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Nigerian Preservice Science Technology and Mathematics Teachers' Computer self-efficacy: An Exploration based on Gender, Age, and Discipline of Study

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Abstract

The global acceptance of information and communication technologies in education is not without barriers and one major barrier on the part of teacher educator implementation effort is preservice teachers' perception of and capabilities for applying computer technology. Although the construct of computer self-efficacy has gained widespread investigation in the developed world, few researches have been conducted on this construct in Nigeria. The purpose of this study was to investigate preservice teachers' level of computer self-efficacy and to determine the invariability of this construct with respect to the demographic variables of gender, age, and discipline of study. Using the slightly modified computer self-efficacy scale (Durndell, Haag & Laithwaite, 2000) in a cross-sectional survey involving a sample of preservice teachers at two universities (N=480), we found that preservice teachers reported high level of computer self-efficacy. Exploratory factor analysis of the survey data supported the multidimensional nature of the computer self-efficacy construct. A 2×3×2 multivariate analysis of variance showed that the construct of computer self-efficacy appeared invariant with respect to the demographic variables of discipline of study and age classification while gender remained a determining factor in preservice teachers' aggregate computer self-efficacy even at the subscale levels of beginning and advanced skills.

Key words: Computer self-efficacy, Preservice teachers, Gender, Age, Discipline of study, Nigerian.

Introduction

The new millennium has witnessed global acceptance of computers, information and communication technologies (ICTs) in education. This is because, computers and ICTs integration in the curriculum may result in improvement of classroom instruction and learning (Libscomb & Doppen, 2004; Mills & Tincher, 2003), provide students with the required skills to effectively perform in the twenty-first century digital society (Norris, Sullivan, Poirot & Soloway, 2003), promote critical thinking skills (Harris, 2002), and enhance learning outcomes of achievement, motivation and attitudes (Waxman, Lin & Michko, 2003). Despite the potential benefits of computer technology integration in the curriculum, one major barrier on the path of teacher educator implementation effort is preservice teachers' perception of and capabilities for applying computer technology (Compeau & Higgins, 1995). This phenomenon called computer self-efficacy (Murphy, Coover & Owen, 1989) is situated in the Bandura's theory of self-efficacy (Bandura, 1993) which provides a basis for understanding the behaviour of individuals with regard to their acceptance or rejection of technology (Olivier & Shapiro, 1993). Computer self-efficacy defined as individual self-efficacy about using computers (Murphy, Coover & Owen, 1989), has been identified as a major determinant of computer-related ability and usage in organizational contexts (Madhavan & Phillips, 2010).

Literature is replete with numerous studies on factors affecting computer self-efficacy (Hasan, 2003; Potosky, 2002; Busch, 1995; Harrison & Rainer, 1992). Computer self-efficacy may determine the success of computer learning (Hsiao, Tu & Chung, 2012) is associated with self-confidence (Kinzie, Delcourt, & Powers, 1994) and the perceived computer self-efficacy of teachers will have an influence on their attitudes toward computers (Zhang & Espinoza, 1998; Griffin, 1988) and on computer assisted language learning (Ertmer, Addison, Lane,

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Ross & Woods, 1999). Teachers with higher computer self-efficacy are likely to be more enthusiastic to use technology in their classrooms than those with lower self-efficacy (Pearson, Bahmanziari, Crosby & Conrad, 2003; Ertmer et al, 1999). Ertmer, Evenbeck, Cennamo and Lehman (1994) found that positive computer experience increased computer self-efficacy, but the actual amount of experience (i.e., time on task) had no correlation to the self-efficacy beliefs of undergraduate students. While computer self-efficacy is correlated to computer use (Hasan, 2003; Potosky, 2002; Compeau, Higgins & Huff, 1999; Marakas, Yi & Johnson, 1998; Compeau & Higgins, 1995), significant positive correlation exists between previous computer experience and computer self-efficacy and experience influences behavioural intentions to use computers indirectly through computer self-efficacy (Hill, Smith & Mann, 1987). Hakverdi, Gücüm & Korkmaz (2007) reported that the level of computer use and educational use of computers are closely related to the outcome measure of preservice science teachers' personal self-efficacy in teaching with computers. Hasan (2007) found that computer self-efficacy had a significant direct effect on perceived usefulness and perceived ease of use as well as indirect effect on attitude and behavioural intention.

The relation between computer self-efficacy and demographic variables is gathering research momentum with current findings being inconclusive (Aremu & Fasan, 2011; Awoleye & Siyanbola, 2005; Bimer, 2000). Computer self-efficacy has been found to be a function of individual teacher characteristics such as gender, age, prior experience and subject areas (Paraskeva, Bouta & Papagianni, 2008). Studies have found gender differences in computer self-efficacy in favour of males (Simsek, 2011; Durndell & Haag, 2002; Torkzadeh & Koufteros, 1994; Harrison & Rainer, 1992) and in favour of females (Aremu & Fasan, 2011) whereas others have found no gender differences (Adebowale, Adediwura & Bada, 2009; Smith, 1994). With respect to age groupings in computer self-efficacy, findings are mixed. Adebowale et al (2009) found that age has nothing to do with computer self-efficacy while Hakverdi, Gücüm and Korkmaz (2007) found that computer self-efficacy has negative correlations with age and grade level of preservice science teachers. Chen (2012) found that younger teachers tend to have a higher computer self-efficacy which is associated with a low computer anxiety (Doyle, Stamouli & Huggard, 2005; Brosnan, 1998). The influences of demographic variables such as gender, age, and discipline of study on computer self-efficacy have drawn attention in the present study because they can add to potential interpretations of students' low participation in computer related fields.

Like mathematics self-efficacy (Akinsola & Awofala, 2009), various scales have been developed to measure computer self-efficacy with the most popular scale developed by Murphy, Coover and Owen (1989). The original Murphy computer self-efficacy scale has been adapted by various researchers (Harrison & Rainer, 1992) and some other researchers have adapted a slightly modified version of the scale for their study (Torkzadeh & Koufteros, 1994; Delcourt & Kinzie, 1993; Ertmer et al., 1994; Zhang & Espinoza, 1998). However, the perception of inadequacy in statistical terms in previous scales as a result of the rapid change in society occasioned by explosion in ICT has led some researchers to develop their own measure of computer self-efficacy (Gist et al., 1989; Burkhardt & Brass, 1990; Compeau & Higgins, 1995) and the proliferation of the computer self-efficacy scale is ongoing.

Although most of these scales were developed in the late twentieth century, recent investigations have been conducted in order to re-examine their psychometric properties. While some saw the need for refinement (Torkzadeh, 2003; Torkzadeh & Koufteros, 1994) and slight modification to allow for changes in computer-related practice and technology (Durndell, Haag & Laithwaite, 2000), others (Simsek 2011) indicated no changes were needed. These scales were developed in the most technologically developed countries (e.g., UK, USA, etc.) where proliferation of computers in schools is evident (Durndell & Haag, 2002) and computer self-efficacy is culturally invariant in these societies (Barbeite & Weiss, 2004). Although there are studies in less developed countries on computer self-efficacy (Chen, 2012; Simsek, 2011; Halder & Chaudhuri, 2007; Seferoglu, 2007; Hakverdi, Gücüm & Korkmaz, 2007), and in Nigeria with in-service teachers and secondary school students samples (Aremu & Fasan, 2011; Adebowale, Adediwura & Bada, 2009), studies that determine the prevalence of computer self-efficacy in Nigerian preservice STM teachers' sample are scarce. More so, studies that investigated the individual subscale scores of computer self-efficacy of Nigerian preservice (inservice) teachers in relation to their demographic variables are not in existence. This is a topical issue of concern going by the low level of technology integration into Nigerian schools at all levels and preservice teachers on completion of their programmes are expected to fill the vacant posts in the Nigerian Teaching Service Commissions made possible through expansion in school, retirement of teachers, and government policies to reduce graduate unemployment.

