommended that this item be reviewed by experts for potential revision, replacement or deletion. This item will be sent to the panel of measurement and instructional technology experts to determine if the wording needs to be revised, if the placement in the survey should be changed, if it should be deleted, and if a new item should be written to try to better measure the construct.

After a process of review and revision, items from this pre-survey will be given to participants in the end of the year survey. The psychometrics of this end of year survey will be studied. Further analyses are planned to examine construct validity for differential functioning of this instrument among subgroups, predictive validity of the pre-survey for predicting changes in use of computers for instruction, concurrent validity with the ITT skills survey, and convergent validity with the qualitative portions of the study from the open ended questions on the survey and reflective blogs. The revised pre-survey will be used again next year with a new round of training participants. On-going psychometric studies will be conducted as the validation process is continuous.

#### Educational and/or Scientific Importance

Having access to free, validated survey instruments for measuring teachers' attitudes and perceptions toward integrating technology will enhance the ability for state policy-makers and decision-makers in K-12 institutions to obtain valuable teacher feedback. Teachers will be able to use this survey for monitoring themselves during the integration of technology process, and educators and academic researchers at universities and colleges will be able to use this instrument to improve and increase their quality of research.

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