

## **Development and Validation of Technostress Rating Scale**

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### **Abstract**

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The aim of this study was to develop and validate the Technostress Rating Scale (TRS). This scale assesses the cognitive, emotive, behavioural and physiological manifestations of computer-related stress. It is a 29-item scale comprising a statement which participants are required to respond to on a 4-point Likert-type format, ranging from 4 (Strongly Agree) to 1 (Strongly Disagree). Participants for this study were 523 students randomly drawn from the National Open University of Nigeria (NOUN). They comprised 261 males and 262 females, in the age range of 18-70 (mean =35 years). Initial item collation of TRS comprised 38 items which were systematically reworked based on focused group observation and pilot testing and this resulted in 29 items. The test instrument: TRS was administered to 523 students along with a validating questionnaire, the Psychophysiological Symptom Checklist (PSC). Normative score for TRS were 79.71 for females, 82.64 for males and 81.15 for males and females collectively. The Kaiser-Meyer-Olkin measure of sampling adequacy showed a value of 0.81, and a chi square of 1723.21, @ $p < .05$  respectively. TRS presented a concurrent validity of 0.53, a 14-day test-retest reliability coefficient of 0.79, split-half reliability coefficient of 0.74, a Cronbach-alpha reliability of 0.76. Eight orthogonal items were further extracted after Factor Analysis. Results indicated that Technostress Rating Scale presented good reliability and validity scores and thus, its usefulness in the assessment of computer-related stress appears promising.

**Keyword:** Development, validation; assessment, norm, technostress, scale

## Introduction

Historically, human evolution over the course of millions of years has equipped humans to live in a natural environment. However, since the industrial revolution, the living environments for the vast majority of people are becoming far from natural. Chemicals pollute and permeate every aspect of our lives; incidence of global warming is gradually re-defining our ecosystems, while the demand for energy to power desirable technological goods is on the increase. In the age of Information Communication Technology (ICT), characterised by explosion in the use of modern computers, cellular networks and satellite communication which has made it impossible for individuals and the society at large to remain isolated. The fact that ICT is extremely important to survive in the modern world is not in doubt, however, what is becoming increasingly worrisome is the *impact* of the use of Information Communication Technologies (ICTs) on the physical and mental health of users, and this is often taken for granted or ignored in our quest to understand, enjoy, apply or use the computer to achieve both individual and collective goals. The literature, however, indicates that the rapid introduction of ICT in virtually all spheres of life may cause individuals to suffer from a combination of technology fatigue and aversion known as technostress (Brod, 1984; Shenk, 1998; Rosen and Weil, 2000).

The term "technostress" was coined in 1984 by a clinical psychologist, Dr. Craig Brod who conceptualised it as "a modern disease of adaptation caused by inability to cope with the new computer technologies in a healthy manner. It manifests itself in two distinct but related ways: in the struggle to accept computer technology and in the more specialised form of over identification with computer technology" (Brod, 1984). Shenk (1998) also defined technostress as any negative impact on attitudes, thoughts, behaviour or body physiology that is caused either directly or indirectly by technology. Rosen and Weil (1998), in their study perceived technostress as reaction to technology and the attendant changes due to its influence. Tarafdar, Tu, Ragu-Nathan, and Ragu-Nathan (2007) further described technostress as a problem of adaptation as a result of a person's inability to cope with or to get used to information and communication technologies (ICTs). Thus, the consensus is that technostress is a modern disease of adaptation to ICT, that negatively affects our behaviour as normal human beings.