Preservice teachers as tomorrow leaders and transmitters of up-to-date knowledge, values and skills should not only have a working knowledge of the computer and computer-linked technologies but also display positive and high efficacy beliefs regarding their use. Preservice teachers with high judgment of their knowledge and capabilities to use computers in diverse situations (Compeau & Higgins, 1995; Bandura, 1986) tend to believe that they are competent in operating computers and are eager to attend to computer related activities (Delcourt & Kinzie, 1993; Hill, Smith & Mann, 1987).

Purpose of the Study

The purposes of this study are threefold:

- Firstly, to analyse the level of computer self-efficacy among Nigerian preservice science, technology, and mathematics teachers. Preservice science, technology, and mathematics teachers are expected to record low computer self-efficacy considering the low level of technological development and low ICT penetration in Nigeria.
- Secondly, to determine the relationship between individual preservice teachers' demographic variables and computer self-efficacy. It is conjectured that the preservice teachers' gender, age, and discipline of study will relate positively and significantly with computer self-efficacy.
- And thirdly, to examine the effects of demographic variables of gender, age, and discipline of study on computer self-efficacy of preservice teachers within the Nigerian higher education context. It is hypothesized that men and women will differ in their computer self-efficacy. Preservice teachers below the age 20 years and those within the age 20-30 years will differ in their computer self-efficacy. Discipline of study (science, technology, and mathematics) will exert an effect on computer self-efficacy

Research Hypotheses

1. Nigerian preservice science, technology, and mathematics teachers will record significantly low computer self-efficacy.

2. There will be significantly positive relationships between gender, age, and discipline of study and preservice teachers' computer self-efficacy.

3. There will be significant main and interaction effects of gender, age, and discipline of study on preservice teachers' computer self-efficacy.

Method

Participants

A sample of 480 out of 1,600 preservice teachers from two out of eight public universities in the south-western part of Nigeria participated in the study. Purposive sampling technique was used to select two universities and a random sampling technique was used to select the preservice science, technology and mathematics teachers in junior and senior years for the study. Purposive sampling was adopted because not all the universities were offering courses leading to the award of degrees in education science, technology and mathematics. 191 (39.79%) studied science [92 (48.17%) men, 99 (51.83%) women, M_{age} = 23.4 years, *SD* = 2.8, age range: 18-30 years], 106 (22.08%) studied technology [66 (62.26%) men, 40 (37.74%) women, M_{age} = 24.2 years, *SD* = 2.2, age range: 18-30 years], and 183 (38.13%) studied mathematics [88 (48.09%) men, 95 (51.91%) women, M_{age} = 22.3 years, *SD* = 3.2, age range: 17-30 years] and altogether their ages ranged between 17 and 30 years (M_{age} = 23.3, *SD* = 2.7). There were 258 (53.75%) within the age bracket below 20 years and 222 (46.25%) within the age bracket 20-30 years.

The minimum entry age into any university in Nigeria is 16 years. Students in the science cohort either studied for B.Sc.Ed. Education/Biology, Education/Chemistry, Education/Physics or Education/Integrated Science, those in the technology cohort studied for B.Sc.Ed. Technology Education with options in Building/Wood Technology, Electrical Technology, or Mechanical Technology while those in mathematics cohort studied for B.Sc. Ed. Education/Mathematics. The participants could also be categorised into 36% in the final or senior year and 64% in the third or junior year of a four-year degree programme and all took the introductory computer science course in the first semester of their first or freshman year. In this course, students were taken through hardware and its functional components, software and system application packages, program development, flowcharting, program objects, basic programming, computer application areas and technological trends.

Measures

The 29-item positively worded Computer Self-Efficacy Scale (CSES) (Durndell, Haag & Laithwaite, 2000) on a 5-point Likert type scale anchored by 1: *strongly disagree* and 5: *strongly agree* developed originally by Murphy, Coover, and Owen (1989) and refined by Torkzadeh and Koufteros (1994) and Durndell & Haag (2002) with a slight modification in the present study was administered to participants in the first semester. The modification was related to the rewording of one of the statements of the scale for clarity and to be in accordance to the current computer terminology. Thus, the item with the description "Calling up a data file to view on the monitor screen" in the original version was reworded as "Retrieving a data file to view on the monitor screen." Each item in the section B of the CSES was preceded by the phrase '1 feel confident' and provision was made in the section A for participants to indicate gender, age, year of study and discipline of study. Durndell and Haag (2002) reported reliability coefficient of .97 while Simsek (2011) reported reliability coefficient of .96 for student responses and .98 for teacher responses for the entire scale. The developers of this scale identify three different subscales within the overall scale (Torkzadeh & Koufteros, 1994), which normally correlate significantly with each other. Durndell and Haag (2002) found the three subscales correlating between .81 and .89 with each other, somewhat higher than the correlations (.64 to .79) found with the same scale in Romania (Durndell, Haag & Laithwaite, 2000). However, the modification of one item in the computer self-efficacy scale necessitated the re-assessment of the scale for full reliability and validity.

After collecting the data from the 480 preservice STM teachers through the 29-item positively worded five-point Likert computer self-efficacy scale, both the Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were performed to examine whether the data set was appropriate for a factor analysis. The KMO is a test that compares the weight of observed correlation coefficients with the weight of partial correlation coefficients (Kalayci, 2005) and in cases where KMO is smaller than 0.50 (Tavşancil, 2002) or smaller than 0.60 (Büyüköztürk, 2002) factor analysis can no longer be resumed. The Bartlett's test of sphericity tests the hypothesis that the correlation matrix is an identity matrix and the value of Bartlett's sphericity test gains and its significance indicate whether or not variables are inter-correlated and in cases where Bartlett's sphericity test is above 0.05, factor analysis cannot be conducted (Şencan, 2005). In this study, the KMO measure of sampling adequacy was high (0.799) and significant (p = 0.000). Bartlett's Test of Sphericity was also notably high and significant (chi-square = 7210.135 with 406 degree of freedom at p = 0.000). The mean scores were above the mid-point of 3.0 for all 29 items and these ranged from 3.41 to 4.29. The standard deviations ranged from .75 to 1.31 and the skewness and kurtosis indices were within the recommended values of |3| and |10| respectively (Kline, 1998). Then an exploratory factor analysis (principal components, direct oblimin rotation with Kaiser Normalization) was applied to analyze the items and to clarify the structure of the computer self-efficacy scale. The oblique rotation was used because it allows the factors to correlate with each other. This was needed since all subscales were expected to be inter-related and together form the overall computer self-efficacy level. The analysis identified three factors with eigenvalues > 1 and these were further confirmed by the Cattel scree plot (Figure 1).

