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ABSTRACT

The reliability and factorial validity of the Computer Attitudes Scale (CAS) was assessed with college students in South Korea. The CAS was developed for use with high school students, but has been used in higher education in the United States. It is a Likert-type scale of 30 positive and negative statements about the use of computers, and is one of the most extensively used and tested computer attitude scales. Subjects were 182 female and 121 male Korean college students who completed a Korean translation of the instrument. Reliability coefficients of the three subscales and the total score were high, indicating that the scale is stable enough to be used and reliable in measuring attitudes toward computers. Results from factor analyses imply that the CAS measures more various traits in Korean culture than in the United States. Korean students had more negative attitudes overall about computers than did students in the United States, and these may distinguish beyond the three previously identified factors of computer dislike, anxiety, and confidence. In addition, Korean students demonstrate more persistence in learning overall. Further research is needed to investigate causes of Korean students' differentiated feelings about computers. (Contains 36 references.) (SLD)

A CROSS-CULTURAL VALIDATION STUDY OF THE COMPUTER ATTITUDE SCALE

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A CROSS-CULTURAL VALIDATION STUDY OF THE COMPUTER ATTITUDE SCALE

Students' and teachers' attitudes toward computers are one of the most important factors that may affect the success or failure of the new computer programs (Loyd & Gressard, 1984a). It is crucial to develop effective instruments to measure their computer attitudes. A number of scales have been introduced recently to measure computer anxiety or attitudes toward computers. Woodrow (1991) has summarized the characteristics of the following 10 computer attitude measures: Minnesota Computer Literacy and Awareness Assessment (MCLAA) instrument (Anderson, et al., 1982), Computer Attitude Scale (Loyd & Gressard, 1984a, 1986), Attitudes Toward Computers (Reece & Gable, 1982), Computer Use Questionnaire (Griswold, 1983), Computer Survey (Stevens, 1980), Attitudes Toward Computer Usefulness Scale (Byrd & Koohang, 1989), General Computer Attitude Measure (Loyd & Gressard, 1986), Student Survey (Norales, 1987), Survey of Computer Attitudes (Marshall & Bannon, 1986), and Bath Attitude Survey (Bear, Richards, & Lancaster, 1987).

There are so many instruments that educators face the problem of which one to choose. To solve this problem, two recent studies have compared the reliability and factorial validity of the available computer attitudes scales using a single population sample (Gardner, Discenza, & Dukes, 1993; Woodrow, 1991). Most studies on computer attitudes have been performed in the western culture. Cross-cultural validity and reliability of the computer attitudes scales have seldom been investigated (Berberoglu & Calikoglu, 1993). The purpose of this study was to assess the reliability and factorial validity of the Computer Attitudes Scale (CAS) of college students in Korea.

The CAS was developed by Loyd and Gressard (1984a) for use with high school students, but was used for relatively distinct subpopulations: middle school students, community college students, university students, teachers, and adults. This scale was a Likert-type instrument consisting of 30 positive and negative statements about computers and the use of computers. The items were divided into three

subscales: computer anxiety, computer confidence, and computer liking. Loyd and Loyd (1985) added a fourth subscale, computer usefulness, to the CAS.

Of the previous 22 studies using the CAS, both reliability and validity were reported on 10 occasions (Bandalos & Benson, 1990; Berberoglu & Calikoglu, 1993; Gardner, Discenza, & Dukes, 1993; Gressard & Loyd, 1986, 1987; Loyd & Gressard, 1984a; Loyd & Loyd, 1985; Massoud, 1990; Roszkowski, et al., 1988; Woodrow, 1991). Only validity of the CAS was reported by 5 studies (Colley, Gale, & Harris, 1994; Dyck & Smither, 1994; Hunt & Bohlin, 1993; Massoud, 1991; Munger & Loyd, 1989). Reliability of the CAS was reported in both Koohang (1989) and Dukes, Discenza, and Couger (1989). In five studies (Gressard & Loyd, 1985; Koohang, 1986; Loyd & Gressard, 1984b, 1986; Loyd, Loyd, & Gressard, 1987), psychometric criteria such as reliability and validity were reported, but based on the results of others.