According to Tarafdar, Tu, Ragu-Nathan, and Ragu-Nathan (2007), there are five components of technostress, which are also known as technostress creators. They are as follows:

- **Techno-overload:** One well-documented form of technostress is the escalating problem of information overload. Just as fat has replaced starvation as most nations' number one dietary concern, "information overload" has now replaced "information scarcity" as new important emotional, social, and political problems. Until recently, the generation, processing and distribution of information remained evenly balanced. People could receive and think about information roughly at the same pace as it was generated. Since the mid 20<sup>th</sup>-century, computers, television, mobile phones, satellite and the internet have created a condition of hyper-production and hyper-distribution that has surpassed human processing abilities (Shenk,1998). Without doubt, technology has made access to information easier than ever before. Access to all this information is one thing, processing it is quite another.
- **Techno-invasion** is concerned with technology such as e-mail, cell phones, sms, tweets and status updates. These kinds of technology make it easier for people to stay in touch. Similarly, these communications are often invasive, intrusive and impinge on the ability to concentrate and work uninterrupted. All the task-switching and additional pieces of information are being forced to process while extra decisions only add to the stress already being experienced.
- **Techno-complexity** explains how change is stressful to some degree-even positive changes like getting married or starting a new job, because of the need to learn new skills and update the mental map of the world. In considering the rate at which technological change is occurring and the requirements of learning new operating systems, new software programmes, new ways of processing data, new hardware, etc, it is easy to see why rapid changes in technology can be stress-inducing.
- **Techno-insecurity** is of dual perspectives. For example, this form of technostress is as a result of workers feeling threatened that they will lose their jobs, in which case they can either be replaced by the new

ICT or by other people who are better in ICT compared to them. The other dimension is the vulnerability and security threat experienced due to massive personal information that is available on the internet.

- **Techno-uncertainty:** This is a situation where ICT users feel uncertain and unsettled since ICT is continuously changing with upgrading.

It is thus important to note that successful insight and management of technostress is partly based on a proper diagnosis, which only a valid and reliable assessment could offer. This study seeks to develop and validate a Technostress Rating Scale to identify the cognitive, emotive, behavioural and physiological manifestations of computer-related anxieties.

## **Review of Literature**

Studies indicate the existence of test instruments that tap into symptoms and manifestations of technology stress (Hudiburg,1989; Hudiburg, 1992; Carlotto and Camara, 2010). Carlotto and Camara (2010) assessed technostress from a theoretical model of four dimensions of Fatigue; Anxiety; Disbelief, and Ineffectiveness to portray the impact of the four variables in a successful adjustment to computer technology. Empirically, the Computer Technology Hassles Scale, for example, was developed by Hudiburg in 1989 as a measure of the construct of computer-related stress (Hudiburg,1989). This scale has been found to correlate with academic performance in computer courses (Hudiburg and Jones, 1991).

In 1992, Hudiburg later used factor analysis to produce a refined and shortened version of the scale which he renamed the Computer Hassles Scale (Hudiburg,1992). Hudiburg has since used this scale to demonstrate construct validity, to study gender differences, and to establish normative data for researchers (Hudiburg, Brown and Jones, 1993; Hudiburg, Ahrens, and Jones, 1994). In that particular study using the Computer Hassles Scale, participants were asked to indicate which of the thirty-seven hassles have affected them over the past two months and to rank the severity of each hassle on a four-point scale (0=not at all; 1=somewhat severe; 2=moderately severe; 3=extremely severe). These hassles include items such as computer system is down, lost data, slow computer speed, and incomprehensible computer instructions. The scale can be scored as the number of hassles

experienced (with a range from 0 to 37) or as the severity of hassles experienced (with a range of 0 to 111). Other test instruments include the computer self-efficacy instrument originally developed by Compeau and Higgins (1995). It consists of ten items on a 7-point Likert scale, ranging from 1 (*not at all confident*) to 7 (*totally confident*). It asked respondents to indicate whether or not they could use an unfamiliar software package under a variety of confident levels. Reliability for the original scale was above 0.9.