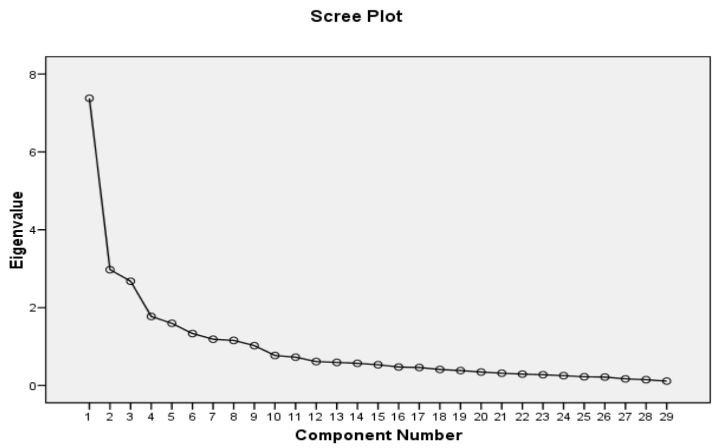

Figure 1. Scree plot showing number of components and eigenvalues of the correlation matrix

The items and corresponding factors (subscales) in the scale are represented in Table 1. As shown in Table 1, the factor loadings of the items differ between 0.793 – 0.467, 0.777 – 0.471, and 0.806 – 0.486 respectively for advanced skill, beginning skill, and file and software skill subscales. The factor loadings of the items can be considered as sufficient and they reflect proof of the factorial validity and construct validity of the computer self-efficacy scale (Thompson & Daniel, 1996). The factor solution with three factors explained 44.92% of the global variance. All the items exhibited high loadings (>.40) on the constructs they were intended to measure, and no item displayed a higher loading on any unintended construct than its underlying construct. The zero order correlations for the whole sample between components of the CSE scale indicated that all three correlations between the three components of CSE score identified in the pilot testing were significant (p=.01). Beginning skills CSE correlated at +0.57 with advanced skills CSE, beginning skills CSE correlated at +0.46 with file and software skills CSE, and advanced skills CSE correlated at +0.21 with file and software skills CSE. Coefficient alpha for the beginning skills subscale was .808, advanced skills subscale was .826, and .742 for the file and software skills subscale and the overall Cronbach alpha reliability coefficient for the entire scale was calculated to be 0.870. These analyses were in agreement with those previously reported (Durndell & Haag, 2002; Barbeite & Weiss, 2004).

Table 1. Rotated factor loadings and Cronbach's alpha coefficients for the three factors (subscales of the Computer Self-Efficacy Scale)

Item	Factor 1: Advanced α=.826	Factor 2: Beginning α=.808	Factor3: Software α=.742
I feel confident:			
1. working on a personal computer		.554	
2. getting the software up and running			.486
3. entering and saving numbers or words into a file		.471	
4. exiting from the application software		.723	
5. retrieving a data file to view on a monitor screen			.605
6. handling removable storage devices correctly			.570
7. making selections from an onscreen menu		.687	
8. using a printer to print out my work		.523	
9. copying a disk.		.700	
10. copying an individual file			.802
11. adding and deleting information from a data file			.761
12. moving the cursor around the monitor screen		.777	
13. using the computer to write a letter or essay		.518	
14. installing software correctly		.566	
15. deleting files when they are no longer needed			.585
16. organizing and managing files			.596
17. using the user's guide when help is needed	.698		
18. understanding terms relating to computer hardware.	.568		
19. understanding terms relating to computer Software	.654		
20. learning to use a variety of application software	.609		
21. learning advanced skills within a specific application software	.511		
22. using the computer to analyze on numeric data	.517		
23. writing simple programs for the computer	.654		
24. describing the function of computer hardware (keyboard, monitor, disk drives, processing unit)	.624		
25. understanding the three stages of data processing: input, processing, output	.593		
26. getting help for problems in the computer System	.793		
27. explaining why application software will or will not run on a computer	.752		
28. using the computer to organize information	.560		
29. troubleshooting computer problems	.467		
Eigenvalue	7.376	2.974	2.676
% of variance	25.436	10.256	9.229
Overall α=.870. Total variance explained is 44.921			

The descriptive results for the preservice science, technology and mathematics teachers' scores on the subscales are indicated in Table 2. The higher mean scores of the participants on the subscales indicate high confidence toward the computer.

Table 2. The preservice science, technology and mathematics teachers' scores on the subscales of the Computer Self-efficacy Scale

Factors	N	Items	possible range	range	mean	(SD)	Skewness	Kurtosis
Beginning	480	10	25-50	25	37.90	5.27	.303	-.564
Advanced	480	13	31-64	33	48.42	7.11	.574	-.363
File & Software	480	6	14-30	16	22.75	3.92	.298	-.570

The degree of confidence was sorted into four categories (a) scores ranging between 29-57 were categorized as not confident, (b) 58–86 as little confidence, (c) 87-115 as confident, and (d) 116-145 as very confident on the computer self-efficacy scale. The confidence level was gotten by deducting one from five the highest scale level and multiplying one, two, three, and four by 29 the number of items on the scale to get the starting point of the confidence level for the convenience of the researchers. High scores indicate respondents' high levels of self-efficacy in using computers and vice-versa.

The participants had taken and passed the university course requirement labeled "use of English" in the first semester of their freshman year. While admission into any university in Nigeria is predicated on entrants possessing a minimum of credit level pass in English Language in addition to credit level passes in four other university requirement Ordinary Level subjects, the participants in this study were adjudged to have acquired nothing less than the pass mark (40%) in English Language required by any student for graduation. More so, English is the official language and language of commerce, government, education and communication from primary four to the university level in Nigeria. With this level of competency in English Language, it was expected that none of the participants would find the CSES difficult to read, understand, and response to.

Procedure

Prior to the administration of the research instrument, details of the study in face-to-face meetings with the participants were given and all participants were told that their responses were anonymous and that they could withdraw at any time from the study. Thereafter, one of the researchers with the support of six research assistants who were graduate students in one of the universities administered the CSES to the participants in their respective cohorts (science, technology, and mathematics) while they filled the questionnaire within an average completion time of 15 minutes.

Data Analysis

Descriptive statistics of percentages, mean, standard deviation, and range were applied to the data in respect of the level of computer self-efficacy of the preservice teachers. A 2×3×2 MANOVA was used to determine whether significant effect of gender at two levels (male and female), discipline of study at three levels (science, technology, and mathematics), and age group at two levels (below 20 years and 20-30 years) each exist on preservice teachers' computer self-efficacy. Pearson correlation analysis was then used to find the relationship between gender, discipline of study, age, and computer self-efficacy of preservice teachers.

Results and Discussion

Research Hypothesis-1: Nigerian preservice Science, Technology and Mathematics teachers will record significantly low computer self-efficacy.

A total score was computed from the 29 items, the range being 29 to 145. Table 3 displays the levels of computer self-efficacy among the preservice STM teachers. Of 480 preservice STM teachers, 6 (1.25%) had scores that fell within the little confident range (M=82.50, SD=5.96, score range: 71-86, 95%CI= 76.25–88.75), 353 (73.54%) had scores that fell within the confident range (M= 103.27, SD=6.78, score range: 87-116, 95%CI=102.56-103.98), while 121 (25.21%) had scores that fell within the very confident range (M=127.33, SD=7.82, score range: 117-141, 95%CI= 125.93–128.75).