The reliability of the CAS was reported using the alpha coefficient in all but two studies (Roszkowski, et al., 1988 - test-retest method; Dukes, Discenza, & Couger, 1989 - Spearman-Brown method). The ranges of the alpha reliabilities in the 10 previous studies were as follows: computer anxiety (.57 - .93; median = .87), computer confidence (.72 - .93; median = .89), computer liking (.68 - .95; median = .90), and total scores (.90 - .97; median = .95).

Factorial validity of the CAS was reported in 8 of 15 cases with the following results: one factor (Berberoglu & Calikoglu, 1993), two factors (Woodrow, 1991), three factors (Bandalos & Benson, 1990; Gressard & Loyd, 1986; Loyd & Gressard, 1984a; Loyd & Loyd, 1985; Massoud, 1990), and eight factors (Gardner, Discenza, & Dukes, 1993). On seven occasions the predictive validity of the CAS was investigated: course (Colley, Gale, & Harris, 1994; Roszkowski, et al., 1988), computer knowledge (Massoud, 1991), computer experience (Colley, Gale, & Harris, 1994; Hunt & Bohlin, 1993; Gressard & Loyd, 1987), age (Dyck & Smither, 1994), and math performance (Munger & Loyd, 1989).

The CAS is one of the most extensively used and tested computer attitudes scales (Woodrow, 1991). Gardner, Discenza, and Dukes (1993) concluded that the CAS and BELCAT (Blomberg-Lowery

Computer Attitude Task, Erickson, 1987) were superior to two other scales on the psychometric criteria of reliability and validity. Although its subscales and overall reliability coefficients were high indicating that each subscale was stable enough to be used separately and the total score gave a reliable measure, Woodrow (1991) strongly suggests that the CAS is two dimensional, not three as claimed by its developers. As Chen (1986) commented, anxiety and confidence are generally taken as opposites of the same construct. However, Massoud (1990) supports the findings of its developers (Loyd & Gressard, 1984a; Gressard & Loyd, 1986). On the other hand, Berberoglu and Calikoglu (1993) have indicated that the CAS measures a primary single trait in the Turkish culture. The results raise some interesting questions and issues that deserve more attention and cross-cultural research.

Method

Subjects

The Korean sample for this study consisted of 303 undergraduate students enrolled in test and measurement, curriculum evaluation, and educational psychology courses for the spring semester of 1994 at the Kyungpook National University, Taegu, Korea. There were 182 females and 121 males.

Instrumentation

The Computer Attitude Scale (Loyd & Gressard, 1984a) consists of 30 items, divided into three 10-item subscales: computer anxiety, computer confidence, and computer liking. The items include positively and negatively worded statements. The instrument employs a four-point Likert scale in which the students indicate their feelings by selecting exactly one of four choices; it does not include a neutral choice. The alpha reliability coefficients for computer anxiety, computer confidence, computer liking, and total scores were .87, .91, .91, and .95, respectively (Loyd & Gressard, 1984a). Detailed information regarding translation of the Korean version of CAS, test administration, and data collection procedures are provided in Moon, Kim, and McLean (1994, November).

Data Analysis

Four scores of the Computer Attitudes Scale were computed for each student, one score for each of the three subscales and total scores. Higher scores on the Computer Anxiety subscale correspond to lower anxiety, while higher scores on the Computer Confidence and Computer Liking subscales correspond to greater degrees of confidence and liking, respectively (Loyd & Gressard, 1984a). Means, standard deviations, and alpha coefficients were calculated for each of the three subscales and for the total score. Intercorrelations among the subscales were also computed.

A 30 x 30 matrix of item intercorrelations was formed. A principal component analysis of the data was conducted, followed by a factor analysis using a three factor solution with a varimax rotation (Gressard & Loyd, 1984a, 1986; Massoud, 1990).

The coefficient of congruence (Harman, 1976) was computed to compare factor solutions obtained on the factors of the Korean version with those from the Gressard and Loyd study (1986) using a computer program developed for that purpose (Hebbler, 1989).