In addition, the Computer Anxiety Scale was developed by Beckers and Schmidt (2001) to measure six latent factors underlying computer anxiety. These are: (1) computer literacy (in terms of acquired computer skills), (2) self-efficacy (confidence in one's capacity to learn to use computers), (3) physical arousal in the presence of computers (such as sweaty hand palms, shortness of breath), (4) affective feelings towards computers (like or dislike of computers), (5) positive beliefs about the benefits for society of using computers, and (6) negative beliefs about the dehumanising impact of computers. The scale contains 32 Likert-type items, consisting of statements on computers that could be scored between 1 (entirely disagree) and 5 (entirely agree). Computer literacy was referred to by items such as "I find it easy to make computers do what I want," "I have difficulty in understanding the technical aspects of computers". Self-efficacy was referred to by items such as "Everyone can learn to use a computer, as long as one is patient and motivated," and "I am confident that I can learn computer skills." Affective feelings toward the computer were measured by items such as "Life will be easier and faster with computers" and "Computers are nice to work with." Examples of physical arousal items are "I feel suffocated when I am in front of the computer," "My heart beats faster when I think about working with a computer." Beliefs on the dehumanising power of computers were measured using items such as "Soon our lives will be controlled by computers," and "People are becoming "slaves" to computers." Beliefs on the benefits of personal computers, especially for the good of society, were measured by items such as "Computers are bringing us into a bright new era," "Computers create economic stability."

Heinssen, Glass and Night (2002) validated the Computer Anxiety Rating Scale (CARS), by examining the behavioural, cognitive, and affective components of computer anxiety. The CARS was shown to be a reliable and

valid measure, with internal consistency of 0.86. Higher levels of computer anxiety were related to greater math and test anxiety, and to less computer *experience* and mechanical interest. During an actual computer interaction, greater computer anxiety was associated with lower expectations and poorer task performances, as well as with greater state of anxiety, reported physiological arousal, and debilitating thoughts. These results are consistent with cognitive-attention theory of computer anxiety and suggest directions for future research. Consistent differences between women and men on indices of computer anxiety were, however, not found.

Studies reviewed showed theoretical and empirical findings of computer-related stress. In order to add to existing knowledge in this area and to specifically present a culture-fair assessment instrument, this study seeks to develop a technostress scale using the Nigerian sample. The present study therefore presents the following objectives and hypotheses.

### **Objectives of the Study**

This study seeks to:

- a) develop a scale to assess symptoms and manifestations of technostress
- b) determine the normative score of Technostress Rating Scale for males and females
- c) identify the test-retest, split-half and Cronbach alpha coefficients of Technostress Rating Scale
- d) determine the concurrent validity of Technostress Rating Scale
- e) determine the factor structure of Technostress Rating Scale.

### **Research Hypotheses**

- a) Males will present higher norm score on Technostress Rating Scale than females.
- b) There would be positive and high correlations between the test-retest and split-half scores of participants on TRS indicating its reliability.
- c) Technostress Rating Scale will record high concurrent validity score.
- d) Distinct factors and subscales will emerge from the Technostress Rating Scale.

## **Methods**

In this section, the specific steps taken to develop the new scale, the rationale and items for the new scale are presented and the methods for the validation study are described.

### **Item Generation for the Technostress Rating Scale (TRS)**

The TRS was operationalised based on previous conceptualisations of technostress (Brod, 1984; Hudiburg, 1992; Beckers et al., 2001; Tarafdaret al., 2007), in the literature. Item generation was based on considerations regarding the selection of complaints from participant observation of computer users' complaints and a diligent electronic and manual search of technostress literature. It was ensured that the items covered a high percentage of aspects of technostress components and complaints.

Widely used instruments in computer technology and anxiety literature were reviewed for item structure and content thought to be reflective of the dimensions described above. Most of the instruments reviewed contained items that were intended to measure a general construct but were not context-specific. In some instances, selected items thought to be extremely relevant to the current development of the TRS were found as part of larger multidimensional instruments on technology, stress and anxiety. Other items were recommended based on the formal and informal observations of the author. Items were constructed as questions or statements that could be presented in a self-report format. The resulting 38 sample items were presented to a focus group of seven members made up of Information Technology workers and students. This group addressed the face and content validity of this new scale. The members were provided with a theoretical rationale for the development effort, the operational definitions of the measurement domains, the sample of items, a set of instructions, and a score sheet. The focus group members evaluated each item on the basis of (i) its 'relevance' to the concept of technostress as portrayed in the provided definitions, (ii) its 'conciseness' i.e. its ability to capture and adequately present to patients or clients the main idea of the statement as concisely as possible, and (iii) its clarity. A 4-point ordinal scale (4: most hassles, 3: hassles, 2: little hassles, 1: no hassles) was used for each rating and panellists provided an explanation of why and what suggestions they might make to

improve the item, receiving a rating of either poor or very poor. Finally, they were asked to contribute additional items where they thought it relevant, or delete irrelevant questions as the case may be. Based on the focus group exercise, difficult-to-understand items were dropped while items that participants found to be ambiguous were rephrased and this reduced the scale to 32 items. The response format was also changed to the following four-point Likert scale: (4: strongly agree, 3: agree, 2: disagree, 1: strongly disagree).

