DEVELOPMENT OF A TOOL TO MEASURE COMPUTER SELF-EFFICACY OF PRE-SERVICE TEACHERS

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Abstract

This paper describes the process of the development of an instrument to measure computer self-efficacy of pre-service teachers. Self-efficacy beliefs have repeatedly been reported as a major factor in understanding the frequency and success with which individuals use computers. Computer self-efficacy is also an indicator of computer competency of individuals. But it is observed that there is no tool with desired psychometric properties to measure the computer self-efficacy of pre-service teachers. The scale has high validity and reliability indices indicating that the tool can be used to measure the self-efficacy of the pre-service teachers.

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INTRODUCATION

Self-efficacy

Self-efficacy is a concept introduced by the American psychologist Alberto Bandura. According to Bandura, Barbaranelli, Caprara, and Pastorelli (1996), self-efficacy is a belief that someone has in him/herself of his/her ability to accomplish an action, but which has an influence on the individual's ways of thinking, motivation, behavior and emotional state of mind. It includes a person's perceptions of his/her own ability, endeavors, the difficulty level of an assignment, and others' assistance (Bandura, 2006). While performing learning activities, self-efficacy has influences on learners' motivation, mission concentration, effort engagement, anxiety or negative thoughts of self- denial (Kinzie, 1990; Semiatin& O'Connor, 2012). Self-efficacy is a person's belief in their capability to perform specific tasks and it consists of three dimensions: Magnitude, Strength and Generality: (A) Magnitude – the level of task difficulty an individual believes that he or she can attain, (B) Strength – the confidence one has in attaining a particular level of difficulty and (C) Generality – the degree to which the expectation is generalized across situations.

Computer Self-efficacy

The term self-efficacy was soon extended to particular domains, including the use of computers. Compeau and Higgins (1995) defined computer self-efficacy as "a judgment of one's capability to use a computer" (p. 192). It was noted that self-efficacy judgments could influence an individual's expectations because "the outcomes one expects derive largely from judgments as to how well one can execute the requisite behaviour" (Bandura, 1978, p. 241). Computer self-efficacy has a major impact on an individual's expectations towards using computers according to Compeau and Higgins (1995). In addition, individuals who did not see themselves as competent computer users were less likely to use computers (Kinzie and Delcourt, 1991; Oliver and Shapiro, 1993).

Studies of computer self-efficacy have been conducted on individuals in the work force (Gist. et al, 1989; Burkhardt and Brass, 1990; Compeau and Higgins, 1995; Harrison and Rainer, 1997; Decker, n.d). These studies demonstrated the impact that computer self-efficacy has on increasing performance and the technological innovation of employees, reducing computer-induced anxiety, and promoting higher occupational positions. Other computer self-efficacy studies have used student subjects at a university level (Karsten and Roth, 1998a; 1998b; Langford and Reeves, 1998). Overall, these studies showed that higher levels of computer self-efficacy corresponded to increased performance in computer courses and a greater achievement of computer competency.

THE IMPORTANCE OF COMPUTER SELF EFFICACY

Information systems have expanded into many aspects of our lives. Today, technology is pervasive in terms of information storage and retrieval, productivity tools and telecommunications. Additionally, in recent years, opportunities to learn and use technology have increased in elementary and secondary education. The user friendliness of technology has improved and the types of skills included in computer literacy have changed. Self-efficacy levels need to be sufficient enough so that individuals will choose to take advantage of opportunities to enhance their skills. This concerns all stakeholders in our society given that we accept that literacy of any kind is essential to the continued growth and prosperity of society..

Measuring Computer Self-Efficacy

Many instruments have been developed to measure computer self-efficacy. There are measurement tools developed by Hill, Smith, & Mann (1987), Murphy, Coover, & Owen (1989), Delcourt&Kinzie (l993), Busch (1995), Compeau& Higgins (1995), and Durndell, Haag, &Laithwaite (2000). Several computer self- efficacy measures were found in the literature, but no single measure is universally accepted.

The first computer self-efficacy scale was introduced by Murphy, Coover and Owen (1989) with 32 items to measure an individual's perceptions of his capability regarding specific computer related knowledge and skills. The instrument was administered to 414 individuals that included graduate students, adult vocational students, and professional nurses learning to use computers. The authors used the 5 point Likert-type format (1 = very little confidence to 5 = quite a lot of confidence), and participating respondents were asked to indicate the degree to which they felt. The authors performed factor analysis with an oblique rotation which produced three factors concerning computer skills (a) beginning level, (b) conceptual (advanced), and (c) mainframe. The reported Cronbach's alpha for the three empirically derived factors was 0.97, 0.96, and 0.92, respectively.

Harrison and Rainer (1992) replicated the factor structure found by Murphy, Coover and Owen (1989) in their study to measure respondent perceptions regarding specific computer-related knowledge and skills. The instrument was administered to 693 university personnel who fully completed the survey. The participant group derived from four broad university job categories: (a) clerical, (b) technical, (c) faculty, and (d) administrative.