Results

The results are presented in three sections: first is the descriptive information including intercorrelations among the subscales of the CAS. This is followed by the reliability and factorial validity of the CAS.

Descriptive Analysis

The means and standard deviations of the subscale scores and the total score are presented in Table 1. As seen in Table 1, the lowest mean was obtained on the confidence subscale, and the highest mean was obtained on the liking subscale.

Table 1

Means and Standard Deviations of the Computer Attitude Scale

	Female	(N=182)	Males	(N=121)	Total	(N=303)
Subscales	M	SD	M	SD	M	SD
Computer Anxiety (Anf.)	26.05	5.65	27.03	4.31	26.44	5.17
Computer Confidence (Conf.)	21.85	4.91	24.91	4.59	23.07	5.00
Computer Liking (Like.)	26.82	5.48	27.56	4.94	27.12	5.28
Total Scores	74.73	14.61	79.50	11.90	76.63	13.78

Table 2 presents the intercorrelations among the subscales of CAS from the present study with those of the previous studies. Correlations among these subscales ranged between .67 and .74 in this study. As seen in Table 2, the highest correlation was between computer anxiety and computer confidence, but the intercorrelations between computer anxiety and computer liking was .67, and the intercorrelations between computer confidence and computer liking was .67. Intercorrelations between computer anxiety and computer confidence were the highest (.82) in the Gressard and Loyd study (1986) and the lowest (.63) in the Turkish version (1993). Intercorrelations between computer anxiety and computer liking were the highest (.69) in the Gressard and Loyd study (1986) and the lowest (.64) in the Loyd and Gressard study (1984a). Intercorrelations between computer confidence and computer liking were the highest (.80) in the Loyd and Gressard study (1984a) and the lowest (.67) in the Korean version.

Table 2

Intercorrelations for the Computer Attitude Subscale and Total Scale

	Loyd & Gressard (1984a)	Gressard & Loyd (1986)	Turkish Version	Korean Version
Anx. Vs Conf.	.73	.82	.63	.74
Anx. Vs Like.	.64	.69	.67	.67
Conf. Vs Like.	.80	.77	.70	.67
Anx. Vs Total	.85	.91	.83	.90
Conf. Vs Total	.93	.94	.89	.90
Like. Vs Total	.91	.89	.88	.88

* Turkish version is Berberoglu and Calikoglu (1993).

Reliability

The coefficient alpha reliabilities were computed for the CAS and its subscales; computer anxiety, computer confidence, and computer liking. Table 3 shows the alpha coefficient of the subscales of CAS with the results of the previous studies. As seen in Table 3, the coefficients are .82, .80, .84, and .92 for computer anxiety, computer confidence, computer liking, and total score, respectively. The results indicate that the scales are highly reliable, but it should be noted that the coefficients of its developers were even higher.

Table 3

Alpha Coefficient Reliabilities for the Computer Attitude Scale

Studies	Anxiety	Confidence	Liking	Total
Loyd & Gressard (1984a)	.86	.91	.91	.95
Gressard & Loyd (1986)	.89	.89	.89	.95
Massoud (1990)	.78	.82	.75	.91
Turkey (1993)	.57	.72	.68	.90
Korea (1994)	.82	.80	.84	.92

Factorial Validity

The principal components factor analysis using a combination of the scree test and Kaiser criterion suggested the possible existence of 3 to 5 factors. Varimax rotation was performed on 3 and 5 factors. The three-factor solution was reported to compare with the 1986 Gressard and Loyd study (see Table 6). The five-factor solution was reported as it seemed to be the best structure of the Korean version.

Tables 4 presents the varimax-rotated three-factor solution of the CAS in this study. The three-factor solution accounted for 46% of the total variation. The eigenvalues of the first three factors from the principal component analysis were 9.45, 2.89, and 1.53. As is seen in Table 4, all items of the CAS indicated that the factor loadings were at or above .40 in the three factors . Items 1, 2, 4, 5, 7, 8, 13, 14, 19, 20, 22, 23, 25, 28, and 29 correlated with the first factor; items 6, 10, 16, 17, 18, 24, 26, and 30 correlated with the second factor; items 3, 8, 9, 11, 12, 15, 21, and 27 correlated with the third factor. In this analysis, 23 items loaded on a single factor, and 7 items (3, 6, 8, 11, 16, 22, and 25) loaded on two factors.