**Pilot Study:** The 32-item Technostress Rating Scale was administered to 20 participants made up of students and workers. Difficult-to-understand questions were further rephrased based on observations from the field. Items that appeared similar were subsequently dropped and this further reduced the scale to 29 items. The 29 items were pilot-tested on 30 participants (Nursing students of the National Open University of Nigeria - 15 males, 15 females) while a reliability coefficient of 0.86 was obtained.

## **Population**

Population for this study was randomly selected from the National Open University of Nigeria (Lagos Study Centre). This homogenous group (open and distance learning students) was made up 523 participants (males:261, females:262), in the age range of 18-70(mean 35 years)

The students were guaranteed strict confidentiality after which they were requested to respond to the instruments: Technostress Rating Scale (TRS) and Psychophysiological Rating Scale (PSC) by Omoluabi (1987),

## **Research Design**

The survey design used for the study involved the use of two psychometric instruments (TRS and PSC), which were randomly administered to a sample of 523 participants. Correlation design was also used for the 2-wcck test-retest analysis, The independent variable was time interval while the dependent variable was scores obtained with the test instruments.

## Instruments

The following psychometric instruments were used:

1. *Technostress Rating Scale (TRS)*: was 29-item test instrument constructed and validated in this study. Each item is a statement which participants were required to respond to on a four-point Likert-type scale ranging from 4: (strongly agree) to 1; (strongly disagree). Specifically, TRS laps into the emotive, cognitive, behavioural and physiological manifestations of Information Communication Technology-related anxiety.
2. *Psychophysiological Symptoms Checklist (PSC)*: was developed by Omoluabi (1984). It was used to measure participant's level of emotional and psychological reactions to stressors. It comprises 50 self-descriptive items to which participants respond on a 5-point Likert-type scale. It has a reliability coefficient of 0.84 obtained with Kuder Richardson formula 20 and a concurrent validity coefficient of 0.47

## Test Administration Procedure

TRS and PSC were administered by the researcher with the aid of four research assistants. Test administration was generally done after establishing adequate rapport and with the assurance of confidentiality. Observations raised by the participants were clarified. Participants were encouraged to respond honestly to the items. A total of 350 items of the questionnaire was administered but 523 were correctly responded to and therefore used for this study (response rate 96.1%). TPS was administered concurrently validity of the, new scale. In order to obtain the test-retest reliability coefficients of TRS, the scale was re-administered two weeks after to 100 participants drawn from the Lagos Study Centre of the National Open University of Nigeria, who also took part in the first administration.

## Scoring

TRS-scores were obtained through direct and reverse scoring methods. The

negatively-worded items were subject to direct scoring method; while values of numbers shaded on them were added together. Item 25 was positively-worded and was scored with reverse scoring method by changing numbers 1,2,3,4, to 4,2,1 respectively. TRS yielded a maximum score of 116. PSC scores were also obtained by adding together the values of the numbers shaded in all the items.

## Data Analysis

The Statistical Package for Social Sciences (SPSS-15) was used for statistical analysis. The statistical methods used in the standardisation of TRS were: Mean, Standard Deviation, Pearson Product Moment correlation, Principal Component Factor Analysis with Varimax Rotation and Cronbach alpha (SPSS.2008).

## Results

### Norm Score

The normative scores of the tests were obtained by computing the mean scores and standard deviations for the 523 participants (261 males and 252 females). The result is presented in Table 1.