The Cronbach's alpha coefficients for the three subscales on the computer self-efficacy skill scale were 0.97 on the beginning, 0.95 on the advanced, and 0.98 on the mainframe. Torkzadeh and Koufteros (1994) used the 32 item scale with slight modification from Harrison and Rainer (1992). The authors removed two items from the original scale and opted to alter a Likert scale (1 = strongly disagree to 5 = strongly agree). The items removed were (a) using the computer to analyze number data, and (b) learning advanced skills within a specific program (software). The authors administered the instrument to 224 business undergraduates at a large State university in the Midwest of the United States at the beginning and at the end of an introductory computer course. The authors examined factorial validity of this instrument with an oblique rotation and recommended a four-factor skill solution which was identified as (a) beginning, (b) mainframe, (c) advanced, and (d) file and software. The authors reported reliability for each factor as 0.94, 0.96, 0.90 and 0.91 respectively.

Compeau and Higgins (1995) developed and tested a measure of computer self-efficacy, using a survey in an effort to understand the impact of self-efficacy on individual reactions to computer technology in business and industry. Bandura's (1997) social cognitive theory was employed to create a model for testing the effects of computer self-efficacy. The researchers' 10 item computer self-efficacy measure was designed to be task focused and to incorporate elements of task difficulty including computer use, anxiety, affect, outcome expectations, and organizational support, as well as encouragement by others. This survey was administered to 1,020 managers and professionals including insurance adjusters, financial analysts, researchers, consultants, and accountants. Their research concluded that computer self-efficacy influences individuals' use of the computer and learning to use computers, and empirically verified a strong link between self-efficacy and individual reactions to computing technology. They also found that computer self-efficacy exerted significant influence on (a) individuals' expectations of the outcomes of using computers, (b) emotional reactions to computers, and (c) their actual computer use. In this research, the authors discovered that individuals with high self-efficacy used more computers, enjoyed using them, and experienced less computer-related anxiety.

Durndell and Haagb (2002) adopted a computer self-efficacy instrument that had been modified by Torkzadeh and Koufteros (1994) and made further changes to it in their study. The researchers removed all three statements that were related to mainframe as they reasoned that technology through the emphasis on standalone machines has rendered these skills obsolete for most persons. The authors later added back the two statements that were originally used by Murphy, Coover and Owen (1989) (a) using the computer to analyze number data, and (b) learning advanced skills within specific program (software). This instrument was translated into the Romanian language and was administered to 200 students at a university in Romania at the end of the participants first academic year. A year later, the English version of Durndell and Haagb scale was administered to students in a university in Scotland under the same conditions and time of the academic year. A total of 148 students (male = 43, female = 105) participated in the study. In Scotland, the reported Cronbach's alpha coefficient was 0.96 and in Romania was 0.95. These alpha coefficients indicated that the instrument used was reliable. There are many notable instruments used to measure computer self-efficacy. Lee and Bobko (1994) found that asking the respondents to rate their self-efficacy strengths and weaknesses were the most common measures of self-efficacy. Karsten and Roth (1998) recommended that researchers select the computer self- efficacy instrument whose items most closely reflect the skills they wish to measure and that the skills be clearly identified.

Timothy Teo and Joyce Hwee Ling Koh.(2010)examines the computer self-efficacy among pre-service teachers (N=708) at a teacher training institute in Singapore. Data were collected through self-reported ratings on a 7-point Likert-type scale. Exploratory factor analysis (EFA) was performed on an initial sample (N=354).The results show that the pre-service teachers' computer self-efficacy is a multidimensional construct underlying three dimensions: BCS, MRS and WBS. These three dimensions significantly correlate with each other at a moderate level, suggesting that they are indeed perceived as separate skills although collectively, the results suggest that pre-service teachers perceived these dimensions as a unitary construct for self efficacy.

Preparation of items

In the development of computer self-efficacy scale, the first step involved was careful identification and selection of items relating to computer self-efficacy. For this purpose, an exhaustive review of literature computer self-efficacy was made. The investigator scanned several scales developed by foreign authors and selected the statements were written under the three dimension of the variable namely, computer performance skill, Basic computer skill, Media Related Skill and Web-based Skill .The draft tool consisting of 41 statements.. In order to ensure the relevancy and to remove the ambiguity in the wordings, the prepared statements were discussed with the supervisor. After proper editing and scrutiny, the final form of the draft scale was prepared.

TABLE:1.1Summary of the total dimensions and number of statements in each dimension of the tool

Table 1.1

Dimensions	Item No	Total number of items
1. computer performance skill	1-29	29
2. Basic computer skill	30-33	4
3. Media Related Skill	34-37	4
4. Web-based Skill	38-41	4

The final form of the draft scale of 41 items was printed with five points of answers against each item.

Mode of Responding

The scale consisted of 41 statements. For each statement, there were five answers namely 'Strongly agree', 'Agree', 'Undecided', 'Disagree', 'Strongly disagree'. The response to each statement was made by entering a tick mark (v) for the appropriate one from the five alternatives provided in the separate response sheet.

Scoring procedure

The scoring was done with the help of the key given by the investigator. The scale consisted of both positive and negative statements. The responses ranged from strongly agree to strongly disagree. For getting the scores, each answered item was checked by using the following criteria.