The varimax-rotated five-factor solution of the CAS is presented in Table 5. The five-factor solution accounted for 54% of the total variation. The eigenvalues of the first five factors from the principal component analysis were 9.45, 2.89, 1.53, 1.29, and 1.11, respectively. As is seen Table 5, all items of the CAS indicated that the factor loadings were at or above .40 in the five factors. Items 6, 10, 12, 16, 18, 24, 26, and 30 correlated with the first factor; items 3, 13, 19, 22, 23, 25, 28, and 29 correlated with the second factor; items 2, 8, 11, 12, 14, and 20 correlated with the third factor; items 3, 9, 15, 21, and 27 correlated with the fourth factor; items 1, 4, 5, 7, and 17 correlated with the fifth factor. In this analysis, 24 items loaded a single factor, 5 items (3, 4, 12, 16, 17, and 22) loaded on two factors, and item 12 loaded on three factors.

Table 4

Varimax-rotated Three-factor Solution of the Computer Attitude Scale

Subscales	Item No.	Factor I	Factor II	Factor III
Computer	1	**.47**	.16	.09
Anxiety	4	**.62**	.37	.00
	7	**.59**	.12	.18
	10	-.03	**.73**	-.09
	13	**.42**	.23	.24
	16	**.40**	**.63**	-.02
	19	**.60**	.08	.37
	22	**.56**	**.47**	.04
	25	**.62**	-.05	**.41**
	28	**.58**	.38	.13
Computer				
Confidence	2	**.63**	.05	.35
	5	**.53**	-.16	.19
	8	**.46**	-.28	**.40**
	11	**.45**	-.25	**.46**
	14	**.44**	.30	.11
	17	.28	**.46**	.08
	20	**.56**	.38	.24
	23	**.54**	.19	.30
	26	.17	**.63**	.13
	29	**.62**	-.01	.36
Computer				
Liking	3	**.41**	.19	**.52**
	6	.24	**.52**	**.41**
	9	.24	.26	**.63**
	12	.23	.38	**.54**
	15	.29	.11	**.70**
	18	-.18	**.58**	.31
	21	.24	.15	**.66**
	24	-.07	**.61**	.28
	27	.14	.19	**.62**
	30	.27	**.56**	.34

Note: Loadings of .40 or above are bolded.

Table 5

Varimax-rotated Five-factor Solution of the Computer Attitude Scale

Subscales	Item No.	Factor I	Factor II	Factor III	Factor IV	Factor V
Computer	1	.08	.24	.08	.13	**.54**
Anxiety	4	.33	.29	**.43**	-.08	**.44**
	7	.07	.23	.27	.19	**.59**
	10	**.69**	.08	-.19	-.09	.14
	13	.13	**.56**	-.10	.28	.28
	16	**.56**	**.55**	.08	-.08	.11
	19	.02	**.63**	.26	.33	.16
	22	**.44**	**.48**	.38	-.08	.15
	25	-.09	**.56**	.35	.35	.17
	28	.33	**.61**	.33	.02	.09
Computer Confidence						
	2	.08	.25	**.69**	.21	.23
	5	-.21	.16	.25	.22	**.54**
	8	-.23	.14	**.62**	.29	.08
	11	-.19	.13	**.63**	.35	.06
	14	.32	.03	**.50**	.01	.33
	17	**.41**	-.01	-.01	.13	**.64**
	20	.38	.32	**.52**	.11	.21
	23	.11	**.50**	.10	.31	.39
	26	**.59**	.26	-.05	.11	.18
	29	-.06	**.53**	.31	.32	.25
Computer Liking						
	3	.17	**.47**	.24	**.47**	.06
	6	**.54**	.23	.25	.32	.05
	9	.25	.38	.08	**.60**	.04
	12	**.45**	.14	**.45**	**.40**	-.05
	15	.12	.19	.21	**.69**	.21
	18	**.65**	-.17	.06	.25	-.05
	21	.17	.13	.20	**.65**	.20
	24	**.63**	.01	-.03	.25	.03
	27	.20	.08	.11	**.62**	.18
	30	**.59**	.20	.32	.23	.08

Note: Loadings of .40 or above are bolded.