**Table 1: TRS and PSC Norm Score**

Group	TRS		PSC	
	Mean	Standard deviation	Mean	Standard deviation
<b>Females(n=262)</b>	79.71	10.36	59.11	20.09
<b>Males(n = 261)</b>	82.64	9.40	59.65	20.13
<b>M&amp;F(n = 523)</b>	81.15	10.01	59.34	20.08

**Note:** TRS = Technostress Rating Scale; PSC: Psychophysiological Symptom Checklist

Results in Table 1 show that males have higher manifestations of technostress as measured by TRS, with a mean score of 82.64, than females (mean = 79.71). The male group also obtained higher mean score on PSC (59.65) than females (59.11). Overall mean scores for both males and females for TRS and PSC were 81.15 and 59.34 respectively. Thus, norm

score of 79.71 for females; 82.64 for males and 81.15 for both males and females combined are indicative of manifestation of technostress. In addition to providing a norm score for TRS, this result confirms hypothesis 1 that states that males will present higher norm score than females on Technostress Rating Scale.

### Reliability

Pearson Product-Moment Statistical Method was used to obtain the 14-day test-retest reliability coefficients of TRS, while Cronbach-alpha was used to obtain its internal consistency reliability coefficient. The result is presented in Table 2.

**Table 2: Reliability Coefficients of Technostress Rating Scale**

Type	R
14-day test-retest	.79
Spilt- half	.74
Cronbach alpha	.76

Table 2 shows that Technostress Rating Scale had internal consistency alpha coefficient of .76, split-half reliability coefficient of .74 and an equally strong two-week test-retest reliability coefficient of .79. Thus, hypothesis 2 that states that there would be positive and high correlations between the test-retest and split-half scores of participants on TRS indicating its reliability is confirmed.

### Validity

In order to obtain the concurrent validity of Technostress Rating Scale (TRS), the scores of TRS were correlated with those of Psycho physiological Symptom Checklist (PSC) using the Pearson Product-Moment Statistics. The result is presented in Table 3.

**Table 3: Correlation Matrix of TRS and PSC**

Measure	TRS	PSC
TRS-90	1	
PSC	0.56*	1

**Note: \* Significant @  $p < .05$ ;  $df = 521$ , Critical  $r = .196$ ; TRS: Technostress Rating Scale; PSC: Psychophysiological Symptom Checklist**

Result in Table 3 show significant concurrent validity coefficients of the 2measures (Technostress Rating Scale and Psychophysiological Symptom Checklist). The concurrent validity coefficient obtained was .56 which is significant at  $p = <.05$ . This therefore confirms hypothesis 3 that states that: Technostress Rating Scale will record high concurrent validity score.

### **Construct Validity**

In order to determine the factorial structure of Technostress Rating Scale (TRS), which is an aspect of construct validity, Factor Analysis, Principal Component and Direct Varimax Rotation were used (Brace, Kemp & Snelger, 2006). The procedure for Factor Analysis was conducted in stages which include: data analysis to order to determine the data compatibility with factor analysis, establishment of the factors, factor rotation and naming or labelling.

The initial stage was achieved using the Bartlett's test of Sphericity and Kaiser-Meyer-Olkin (KMO) sample sufficiency tests. The 29 items on the TRS showed good inter-item correlation pointing to the fact that the data was sufficient enough for factor analysis to be applied. The KMO measure of sampling adequacy showed a value of 0.81, and a chi square of 1723.21,  $p < .05$  respectively. According to Brace et al., (2006), as a measure of factorability, KMO values of .60 and above is accepted.

Factor Analysis was further conducted with the Principal Component Analysis (PCA) which provides a roadmap for how to reduce a complex data set to a lower dimension to reveal the sometimes hidden factors underlying a particular construct. Twenty-nine (29) items were subjected to factor analysis and eight (8) factors emerged from the factor analysis result. The result is presented in Table 4.