Table 3. Overall computer self-efficacy levels

Computer self-efficacy levels	N	Percentage (%)
Not confident	-	-
Little confident	6	1.25
Confident	353	73.54
Very confident	121	25.21

Over 98% of the participants showed that their levels of computer self-efficacy were in the confident or very confident categories. In short, the overall *M*=109.08, *SD*=12.94 as contained in Table 4 below, score range: 71-141, and 95%*CI*= 108.44–109.71 for the entire sample showed high degree of confidence in preservice teachers' ability to use computers.

Table 4. Descriptive statistics of preservice science, technology and mathematics teachers' computer self-efficacy according to gender, age, and discipline of study

Age	Discipline	Gender	Mean	SD	N
Below20yrs	B.Sc(Ed) Technology	Female	105.9655	12.76290	29
		Male	109.2162	17.78910	37
		Total	107.7879	15.75047	66
	BSc(Ed) Maths	Female	107.1579	11/74246	57
		Male	111.9778	12.57069	45
		Total	109.2843	12.29133	102
	BSc(Ed) Science	Female	106.7750	9.85663	40
		Male	111.2000	13.16923	50
		Total	109.2333	11.95596	90
	Total	Female	106.7619	11.34861	126
		Male	110.9091	14.35773	132
		Total	108.8837	13.11614	258
20-30yrs	B.Sc(Ed) Technology	Female	104.5455	9.28831	11
		Male	109.5172	12.81077	29
		Total	108.1500	12.04170	40
	BSc(Ed) Maths	Female	106.7632	13.60730	38
		Male	111.5116	13.25460	43
		Total	109.2840	13.54828	81
	BSc(Ed) Science	Female	108.9322	12.09569	59
		Male	110.9762	13.02060	42
		Total	109.7822	12.46564	101
	Total	Female	107.7222	12.39221	108
		Male	110.8070	12.96549	114
		Total	109.3063	12.75512	222
Total	B.Sc(Ed) Technology	Female	105.5750	11.81022	40
		Male	109.3485	15.68389	66
		Total	107.9245	14.40350	106
	BSc(Ed) Maths	Female	107.0000	12.45246	95
		Male	111.7500	12.83695	88
		Total	109.2842	12.82666	183
	BSc(Ed) Science	Female	108.0606	11.24207	99
		Male	111.0978	13.03002	92
		Total	109.5236	12.19915	191
	Total	Female	107.2051	11.82566	234
		Male	110.8618	13.70257	246
		Total	109.0792	12.93867	480

This finding turned out to refute the initial expectation considering the relatively low level of Nigerian technological development. This may be attributed to the fact that the two universities under study have made provision for students to use computers and so they were not computer illiterates.

Research Hypothesis-2: There will be significantly positive relationships between gender, age, and discipline of study and preservice teachers' computer self-efficacy.

Pearson correlation analysis was used to assess the association between preservice teachers' demographic variables (gender, age, and discipline of study) and computer self-efficacy. Table 5 below displays the Pearson correlation analysis results of the variables.

Table 5. Pearson correlation analysis results of the computer self-efficacy, gender, age, and discipline of study

	CSE	gender	age	discipline	Mean	SD
Comp. Self-Efficacy (CSE)	1	.141*	.016	.044	109.08	12.94
Gender	.141*	1	.002	-.096*	1.51	.50
Age	.016	.002	1	.118**	1.46	.50
Discipline	.044	-.096*	.118**	1	2.18	.77

*significant at p<0.05, **significant at p<0.01

As contained in Table 5 above, only the gender out of the three demographic variables examined had statistically significant positive correlation with computer self-efficacy (Pearson's $r(480)= .141$, $p=.002$), although the correlation was weak. The correlation is further examined at the computer self-efficacy subscale levels (Table 6) and there were significant correlations for computer self-efficacy subscales of beginning skills and advanced skills with gender. The beginning skills correlated positively with gender, Pearson's $r(480)= .140$, $p=.002$ and advanced skills correlated positively with gender, Pearson's $r(480)= .127$, $p=.005$ although both correlations were weak.

With regard to age and discipline of study, there were no statistically significant correlations between age and computer self-efficacy (Pearson's $r(480)= .016$, $p=.722$) and between discipline of study and computer self-efficacy (Pearson's $r(480)= .044$, $p=.341$). At the subscale level (Table 5b), age had no statistically significant correlations with the beginning skills (Pearson's $r(480)= .023$, $p=.612$), advanced skills (Pearson's $r(480)= -.006$, $p=.889$), and file and software skills (Pearson's $r(480)= .034$, $p=.455$). While the discipline of study had a statistically significantly weak and positive correlation with the beginning skills (Pearson's $r(480)= .091$, $p=.046$), it had no statistically significant correlations with advanced skills (Pearson's $r(480)= -.021$, $p=.646$) and file and software skills (Pearson's $r(480)= .060$, $p=.192$).

Table 6. Pearson correlation analysis results of the computer self-efficacy subscales, gender, age, and discipline of study

	1	2	3	4	5	6	Mean	SD
1.Beginning skill	1	.57**	.46**	.140*	.023	.091*	37.90	5.27
2.Advanced skill	.57**	1	.21**	.127*	-.006	-.021	48.42	7.11
3.File & Software skill	.46**	.21**	1	.011	.034	.060	22.75	3.92
4.Gender	.140*	.127*	.011	1	.002	-.096*	1.51	.50
5. Age	.023	-.006	.034	.002	1	.118**	1.46	.50
6. Discipline	.091*	-.021	.060	-.096*	.118**	1	2.18	.77

*significant at p<0.05, **significant at p<0.01

Research Hypothesis-3: There will be significant main and interaction effects of gender, age, and discipline of study on preservice science, technology and mathematics teachers' computer self-efficacy.

Since the third objective of this study was to examine the main and interaction effects of gender, age, and discipline of study on preservice STM teachers' computer self-efficacy, further examination of the collected data using a 2×3×2 multivariate analysis of variance (MANOVA) was carried out. The adoption of the MANOVA was based on the fact that there were more than one dependent variable which were related in some way (Pallant, 2001) thus revealing whether the differences existed between the groups (gender, age, and discipline of study) on the dependent variables (beginning, advanced, and file and software skills).

Before conducting MANOVA, the seven assumptions of Multivariate Analysis of Variance which include sample size, independence of observations, normality, outliers, linearity, multicollinearity and singularity, and homogeneity of variance-covariance matrices (Pallant, 2001) were checked. For *sample size*, the cases in each cell should be more than the number of the dependent variables (Pallant, 2001). Thus, the expected minimum number of cases in each cell in this study was three (the number of dependent variables) but we have enough cells (independent variables were gender at two levels, age group at two levels, and discipline of study at three levels). Therefore the sample size (*N*=480) assumption was met in this study. During the administration of the questionnaire, the *Independence of Observations assumption* was checked in that it was assumed that the participants were independent, each participant completed the questionnaire individually, and there was no interaction among the participants in the classroom. As noted by Stevens (2002), any violation of this assumption should lead the researcher to set a more stringent alpha value. For the *Normality* assumption, the univariate normality of observations on each variable was examined in order to detect multivariate normality assumption. The non-significant F tests from BOX's M statistic was the sign of homogeneity of variance and covariance matrices ($p>0.05$). According to Pallant (2001), in large samples violation of the assumption of normality is quite met. The Mahalanobis distance was calculated as 5.38 and this value was found lower than the critical value given in the Chi-square table. In this study, there are three dependent variables, so the critical value is 16.27 in the Chi-square table. If Mahalanobis distance is greater than the critical value, there are multivariate outliers (Pallant, 2001). In this study, no cases had higher values than the critical value and so there were no multivariate outliers. For *Outliers*, Field (2005) noted that if the sample size is small (80 or fewer cases), a case is an outlier if its standard score is ±2.5 or beyond whereas if the sample size is larger than 80 cases, a case is an outlier if its standard score is ±3.0 or beyond. In this study, no cases were detected as outliers since no cases with standardised scores exceeding ±3.0 were detected. So, there was no threat of outliers and the sample size of the study did not change and this was considered suitable for the MANOVA. The assumption of *linearity* was checked by generating scatter plots separately for each pair of dependent variables and the straight-line relationship between each group was controlled. The scatter plots showed that there was no violation of the linearity assumption. For *Multicollinearity and Singularity assumption*, the correlation coefficients were calculated and the strength of the correlations among dependent variables examined. Pallant (2001) maintained that correlations up around .8 or .9 were not appropriate for the statistic. Thus, in this study, Pearson correlation coefficients between dependent variables ranged from .210 to .571 and did not exceed the value of .8. So, there was no violation of the multicollinearity assumption.

