Scale of Attitudes Towards ICT (SATICT): Factor Structure and Factorial Invariance in Distance University Students

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Abstract

Attitudes towards Information and Communication Technology (ICT) are preconceived beliefs about influence of the ICT tools in the process of learning. Studies carried out in this area shows that attitudes may influence cognitive and learning processes and also motivation of students. Despite its importance, very few instruments have been proposed to measure student attitudes, and none analyzes the factor structure or the factorial invariance of the scores, for that reason, the aim of the present study is to analyze the factor structure of SATICT, a new instrument proposed to measure the attitudes towards ICT on distance university students. A second aim is to test the factorial invariance across gender and educational level in a sample of 1080 university students of Madrid Open University using multi-group CFA. The results provide high support of the proposed factor structure with significant loadings and adequate model fit, however, the results also showed that factor structure couldn't be considered invariant across groups.

Keywords: Factor structure; Factorial Invariance; Attitudes, Information and Communication Technology, Distance University Students.

1. Introduction

At present, the Information and Communications Technology (ICT) are omnipresent in the teaching-learning processes, specially in distance education (Harasim, 1990; Mclsaac & Gunawardena, 1996). The appropriate use of technology in education is conditioned not only by the technological knowledge about the tools, but also by their attitudes. Is for that reason that the goal of the present study is to propose a new instrument to measure the attitudes towards incorporation of ICT in the learning process of distance university students called SATICT (Scale of Attitudes Towards ICT). Secondary goals were to study the factor structure and factorial invariance of the test scores across gender and educational level. To reach this goals the test SATICT were applied to a sample of 1080 university students of Madrid Open University, then, confirmatory factor analysis and multi-group analysis were made in order to meet the secondary objectives. This paper was structured as follows: first, a brief theoretical framework was presented, second, methodology aspects, including sample and instrument description and data analysis procedures were exposed, third, the main results are shown and finally, a brief discussion of the implications, limitations and future research was made.

2. Theoretical Framework

Several studies of national and international levels has been developed in the last years with the aim to know the attitudes of students towards ICT and to elaborate instruments (mainly surveys) to measure this construct. For example, Ahamed and Adulaziz (2004) examining the relationship between student performance and attitudes towards ICT in a virtual and conventional settings. Their findings revealed no significant differences in attitudes between virtual and conventional students. Francovicová and Prokop (2008) found in a sample of 214 elementary school students that attitudes toward ICT were positive and gender differences are weak. Siragusa and Dixon (2008) made a pilot study with 30 undergraduate students in higher education and their results showed some experienced feeling of anxiety and intimidation when students work with ICT.

Kubiatko (2010) focuses on differences of attitudes towards ICT among 316 Czech university students, he found that male, sophomores, and students living in town showed more positive attitudes in comparison to other groups. Kar, Saha and Mondal (2014) measured the attitude towards e-learning in a sample of 308 university students of four universities in West Bengal. Their results showed that students have high attitude scores and this scores did not differ significantly with their personal variables as gender, stream of study and residence.

Garcia, Escofet and Gros (2009), compared the attitudes towards ICT in 1042 students of blended and virtual universities in Spain. Their results showed statistically significant differences among students in virtual and face-to-face mode in all aspects of attitude.

Edmuns, Thorpe and Conole (2012) studied the influence of work, social context and course study on attitudes towards ICT in a sample of 421 students of an open university in the UK, their results showed that usefulness and ease of use are important variables that influence the attitudes. Rhema and Miliszewska (2014) studied the relationships between demographic characteristics and attitudes towards e-learning, they found no differences between men and women students or between urban and regional students with respect to their attitude towards ICT in a sample of 348 Libian's university students.

A common feature of the above studies is the use of surveys created at hoc to measure attitudes of students, however, the psychometric properties of those instruments are not explored or reported in the published research. On the other hand, although there are some recent studies that analyses different aspects of attitudes toward ICT in university students none of them uses factor analysis techniques to explore or confirm the underlying factors of the instruments used. Others studies are focused on the differences in the attitudes according to interest groups as gender, education level or education settings (virtual vs conventional), however, none of them check the factorial invariance, a step that is essential before any comparison between groups. The results of the present study are an initial approach to this topic.

3. Methodology

3.1 Participants

A total of 1231 students participated voluntarily (with informed consent) in this study, 600 females and 631 males. The instrument was sent to all the students enrolled in the course 2014-2015 both, in undergraduate and master studies (N = 5776), therefore, response rate was 21,31%. All students were recruited from Madrid Open University (MOU) in Spain. 63,44% of the sample are undergraduate and 36,56% are master students. 40,76% of the students works in ICT related areas and 57,66% has completed undergraduate studies previously. All the participants are between 18 and 69 years old (mean= 36,01, SD=9,59). 149 responses were discarded for being incomplete.

3.2 Instruments

The Scale of Attitudes Towards ICT (SATICT) is an instrument composed by 20 items distributed on three scales: affective (8 items, 2 inversely scored), behavioral (5 items, 1 inversely scored) and cognitive (7 items, 2 inversely scored). The format used is 5-point Likert type from 1 (totally disagree) to 5 (totally agree). High test scores indicates positive attitude towards the incorporation of ICT in the learning process. Descriptive results of the total scores and sub-scales are, for the total score: *min*=22; *max*=100; *m*=83,22; *s.d.*=12,24. Cronbach's Alpha (α=,903) indicating high overall reliability of the test scores. For the affective scale *min*=9; *max*=40; *m*=31,55; *s.d.*=5,44; α=,735. For the behavioral scale

min=5; *max*=25; *m*=20,57; *s.d.*=3,63; α=,767. For the cognitive scale *min*=7; *max*=35; *m*=31,09; *s.d.*=4,21; α=,801.