**Table 4: Initial Eigenvalue of the Extracted Components**

Factor	Eigenvalue	% of variance	Cumulative%
1	5.29	18.25	18.25
2	2.75	9.48	27.73
3	2.15	7.42	35.15
4	2.14	7.39	42.54
5	1.53	5.26	47.80
6	1.31	4.52	52.32
7	1.19	4.10	56.42
8	1.15	3.95	60.37

The results presented in Table 4 show that eight factors with Eigenvalues greater than 1 were extracted and accounted for 60.34% of the total variance. Kaiser's criterion states that only factors having latent roots greater than 1 are considered, since factors less than 1 would add nothing to the data (Child,1976). The first factor had an eigenvalue of 5.29 and a variance of 18.25, while the value with the least factor presented an eigenvalue of 1.15 and a variance of 3.95. The items that loaded in each of the factors and their communalities are presented in Table5.

**Table5: Items, Communalities and their Factor Loading**

Item No.	Communalities	Factors							
		1	2	3	4	5	6	7	8
1	.67			.54					
2	.70			.58					
3	.69		.41						
4	.70			.47					
5	.69			.48					
6	.62								
7	.56	.58							
8	.60	.69							
9	.52	.54							
10	.58		.60						
11	.68		.44						
12	.67				.69				
13	.72	.67							

14	.69	.69							
15	.56	.67							
16	.69							.46	
17	.66	.54							
IS	.55						.43		
19	.58	.55							
20	.58					.45			
21	.73								
22	.54				.43				
23	.46		.58						
24	.55								
25	.48								
26	.39								
27	.54	.47							
28									.43
	.65								
29									
	.45								

**Extraction Method: Principal Component Analysis. (8 components extracted)**

The results presented in Table 5 show that nine items loaded significantly in factor 1; four in factor 2; four in factor 3 and three in factor 4. In addition, one item loaded significantly in factors 5,6,7 and 8. The communalities, the variance shared by the variable with other variables, extracted from the Factor Analysis have good communality level ranging from 0.39 to 0.73. The study adopted a common cut-off score of 0.40 as the criterion for the selection of factorially pure items (Kelinger,1986; Kline,1994).

In order to appropriately name the components extracted, the items were arranged in descending order of loading in each factor. The result is presented in Table 6.

**Table 6: Name, Extracted Factors and Items that Load on them**

S/N	Items No.	Items on TRS		
1	27	The light fluctuation damages my computer	.47	Uneasiness
	9	The slow booting -up time of my on computer bothers me	.54	
	17	I worry about loss of privacy due to personal information on the computer	.54	
	19	I feel terrified when I forget to save my work	.55	
	7	I feel frustrated when I experience unexpected shut-down of computer	.57	
	13	I constantly worry about loss of data on my computer	.67	
	8	The slow download of information on computer bothers me	.69	
	14	I constantly worry about loss of my computer program	.69	
	15	I worry that my disk or flash drive might be infected	.70	
	3	The poor computer screen affects my sight	.41	Strain
2	11	I feel that some computer instructions are incomprehensible	.44	
	23	Sitting in front of a computer for a long time bothers me	.58	
	10	I am always apprehensive of virus attack on my computer	.60	
3	4	I feel that my typing skill is poor	.47	Self-Efficacy
	5	I feel pressured to update my software skill I	.48	
	1	feel I have poor computer skill	.54	
	2	I feel agitated when information is lost in the computer	.58	
4	25	I feel comfortable using computer search engines (e.g., yahoo,Google)	.42	Proficiency
	22	I feel frustrated by the increased computer use expectations	.43	
	12	I feel that my computer skill is outdated	.69	
5	20	I feel bombarded with too much computer information	.45	Information overload
6	18	I feel I need to update my computer skill	.42	Dexterity
7	16	I worry about sharing computer	.46	virus attack
8	28	I feel frustrated when I experience poor UPS	.43	Power fluctuation

Extraction Method: Principal Component Analysis with varimax rotation (Kaiser criteria). Rotation converged in 13 iterations.

## **Discussion**

Psychometric instruments continue to be one of the most powerful and essential tools for obtaining objective information about human behaviour and anxieties. The development and validation of Technostress Rating Scale (TRS) is an effort to contribute to the body of knowledge in this area. The first effort about any newly developed instrument is to determine its reliability and validity, that is, to measure what it was designed to measure (American Educational Research Association, 1999).