In the case of *Homogeneity of Variance-Covariance Matrices assumption*, a separate MANOVA was conducted for the each independent variable. The results of the Box Test of Equality of Covariance Matrices showed that the assumption of homogeneity of variance-covariance matrices was not violated. According to Pallant (2001), if the significance value is greater than .001, the assumption is not violated. In this study, significance value was .031 and higher than .001 which indicated that there was no violation of the assumption. Furthermore, in the Levene's Test of Equality of Error Variances table, if the significance value is less than .05, this indicates that there is a violation of the assumption (Pallant, 2001). For beginning and file and software subscales, significance values of .082 and .407 were higher than .05 respectively but significance value of .000 was recorded for advanced skill subscale and this indicated a violation of the assumption. According to Stevens (2009), if the sizes of the groups are equal (e.g., largest/smallest<1.5), analysis of variance is robust to violation of this assumption and the violation of the assumption has the minimal effect. In this study, when the largest group size divided to smallest group size, the ratio obtained was smaller than 1.5. So MANOVA can be conducted.

Main Effects of Gender, Age, and Discipline of Study on Preservice Teachers' Computer Self-Efficacy

This study predicted that (i) gender (ii) age and (iii) discipline of study would not have any significant main effect on preservice teachers' computer self-efficacy and table 6 below shows the descriptive statistics of the preservice teachers on beginning skills in computer according to gender (men and women), discipline of study (science, technology, and mathematics), and age group (below 20 years and 20-30 years). A three-way multivariate analysis was conducted to investigate the effects of gender, age group, and discipline of study on preservice teachers' computer self-efficacy (i.e. beginning, advanced, and file and software skills). In order to evaluate multivariate significance, Pillai's Trace statistic was used. According to Tabachnick and Fidell (2007), if there is violation of some assumptions, Pillai's Trace is more robust. MANOVA results regarding the gender, age group, and discipline of study are presented in Table 7.

The results indicated a statistically significant gender effect on the combined dependent variables (Pillai's Trace=0.023, F (3, 466)=3.603, p=0.013, multivariate ηp^2=0.023). The partial eta squared (ηp^2) which is the proportion of the effect + error variance that is attributable to the effect was just .023 in this study, which means that the factor gender by itself accounted for only 2.3% of the overall (effect+error) variability in the preservice teachers' computer self-efficacy score. This result suggested a medium effect for gender (Cohen, 1988). In other words, men (M = 110.86, SD=13.70) had higher scores compared to the women (M= 107.21, SD=11.82), and this difference was statistically significant ($p<0.05$).

Table 7. MANOVA results for gender, age group, and discipline of study

Effect	Pillai's Trace value	F	Hypothesis df	Error df	Sig	η_p^2
Intercept	.984	9451.470	3	466	.000	.984
Gender (G)	.023	3.603	3	466	.013*	.023
Age (A)	.001	.116	3	466	.951	.001
Discipline (D)	.016	1.236	6	934	.285	.008
G*A	.007	1.103	3	466	.348	.007
G*D	.010	.789	6	934	.578	.005
A*D	.007	.512	6	934	.799	.003
G*A*D	.007	.568	6	934	.756	.004

*significant at p<.05.

However, there were no statistically significant age group and discipline of study effects on the combined dependent variables (Pillai's Trace=0.001, F (3, 466)=.116, p=0.95, multivariate ηp^2=0.001), (Pillai's Trace=0.016, F (6, 934)= 1.236, p=0.285, multivariate ηp^2=0.008) respectively. This indicates that computer self-efficacy scores of preservice teachers within the age groups below 20 years (M=108.88, SD=13.12) and 20-30 years (M=109.31, SD=12.76) did not differ significantly (p<0.05). More so, the computer self-efficacy scores among preservice teachers with different disciplines of study (Science: M=108.06, SD=11.24), (Technology: M=107.92, SD=14.40), and (Mathematics: M=107.00, SD=12.45) did not differ significantly. Based on these results, we upheld that gender had a significant main effect while age and discipline of study did not have any significant main effects on preservice teachers' computer self-efficacy.

Two-way and Three-way Interaction Effects of Gender, Age, and Discipline of Study on Preservice Teachers' Computer Self-Efficacy

The results of this study revealed no statistically significant interaction effects between gender and age (Pillai's Trace=0.007, F(3,466)=1.103, p=0.348, multivariate ηp^2=0.007), gender and discipline of study (Pillai's Trace=0.010, F(6,934)=0.789, p=0.578, multivariate ηp^2=0.005), age and discipline of study (Pillai's Trace=0.007, F(6,934)=0.512, p=0.799, multivariate ηp^2=0.003), and gender, age and discipline of study (Pillai's Trace=0.007, F(6,934)=0.568, p=0.756, multivariate ηp^2=0.004) on preservice teachers' computer self-efficacy.

Further investigations on which dependent variables preservice teachers with different gender (girls and boys), different age groups (below 20 years and 20-30 years) and different discipline of study (science, technology, and mathematics) differed necessitated the adoption of the follow-up univariate analyses of variance and significance was tested using the Bonferroni method which reduces the chance of a type 1 error. This was achieved in this study by dividing the original alpha level of 0.05 by the number of dependent variables and since there were three dependent variables, the alpha level of 0.0167 (0.05/3) was found. Thus, subsequent interpretation of effects on each of the dependent variables was made based on Bonferroni adjusted alpha level of 0.0167. The follow-up analyses for pairwise comparisons are displayed in Table 9, 11 and 13. These tables show the results of the hypotheses stated for the study.

Main Effects of Gender, Age, and Discipline of Study on Preservice Teachers' Beginning Skills in Computer

This study predicted that (i) gender (ii) age and (iii) discipline of study would not have any significant main effect on preservice teachers' beginning skills in computer and Table 8 below shows the descriptive statistics of the preservice teachers on beginning skills in computer according to gender (men and women), discipline of study (science, technology, and mathematics), and age group (below 20 years and 20-30 years). This dimension was measured in the present study with 9 items, thus a maximum score of 45 (9×5) and a minimum score of 9 (9×1) could be obtained from this subscale. In this study we could say that preservice teachers' beginning skills in computer was high (M= 37.90, SD=5.27).