The Scoring key is as shown below

Responses	Score
Strongly Agree	5 Points
Agree	4 Points
Undecided	3 Points
Disagree	2 Points
Strongly Disagree	1 Points

The summated scores of all the 41 statements provide the computer self-efficacy score of the subject. Thus, the maximum possible score of all the 41 statements would be 205 and minimum possible score would be 41.

Tryout of the scale

The draft scale consisting of 41 statements was tried out on a sample of 89Pre-service teacher, selected from the different locales of Rohtak district of Haryana State. The response sheets were collected and scored for each individual response separately.

Item analysis

The statements for the final analysis were selected on the basis of the discriminating power of each item. The discriminating power of each item was determined by calculating the t-value of the item. For this, the procedure suggested by Kelly (1939) was followed. The responses were scored using the scoring procedure mentioned earlier. The scores obtained for each item and the total score for each individual were marked separately. The response sheets were arranged according to the descending order of the scores. Then, the top 27% and the bottom 27% respondents were taken which represented the high and low groups. A frequency table under each group was prepared for each item, to represent the number of subjects marking the five responses namely, 'Strongly agree', 'Agree', 'Undecided', 'Disagree', 'Strongly disagree' The t-value was calculated .The obtained t-value for all items are given in table 1.1.

TABLE 1.1The obtained t-value for each item Item No. t-value Item No t-value Item No. t-value

Item No.	t-value	Item No	t-value	Item No	t-value	Item No	t-value
CSES1	34.468	CSES 12	29.737	CSES 23	27.541	CSES 34	18.068
CSES2	25.222	CSES 13	20.720	CSES 24	20.687	CSES 35	16.570
CSES3	53.011	CSES 14	22.785	CSES 25	24.906	CSES36	18.363
CSES4	43.383	CSES 15	21.649	CSES 26	26.572	CSES37	17.031

CSES5	17.721	CSES 16	28.649	CSES 27	25.463	CSES38	33.992
CSES6	27.319	CSES 17	44.055	CSES 28	22.390	CSES39	27.817
CSES7	27.480	CSES 18	32.291	CSES 29	21.687	CSES40	18.433
CSES8	34.374	CSES1 9	26.414	CSES 30	23.559	CSES41	17.446
CSES9	19.010	CSES 20	31.665	CSES 31	26.188		
CSES10	24.084	CSES21	47.117	CSES 32	27.141		
CSES11	27.874	CSES22	34.697	CSES 33	19.736		

The‘t’ value of the Computer Self Efficacy Scale (CSES) ranged from 17.031 to 53.011. All the items were significant at 0.01 levels. Hence all 41 items were selected for final scale.

Validity of the tool

The present tool ensures most of the essential validities. Content validity is based on the extent to which a measurement reflects the specific intended domain of content. The items in the tool were selected after the judgment of subject specialists. Thus, the tool possesses content validity. Construct validity for the tool was also established. Construct validity seeks agreement between a theoretical concept and a specific measuring device or procedure. To understand whether a piece of research has construct validity, three steps should be followed. First, the theoretical relationships must be specified. Second, the empirical relationships between the measures of the concepts must be examined. Third, the empirical evidence must be interpreted in terms of how it clarifies the construct validity of the particular measure being tested. In the present study, the method followed in the Construction of the scale, criteria considered for preparing the statements, model of selection of dimensions for the scale, all these were done as per theoretical bases. Hence, the investigator assumes that the scale has construct validity. Face validity is concerned with how a measure or procedure appears. Face validity does not depend on established theories for support. As the tool was distributed to some computer super specialists.the judgment of which was positive, the tool ensured face validity. Criterion related validity, also referred to as instrumental validity, is used to demonstrate the accuracy of a measure or procedure by comparing it with another measure or procedure, which has been demonstrated to be valid. The investigator also established criterion related validity of the tool by correlating the scores obtained by sub dimension of the scale.

Table.1.2

Coefficient of correlation of total scores with scores on four dimensions

Dimensions of CSES	1.Computer Performance Skill	2.Basic Computer Skill	3.Media Related Skill	4.Web-Based Skill
1.Computer Performance Skill		0.8297	0.6321	0.7930
2.Basic Computer			0.6987	0.7869

Skill				
3.Media Related Skill				0.6333
4.Web-Based Skill				
Whole CSES	0.9739	0.9004	0.7577	0.8704

The correlations ranged from 0.6321 to 0.9739and all the correlation are significant at 0.01 levels. These high significant correlations demonstrate that the sub dimensions have high validly.

Reliability of the tool

The investigator established the reliability of the tool by split half method. The split-half design in effect creates two comparable test administrations. The items in the test are split into two equal halves that are equivalent in content and difficulty. In the present study, the investigator has done splitting among odd and even numbered items of 48 individual scores. This assumes that the assessment is homogenous in content. Once the test is split, reliability is estimated as the correlation of two separate tests with an adjustment for the test length. The investigator estimated the reliability of the tool by correlating the two half scores using Spearman Brown Prophesy Split-Half Coefficient formula. The value of r, i.e., the reliability coefficient between the two scores was found to be 0.855 (N=48). Cronbach's Alpha value is 0.935.

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