The current study therefore, reports the development and validation of a novel instrument for the assessment of computer-related stress known as Technostress Rating Scale. Participants for this study were students drawn from an open and distance learning institution, the National Open University of Nigeria (Lagos Study Centre). Rationale for the employment of this group of participants was that their delivery and learning mode was largely e-learning-based and thus they require higher mastery of Information Communication Technology with likely manifestations of computer-related stress.

A multidimensional 29-item scale, the Technostress Rating Scale (TRS) was described. The TRS was a readily administered 29-item self-report T questionnaire designed to measure emotive, cognitive, behavioural and physiological manifestations of computer-related stress and anxiety: Empirical validation on 523 open and distance learning students produced the norm score as well as concurrent validity of this new scale. Face and content validity were supported by focus group and expert opinion endorsing the relevance of items for TRS.

It was hypothesised that this new test would present high validity and reliability measures. Results in Table J show that normative score for TRS is 82.64 for males and 79.71 for females. Thus, score higher than the obtained scores was indicative of manifestations of technostress. In addition to confirming hypothesis 1, the study illustrates that normative score for male was a bit higher than that of the females. This was not surprising because it was likely that the biological make-up of men predisposes them to adrenaline-pumping tension and anxiety, unlike women who are more open

and expressive in difficult situations. For a test of reliability, results in Table 2 show that TRS has a Cronbach-alpha coefficient of .76, a split-half reliability of .79, and a test-retest reliability coefficient of .74. According to Aiken (2003), for a test to determine if the mean score of the two groups of people are significantly different, a reliability coefficient of 0.60 to 0.70 may be satisfactory. The reliability coefficient of alpha and split-half obtained on the TRS are above the range and also above the commonly held rule of a minimum Cronbach-alpha of .70. The reliability values obtained for the scale are comparable to those of other similar tests like the computer self-efficacy instrument developed by Compeau and Higgins (1997), with a reliability coefficient of 0.90.

The concurrent validity for TRS was tested by correlating it with Psychophysiological Symptom Checklist (PSC). The concurrent validity obtained was .53 (Table 3). This result is positive and significant @  $p < .05$ ,  $df = 521$ , critical  $r = 196$ . This thus confirmed Aiken (2003) claim that a construct validated instrument should have high correlations with other measures or methods measuring the similar construct (convergent validity), but low correlations with measures of different construct (divergent validity). This statement was further amplified by Brace, Kemp and Snelger' (2006) assertion that convergent validities above 0.85 show that the scales are very similar and might not necessarily be used as two different scales, while values that range between 0.50 and 0.80 show differences in the scales though they may be measures of similar construct. Conversely, values below 0.50 indicate various degrees of divergence between scales. A concurrent validity of 0.53 was an indication that TRS had good validity content.

TRS was further subjected to factor analysis which Brace, Kemp and Snelger (2006) indicated as another way of confirming construct validity of scale. As could be seen in Tables 4 and 5, the data were analysed using the Principle Component Factor Analysis. Orthogonal (uncorrelated) factors greater than 1.0 were therefore found. Rotating the components, 8 component factors were extracted which conformed to Kaiser's criterion and Thurstone's (1947) principles. This means that the factors extracted loaded significantly, and are independent of one another. The component factors extracted could be said to represent different factors that constituted technostress and they are identified in this study to be: Uneasiness, Strain, Self-efficacy, Proficiency,

Information overload, Dexterity, Virus attack and Power Fluctuation.

## Conclusion

Results of the study indicate that TRS presented reliable and valid properties and thus could be viewed as a valid tool for the screening of technostress. This has implication for proper diagnosis and management of computer stress. Technostress Rating Scale (TRS) is potentially useful in screening e-learning students that could be predisposed to technology-related stress. The instrument could be instituted during the student orientation and subsequently at intervals during their programme in order to ascertain the stress-level of technology and administer appropriate intervention.

Despite the important contributions made by this study, several caveats and future directions are noted. First, this study only focused on open and distance learning students and thus, findings may not have a general application. Further, empirical work to support the initial reliability and validity should include replication on other groups namely, bankers, engineers, academics, and so forth.

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