Table 8. Descriptive statistics of preservice science, technology and mathematics teachers' computer self-efficacy (beginning skills) according to gender, age, and discipline of study

Age	Discipline	Gender	Mean	SD	N
Below20yrs	B.Sc(Ed) Technology	Female	36.2069	4.70850	29
		Male	37.9459	6.28024	37
		Total	37.1818	5.67019	66
	BSc(Ed) Maths	Female	37.2105	4.62423	57
		Male	38.8444	5.04505	45
		Total	37.9314	4.85892	102
	BSc(Ed) Science	Female	36.3750	4.37175	40
		Male	39.4400	5.03522	50
		Total	38.0778	4.96782	90
	Total	Female	36.7143	4.55167	126
		Male	38.8182	5.40684	132
		Total	37.7907	5.10767	258
20-30yrs	B.Sc(Ed) Technology	Female	36.2727	4.36098	11
		Male	37.4483	5.35581	29
		Total	37.1250	5.07476	40
	BSc(Ed) Maths	Female	37.0000	5.90465	38
		Male	38.2093	5.89818	43
		Total	37.6420	5.89557	81
	BSc(Ed) Science	Female	38.3390	4.95013	59
		Male	39.2381	5.58224	42
		Total	38.7129	5.21409	101
	Total	Female	37.6574	5.26523	108
		Male	38.3947	5.64373	114
		Total	38.0360	5.46304	222
Total	B.Sc(Ed) Technology	Female	36.2250	4.56007	40
		Male	37.7273	5.85346	66
		Total	37.1604	5.42856	106
	BSc(Ed) Maths	Female	37.1263	5.14521	95
		Male	38.5341	5.45609	88
		Total	37.8033	5.32923	183
	BSc(Ed) Science	Female	37.5455	4.80066	99
		Male	39.3478	5.26326	92
		Total	38.4136	5.09609	191
	Total	Female	37.1496	4.90588	234
		Male	38.6220	5.51060	246
		Total	37.9042	5.27087	480

As observed in Table 9 below, there was a statistically significant main effect of gender [F (1, 468)= 9.554; p=.002; univariate ηp^2=.020] on preservice teachers' beginning skills in computer. In other words, men (*M* = 38.62, *SD*=5.51) had higher mean scores in beginning skills in computer compared to the women (*M*= 37.15; *SD*=4.91), and this difference was statistically significant (p<0.0167). However, there were no statistically significant main effects of age [F (1, 468)= 0.024; p=.878; univariate ηp^2=.000] and discipline of study [F (2, 468)= 2.062; p=.128; univariate ηp^2=.009] on preservice teachers' beginning skills in computer respectively.

Two- and three-way interaction effects of gender, age, and discipline of study on preservice teachers' beginning skills in computer

The results of this study revealed no statistically significant interaction effects between gender and age [F (1, 468)= 1.006; p=.316; univariate ηp^2=.002], gender and discipline of study [F (2, 468)= 0.151; p=.860; univariate ηp^2=.001], age and discipline of study [F(2, 468)= 0.777; p=.460; univariate ηp^2=.003], and gender, age and discipline of study [F (2, 468)= 0.361; p=.697; univariate ηp^2=.002] on preservice teachers' beginning skills in computer as contained in Table 9 below.

Table 9. Follow- up pairwise comparisons of univariate analyses

Source	Dependent Variable	Type III SS	df	Mean Square	F	Sig	η_p^2
Corrected model	beginning	518.551	11	47.141	1.725	.065	.039
Intercept	beginning	565703.625	1	565703.625	20701.264	.000	.978
Gender (G)	beginning	261.095	1	261.095	9.554	.002*	.020
Age (A)	beginning	.649	1	.649	.024	.878	.000
Discipline (D)	beginning	112.719 2	56	.360	2.062	.128	.009
G*A	beginning	27.480	1	27.480	1.006	.316	.002
G*D	beginning	8.262	2	4.131	.151	.860	.001
A*D	beginning	42.481	2	21.240	.777	.460	.003
G*A*D	beginning	19.752	2	9.876	.361	.697	.002
Error	beginning	12789.040	468	27.327			
Total	beginning	702936.000	480				
Corrected total	beginning	13307.592	479				

*significant at $p<.05$

Main effects of gender, age, and discipline of study on preservice teachers' advanced skills subscale of computer self-efficacy

This study predicted that (i) gender (ii) age and (iii) discipline of study would not have any significant main effect on preservice teachers' advanced skills in computer and table 9 below shows the descriptive statistics of the preservice teachers on advanced skills in computer according to gender (men and women), discipline of study (science, technology, and mathematics), and age group (below 20 years and 20-30 years). This dimension was measured in the present study with 13 items, thus a maximum score of 65 (13×5) and a minimum score of 13 (13×1) could be obtained from this subscale. In this study we could say that preservice teachers' advanced skills in computer was high (*M*= 48.42, *SD*=7.11).

As observed in Table 10 below, there was a statistically significant main effect of gender [$F(1, 468) = 7.321$; $p=.007$; univariate $\eta p^2=.015$] on preservice teachers' advanced skills in computer. In other words, men (*M* = 49.30, *SD*=7.86) had higher mean scores in advanced skills in computer compared to the women (*M*= 47.30; *SD*=6.12), and this difference was statistically significant ($p<0.0167$). However, as contained in Table 10 below there were no statistically significant main effects of age [$F(1, 468) = 0.101$; $p=.750$; univariate $\eta p^2=.000$] and discipline of study [$F(2, 468) = 0.495$; $p=.610$; univariate $\eta p^2=.002$] on preservice teachers' advanced skills in computer respectively.

Two-way and Three-way Interaction Effects of Gender, Age, and Discipline of Study on Preservice Teachers' Advanced Skills in Computer

The results of this study revealed no statistically significant interaction effects between gender and age [$F(1, 468) = 0.150$; $p=.698$; univariate $\eta p^2=.000$], gender and discipline of study [$F(2, 468) = 0.609$; $p=.544$; univariate $\eta p^2=.003$], age and discipline of study [$F(2, 468) = 0.085$; $p=.919$; univariate $\eta p^2=.000$], and gender, age and discipline of study [$F(2, 468) = 0.032$; $p=.968$; univariate $\eta p^2=.000$] on preservice teachers' advanced skills in computer.