Item loadings on Factor I were similar to those on the three subscales of the original scale and all items related to various negative feelings and beliefs about computers, suggesting this factor may give some indication of computer dislike. Most Factor II single loadings were similar to the computer anxiety

subscale of the original CAS and suggested computer anxiety. All Factor III single loadings were consistent with the computer confidence subscale of the original CAS and suggested computer confidence. The fourth factor item loadings were similar to the computer liking subscale of the original scale, but particular to the items that indicated computer tenacity in the computer works or activities for Korean college students. The fifth factor item loadings were related to both computer anxiety and computer confidence, but the content of items loading on Factor V suggested computer comfort.

The factor loadings of the CAS presented by Gressard and Loyd (1986) are shown in Table 6. Gressard and Loyd (1986) reported that the three-factor solution accounted for 54% of the total variation with eigenvalues of 13.09, 1.92, and 1.21 respectively for the first three factors. Massoud also (1990) presented that the three-factor solution accounted for 47.2% of the total variation with eigenvalues of 8.75, 3.37, and 2.05 respectively for the first three factors. The factor loadings of Gressard and Loyd's study also were used to compute the coefficients of congruence between the Korean version and the original factor analysis.

The coefficients of congruence were computed to compare the similarity of like factors among the original factor loadings (Gressard & Loyd, 1986), three-factor and five-factor solutions of the Korean version of the CAS. Since the factor loadings below .40 were not reported, zeros were used in the analysis. The results showing the coefficients of congruence are provided in Table 7. When the three-factor solutions were compared, the coefficients of congruence for Factor I were .71, .62, and .55 for computer anxiety, computer confidence, and computer liking, respectively. The coefficients of congruence for Factor II were .57, .52, and .41 for computer liking, computer anxiety, and computer confidence, respectively. The coefficients of congruence for Factor III were .91, .40, and .27 for computer liking, computer confidence, and computer anxiety, respectively.

Table 6

Varimax-rotated Three-factor Solution of the Computer Attitude Scale by Gressard and Loyd (1986)

Subscales	Item No.	Factor I	Factor II	Factor III
Computer Anxiety				
	1	.52		
	4	.56	.44	
	7	.51		
	10	.54		
	13		.43	.40
	16	.66		
	19	.46	.41	
	22	.58		
	25	.58		.50
	28	.65		
Computer Confidence				
	2		.46	
	5			
	8			.44
	11		.51	.45
	14		.76	
	17		.41	.52
	20	.44	.65	
	23		.47	.43
	26			
	29	.45		.49
Computer Liking				
	3			.68
	6			.52
	9			.74
	12		.42	.60
	15			.69
	18			.47
	21			.63
	24			.57
	27			.63
	30			.46

Table 7

The Coefficients of Congruence between Gressard and Loyd (1986) and Korean Version

Korean Version Factor	Gressard & Loyd (1986) Factor		
	Anxiety	Confidence	Liking
Three-factor Solution			
Factor I (Computer Anxiety)	.71	.62	.55
Factor II (Computer Confidence)	.52	.41	.57
Factor III (Computer Liking)	.27	.40	.91
Five-factor Solution			
Factor I (Computer Dislike)	.48	.39	.59
Factor II (Computer Anxiety)	.73	.44	.55
Factor III (Computer Confidence)	.52	.67	.52
Factor IV (Computer Tenacity)	.28	.35	.92
Factor V (Computer Comfort)	.54	.56	.42

When the five-factor solution was compared with the original factor loadings, the coefficients of congruence for Factor I were .59, .48, and .39 for computer liking, computer anxiety, and computer confidence, respectively. The coefficients of congruence for Factor II were .73, .55, and .44 for computer anxiety, computer liking, and computer confidence, respectively. The coefficients of congruence for Factor III were .67, .52, and .52 for computer confidence, computer liking, and computer anxiety, respectively. The coefficients of congruence for Factor IV were .92, .35, and .28 for computer liking, computer confidence, and computer anxiety, respectively. The coefficients of congruence for Factor V were .56, .54, and .42 for computer confidence, computer anxiety, and computer liking, respectively.