Table 10. Descriptive statistics of preservice science, technology and mathematics teachers' computer self-efficacy (advanced skill) according to gender, age, and discipline of study

Age	Discipline	Gender	Mean	SD	N
Below20yrs	B.Sc(Ed) Technology	Female	47.2069	6.58125	29
		Male	49.4054	9.80493	37
		Total	48.4394	8.55054	66
	BSc(Ed) Maths	Female	47.5614	6.61712	57
		Male	49.8889	7.58354	45
		Total	48.5882	7.11901	102
	BSc(Ed) Science	Female	48.1000	5.55993	40
		Male	48.5400	7.27930	50
		Total	48.3444	6.53970	90
	Total	Female	47.6508	6.25117	126
		Male	49.2424	8.11757	132
		Total	48.4651	7.29591	258
20-30yrs	B.Sc(Ed) Technology	Female	46.4545	4.20389	11
		Male	49.0345	6.84253	29
		Total	48.3250	6.28546	40
	BSc(Ed) Maths	Female	47.5789	6.14083	38
		Male	50.1860	7.50319	43
		Total	48.9630	6.97933	81
	BSc(Ed) Science	Female	47.3220	6.22963	59
		Male	48.7619	8.23084	42
		Total	47.9208	7.12697	101
	Total	Female	47.3241	5.98570	108
		Male	49.3684	7.58464 `	114
		Total	48.3739	6.91446	222
Total	B.Sc(Ed) Technology	Female	47.0000	5.97957	40
		Male	49.2424	8.57018	66
		Total	48.3962	7.74188	106
	BSc(Ed) Maths	Female	47.5684	6.39756	95
		Male	50.0341	7.50241	88
		Total	48.7541	7.04067	183
	BSc(Ed) Science	Female	47.6364	5.95126	99
		Male	48.6413	7.68555	92
		Total	48.1204	6.84191	191
	Total	Female	47.5000	6.11917	234
		Male	49.3008	7.85941	246
		Total	48.4229	7.11480	480

Table 11. Follow- up pairwise comparisons of univariate analyses

Source	Dependent Variable	Type III SS	df	Mean Square	F	Sig	η_p^2
Corrected model	advanced	513.003	11	46.637	.920	.521	.021
Intercept	advanced	929416.871	1	929416.871	18326.638	.000	.978
Gender (G)	advanced	371.260	1	371.260	7.321	.007*	.015
Age (A)	advanced	5.144	1	5.144	.101	.750	.000
Discipline (D)	advanced	50.171	2	25.086	.495	.610	.002
G*A	advanced	7.621	1	7.621	.150	.698	.000
G*D	advanced	61.819	2	30.910	.609	.544	.003
A*D	advanced	8.611	2	4.306	.085	.919	.000
G*A*D	advanced	3.269	2	1.634	.032	.968	.000
Error	advanced	23734.145	468	50.714			
Total	advanced	114941.000	480				
Corrected total	advanced	24247.148	479				

*significant at p<.05.

Main Effects of Gender, Age, and Discipline of Study on Preservice Teachers' File and Software Skills Subscale of Computer Self-Efficacy

This study predicted that (i) gender (ii) age and (iii) discipline of study would not have any significant main effect on preservice teachers' file and software skills in computer and Table 12 below shows the descriptive statistics of the preservice teachers on file and software skills in computer according to gender (men and women), discipline of study (science, technology, and mathematics), and age group (below 20 years and 20-30 years). This dimension was measured in the present study with 7 items, thus a maximum score of 35 (7×5) and a minimum score of 7 (7×1) could be obtained from this subscale. In this study we could say that preservice teachers' file and software skills in computer was high (*M*= 22.75, *SD*=3.92).

Table 12. Descriptive statistics of preservice science, technology and mathematics teachers' computer self-efficacy (file and software skill) according to gender, age, and discipline of study

Age	Discipline	Gender	Mean	SD	N
Below20yrs	B.Sc(Ed) Technology	Female	22.5517	3.56156	29
		Male	21.8649	4.59566	37
		Total	22.1667	4.15686	66
	BSc(Ed) Maths	Female	22.3860	3.57948	57
		Male	23.2444	3.60653	45
		Total	22.7647	3.59917	102
	BSc(Ed) Science	Female	22.3000	3.22013	40
		Male	23.2200	3.88766	50
		Total	22.8111	3.61611	90
	Total	Female	22.3968	3.43879	126
		Male	22.8485	4.02565	132
		Total	22.6279	3.75011	258
20-30yrs	B.Sc(Ed) Technology	Female	21.8182	3.68288	11
		Male	23.0345	4.63282	29
		Total	22.7000	4.38061	40
	BSc(Ed) Maths	Female	22.1842	4.16456	38
		Male	23.1163	4.33265	43
		Total	22.6790	4.25390	81
	BSc(Ed) Science	Female	23.2712	3.90769	59
		Male	22.9762	3.98465	42
		Total	23.1485	3.92272	101
	Total	Female	22.7407	3.98682	108
		Male	23.0439	4.24971	114
		Total	22.8964	4.11740	222
Total	B.Sc(Ed) Technology	Female	22.3500	3.56299	40
		Male	22.3788	4.61358	66
		Total	22.3679	4.22988	106
	BSc(Ed) Maths	Female	22.3053	3.80390	95
		Male	23.1818	3.95534	88
		Total	22.7268	3.89162	183
	BSc(Ed) Science	Female	22.8788	3.65969	99
		Male	23.1087	3.91238	92
		Total	22.9895	3.77525	191
	Total	Female	22.5556	3.69768	234
		Male	22.9390	4.12364	246
		Total	22.7521	3.92239	480

In Table 13 below, there were no statistically significant main effects of gender [F (1, 468)= 1.546; p=.214; univariate ηp^2=.003], age [F (1, 468)= 0.124; p=.725; univariate ηp^2=.000] and discipline of study [F (2, 468)= 0.739; p=.478; univariate ηp^2=.003] on preservice teachers' file and software skills in computer respectively.

Two-way and Three-Way Interaction Effects of Gender, Age, and Discipline of Study on Preservice Teachers' File and Software Skills Subscale of Computer Self-Efficacy

The results of this study in Table 13 below revealed no statistically significant interaction effects between gender and age [F (1, 468)= 0.103; p=.748; univariate ηp^2=.000], gender and discipline of study [F (2, 468)= 0.312; p=.732; univariate ηp^2=.001], age and discipline of study [F (2, 468)= 0.213; p=.808; univariate ηp^2=.001], and gender, age and discipline of study [F (2, 468)= 1.171; p=.311; univariate ηp^2=.005] on preservice teachers' file and software skills in computer.

Table 13. Follow- up pairwise comparisons of univariate analyses

Source	Dependent Variable	Type III SS	df	Mean Square	F	Sig	η_p^2
Corrected model	file &soft	115.833 11	10	.530	.679	.759	.016
Intercept	file &soft	204328.029	1	204328.029	13183.063	.000	.966
Gender (G)	file &soft	23.959	1	23.995	1.546	.214	.003
Age (A)	file &soft	1.919	1	1.919	.124	.725	.000
Discipline (D)	file &soft	22.905	2	11.453	.739	.478	.003
G*A	file &soft	1.603	1	1.603	.103	.748	.000
G*D	file &soft	9.684	2	4.842	.312	.732	.001
A*D	file &soft	6.607	2	3.303	.213	.808	.001
G*A*D	file &soft	36.299	2	18.150	1.171	.311	.005
Error	file &soft	7253.665	468	15.499			
Total	file &soft	255845.000	480				
Corrected total	file &soft	7369.498	479				

Prior research in the new millennium has indicated very high computer self-efficacy among preservice teachers in developed countries (Barbeite & Weiss, 2004) even in relatively developed countries such as Taiwan (Chen, 2012). The present study found a high computer self-efficacy among Nigerian preservice science, technology, and mathematics teachers. This finding corroborates prior research in Nigeria in which Aremu and Fasan (2011) found that the computer self-efficacy was average for most of the teachers (n=589) but disagrees with findings especially in rural communities (Halder & Chaudhuri, 2010) and among Thai undergraduate students who had neutral confidence in using computer applications (Niowan & Norcio, 2006).

The finding of high computer self-efficacy recorded in this study showed that most of the preservice science, technology and mathematics teachers were digital natives born within the period of rapid transformation in ICT and who at one time or the other saw the need to be engaged with computers and be computer literate. This finding is in sharp contrast with the initial expectation. The preservice science, technology and mathematics teachers were expected to record low computer self-efficacy in consonance with low level of technology development in Nigeria dotted with large rural communities. This encouraging finding is more surprising considering the report of the International Telecommunication Union (ITU) ICT development index which captures the level of advancement of ICTs in more than 150 countries world-wide and compares progress made at five years interval and for this reference between 2002 and 2007, that ranked Nigeria 130th in 2007 and 123rd in 2002 with ICT Development Index (IDI) of 1.39 and 1.09 respectively. This finding ran contrary to the report of a study conducted by the Global Information Technology (2004) that ranked Nigeria 86th out of 104 countries surveyed using the Networked Readiness Index (NRI), to measure the degree of preparation of a nation or community to participate in and benefit from ICT developments. Succeeding the year 2004, Nigeria was ranked 90th out of a total of 115 countries surveyed (Global Information Technology, 2005) and this showed a decline in Nigeria's preparedness to participate in and benefit from ICT development globally.

Prior research on computer self-efficacy has shown that gender, age, and discipline of study are related to the subject (Chen, 2012; Simsek, 2011; Aremu & Fasan, 2011; Halder & Chaudhuri, 2010; Topkaya, 2010; Seferoglu, 2007; Cheong, Pajares & Oberman, 2004; Işıksal & Aşkar, 2003; Cassidy & Eachus, 2002; Durndell & Haag, 2002; Bimer, 2000; Torkzadeh & Koufteros, 1994). The present study found proof only for the relation between computer self-efficacy and gender in which male preservice STM teachers recorded higher computer self-efficacy than their female counterparts. This means that male preservice STM teachers were more confident in the use of computers than their female counterparts. The gender difference in mean computer self-efficacy in favour of male preservice teachers in this study contrasts with previous finding that indicated higher computer self-efficacy for female teachers (Aremu & Fasan, 2012). This gender difference in computer self-efficacy is in support of previous studies (Öztürk, Bozkurt, Kartal, Demir & Ekici, 2011; Cassidy & Eachus, 2002) that indicated that computers have some gendered attributes in which men are more likely to use computers and are more confident than women.

The findings of significant gender effects on two subscales of the computer self-efficacy (beginning and advanced skills) further buttressed the fact that gender inequity in computer self-efficacy may not be over yet although some studies have indicated no difference. Durndell et al. (2000) reported no significant mean difference between genders in relation to computer self-efficacy in computer beginning skills while Cassidy and Eachus (2002) reported that there was a significant mean difference between males and females pertaining to computer self-efficacy. Öztürk et al. (2011) found out that computer-related self-efficacy perception scores of prospective teachers differed significantly according to gender. That men and women display dissimilar computer self-efficacy in the present study could mean that they vary in their motivations to use computers and encouraging women to engage in the use of computers may reduce the gender differences in computer self-efficacy. In the present study there were significant correlations for computer self-efficacy subscales of beginning skills and advanced skills with gender. The beginning skills correlated positively with gender and advanced skills correlated positively with gender although both correlations were weak. In this study, gender correlated positively with aggregate computer self-efficacy, although the correlation was weak.

The non significant effect of discipline of study on preservice teachers' computer self-efficacy in this study is explainable considering the fact that the participants were in computer related disciplines and might have had similarly richer prior experience in computer use due to their exposure to introductory computer science course in their freshman year and the need for them to constantly engage in the use of computers in their studies. This finding is further corroborated by the no significant correlation between discipline of study and computer self-efficacy recorded in this study. At the subscale level, discipline of study had a statistically significantly weak and positive correlation with the beginning skills but had no statistically significant correlations with advanced skills and file and software skills in the present study. This findings disagrees with the result of the survey by Paraskeva, Bouta and Papagianni (2008) who found positive correlation between teachers' subject area (classical or social studies, sciences, and technology subjects: internet, computers, and multimedia) and computer self-efficacy. Adebowale, Adediwura and Bada (2009) found that gender had no significant influence on secondary school students' computer self-efficacy whereas fields of study showed significant effect.

The non significant effect of age on preservice teachers' computer self-efficacy recorded in this study shows that the two age groups (below 20 years and 20-30 years) considered might not be a determining factor in preservice STM teachers' computer self-efficacy. Most of the participants in the study were fortunate to have been born in this era of rapid advancement in ICT and so they could be regarded as digital natives. Though in contrast with the present study finding, Charness, Schumann and Boritz (1992) found that there was a significant negative relationship between age and computer self-efficacy of adults which implied that the older the adult, the less his/her self-efficacy in the use of computer. Buttressing this result, Hakverdi, Gücüm, and Korkmaz (2007) found that preservice science teachers' computer self-efficacy was negatively correlated with age, grade level, educational use of computers, level of computer use, and personal computer use. At the subscale level, age had no statistically significant correlations with the beginning skills, advanced skills, and file and software skills.

The finding that each of discipline of study and age has no significant effect on and correlation with preservice teachers' computer self-efficacy suggests that these demographic variables may not be determining factors in preservice teachers' computer self-efficacy at least with respect to the sample considered in this study. Gender may still be considered as a determining factor in preservice science, technology and mathematics teachers' computer self-efficacy and intervention strategies should be sought to create an aura of gender equity in technology (computer) self-efficacy by making women to engage in frequent use of computer technology.

Conclusion

This study employed the slightly modified Computer Self-Efficacy Scale as a measure of self assessment regarding one's computer skills and examined the invariability of its scores with respect to gender, discipline of study, and age group of preservice teachers. Factor structures consistent with that of Durndell and Haag (2002) and Torkzadeh and Koufteros (1994) were recorded despite differences in context, culture, technology development and timing. A major finding of this study like earlier studies (Simsek, 2011; Durndell & Haag, 2002) was that the level of computer self-efficacy among the Nigerian sample was high and this compared favourably to high level of computer self-efficacy reported for samples in (relatively) developed countries such as Taiwan. It is apparent that the high level of computer self-efficacy in samples from developed countries may not be unconnected with the citizen high literacy rate, high access to computers and high technological prowess even as indicated in their rankings by the ITU ICTs development index. A developing country like Nigeria needs to replicate these characteristics in her citizens if she is to compete favourable with the developed countries in this era of computers, information and communication technologies. Without these virtues, the digital divide sweeping across developing nations will mar the Nigeria vision of becoming one of the 20 largest economies in the world by the year 2020. It is expected that achieving Vision 20: 2020 unfolded in 2009 by the democratic government will help Nigeria to consolidate her leadership role in Africa and establish herself as a significant player in the global economic and political arena.

Recommendations

The present study has several limitations that suggest further possibilities for empirical studies. For this study, one major limitation relates to the sample. Data were collected from 480 preservice science, technology, and mathematics teachers from two universities in Nigeria and using preservice teachers may not accurately mirror the experiences of the practicing (inservice) teachers, thereby limiting the ability to generalise the results of this study to all educational users and samples not considered. Future studies should attempt to increase the sample size by sampling other universities and incorporate more preservice teachers with diverse disciplines of study that may include Arts and Social Sciences Education and Language Education cohorts. The present study used intact groups without any attempt to randomize the participants. Future studies may consider using randomised subject. More so, the effects of expanded demographic variables on the individual subscale scores of computer self-efficacy of Nigerian preservice (inservice) teachers may be worthwhile examining.

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