Discussion

A major goal of this study was to compare the psychometric characteristics of the Korean version with the original English version of the CAS. The reliability coefficients of the three subscales and total score were high indicating that each subscale was stable enough to be used and was reliable to measure

attitudes toward computers. Although the present reliabilities were lower than those of the original developers, they were similar to Massoud's (1990) findings and higher than those from the Turkish version (Berberoglu & Calikoglu, 1993).

Results obtained from the factor analyses imply that the CAS measures more various traits in Korean culture. In the three-factor solution, the coefficients of congruence for Factor I were dominantly consistent with the computer anxiety subscale of the original scale, and those for Factor III were strongly consistent with the computer liking subscale of the original scale, but those for Factor II were the lowest related to the computer confidence subscale of the original scale. These results support the two factors of the CAS suggested by Woodrow (1991).

However, in the five-factor solution, the coefficients of congruence for Factor II, Factor III, and Factor IV were strongly consistent with computer anxiety, computer confidence, and computer liking subscale of the original scale, respectively. Factor I, computer dislike, related strongly to computer liking subscale, but related moderately to the other two subscales. Factor V, computer comfort, related to computer confidence, computer anxiety, and computer liking subscale at the same time. Although the coefficient of congruence for Factor IV was highly correlated with computer liking subscale, the content of factor loadings suggested computer tenacity or endurance may be a better factor name for Korean students. Unlike the present findings, the original developers (Gressard & Loyd, 1986; Loyd & Gressard, 1984a; Loyd & Loyd, 1985) claimed three factors of the CAS for American teachers and high school students, and Massoud (1990) supported its developers' findings for American adult learners. In Turkish culture, Berberoglu and Calikoglu (1993) found only one primary factor for the CAS. They explained that restricted interaction and experience with computers in daily life might have resulted in a reduced ability to discriminate by the Turkish students. Like Turkish students, Korean college students have less interaction with the computers in everyday life. Nevertheless, Korean students seemed to much finer distinction in their beliefs toward computers. The lack of interaction with computers above could not provide sufficient explanation for the different dimensions of the Korean version of the CAS.

There are at least two possible explanations for the results. First, Korean students may more likely to respond negatively about computers. Overall, Korean students had more negative attitudes toward computers than their American and Turkish counterparts. They may distinguish beyond the three factors of computer dislike (Factor I), computer anxiety (Factor II), and computer confidence (Factor III). These results may be analogous to another example that found that Korean students had more negative attitudes toward school and subjects than American counterparts (Moon, Kim, & McLean, 1993, November). It is possible that their negative feelings about school subjects translated into a negative factor component when applied to computer attitudes.

Second, Korean students had a unique computer tenacity (Factor IV). Most Korean parents prefer their children to be well rounded persons who are good in all school subject matters rather than being talented or concentrating in one area. Korean educators have also emphasized social conformity and "we-feeling" rather than enhanced individuality because of a weak and insufficient educational environment. Under this social and educational climate, Korean students have to master disliked school subjects with patience in order to pass the competitive college entrance examination. Their perseverance in learning is regarded as a very important virtue. Their long-term study habits may directly affect their attitudes toward computers and give rise to a unique factor, computer tenacity. Possibly Korean students perceive using computers as a requirement for good scholarship and have some fear of becoming a social failure in both school and society if they do not master them.

The results of this study indicated that the two versions of the same scale may be useful tools for measuring attitudes toward computers, but the construct functions differently between cultures. Further research is needed to investigate the causes of the Korean students' differentiated feelings about computers and to get more information from different cultures.

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