Previous evidence of face and content validity of the test was gathered by percentages of congruence item-factor. The questionnaire was reviewed by a group of 5 experts in educational technology, they were informed of the definition of the three factors that compose the instrument (affective, cognitive and behavioral) and they were asked to pair up each factor with the item they considered it measured. The percentage of items that is matched correctly with the factors vary from 45,8 to 83: rater 1 (11/24 = 45,8%); rater 2 (15/24 = 62,5%); rater 3 (20/24 = 83%); rater 4 (12/24 = 50%) and rater 5 (17/24 = 70.8%) indicating only partial evidence of content validity. Complete test (in Spanish Language) can be requested to the first author of the present paper.

3.3 Data analysis

Data analysis includes Confirmatory Factor Analysis (CFA) and multi-group analysis (MACs). As input for the CFA the asymptotic covariance matrix was used. Analysis was made with the WLS method. To study the fit of the model several fit indices were considered, following the proposed by Brown and Moore (2014): Satorra-Bentler Scaled χ^2, RMSEA (Root Mean Square Error of Approximation), 90% confidence interval of RMSEA, Comparative Fit Index (CFI) and Non-Normed Fit Index (NNFI). Values recommended as acceptable are: RMSEA under 0,05, CFI and NNFI over 0,95.

The factorial invariance across groups formed by gender (female-male) and educational level (undergraduate-master) was studied following the approach MACs (Little, 1997; Cheung & Rensvold, 2002) that comparatively evaluates the fit of four nested models (configural invariance, weak measurement invariance, strong and strict invariance models). Following the criteria proposed by Cheung & Rensvold, 2002, the change in χ^2 ($\Delta\chi^2$) was analyzed: if there is a significantly increase in the value of this statistic is indicative of lack of factorial invariance.

4. Results

4.1 Confirmatory Factor Analysis

A CFA with the whole sample was made in order to confirm the proposed three-dimensional structure for the SATICT. A correlation between errors of items 7 and 8 was suggested by the modification indices to improve the fit of the model. Tables 1 and 2 exhibit the factorial loadings and fit indices, respectively.

Table 1. Factorial loadings.

Item	A	B	C
1	-	-	.96*
2	-	.97*	-
3	-	-	.98*
4	-	-	.98*
5	.48*	-	-
6	1*	-	-
7	.66*	-	-
8	-	.73*	-
9	.64*	-	-
10	-	-	.77*
11	.75*	-	-
12	-	.96*	-
13	.84*	-	-
14	-	-	.93*
15	.94*	-	-
16	-	.90*	-
17	-	.93*	-
18	.71*	-	-
19	-	-	.81*
20	-	-	.84*

* Sign 1% and 5%.

Table 2. Fit indices.

χ^2	*Df*	*P*	CFI	NNFI	RMSEA	90% CI
693,83	166	,00	,97	,97	,054	,050-,059

4. 2 *Factorial invariance according to gender and educational level*

One objective of the present paper has been to analyze whether the measurement of attitudes was equivalent according to gender and educational level. For this purpose, as first step, the model was applied for each sample independently. Then, the configural model (without constraints) was estimated to demonstrate that the pattern of fixed and free parameters was equivalent across subsamples. As the configural model do not fit well it was impossible to introduce more constraints to the model. The fit indices of different models are summarized in the Table 3.

Table 3. Fit indices. Comparison of models to analyze factorial invariance by gender and educational level

Model	χ^2	df	*p*	CFI	NNFI	RMSEA	90% CI
Females	508,29	165	,00	,99	,98	,063	,057-,069
Males	501,45	165	,00	,98	,98	,061	,055-,067
Configural	5015,72	336	,00	,91	,90	,18	,17-,18
Undergraduate	552,90	165	,00	,98	,98	,059	,053-,064
Master	487,36	165	,00	,98	,98	,070	,063-,078
Configural	5466,21	336	,00	,90	,89	,19	,18-0,19

Table 3 showed that configural invariance is not achieved, indicating that the model do not fit across the groups. Although the model is the same across groups, the unknown parameters of the model are assumed to be different across the groups, and this assumption was not met in this case. The (global) Chi-square test statistic, CFI, NNFI and RMSEA

values for this multiple group model showed that configural invariance was not met and for that reason not make sense to introduce more restrictions to the model.

5. Conclusions

This study was made to examine the factorial structure of the SATICT test, a measure of the attitudes towards ICT in online/virtual education settings. Although several studies have used different surveys to evaluate the attitudes towards ICT, the present study deepens on the factorial structure of a new test instrument composed by three sub-scales (dimensions) that frequently compose the attitude (affective, cognitive and behavioral). Additionally, is the only test in Spanish currently available to measure the attitudes towards ICT for distance university students. The results of CFA supports the proposed three-dimensional structure, with an excellent model fit and significant factor loadings, however, the results also showed that configural invariance can not be confirmed on the groups formed by gender and educational level indicating that the pattern of fixed and free parameters was not equivalent across subsamples of interest in this sample.

This study also present some limitations: first, even though the sample is large it not has been taken probabilistically, which limits the generalizability of results, second, the paper focuses only on the analysis of the factor structure, leaving aside the analysis of other psuchometric properties. For that reason, future research may be focused in other psychometric properties as concurrent or predictive validity by taking a probabilistic sample that represents students of different online universities.

References

Ahmed, A., & Abdulaziz, E. (2004), Examining students performance and attitudes towards the use of information technology in a virtual and conventional setting. *Journal of Interactive Online Learning*, *2*(3), 1-9.

Brown, T. A., & Moore, M. T. (2014). Conformatory Factor Analysis. In R. H. Hoyle (Ed.), *Handbook of structural equation modeling* (pp. 361-379). New York: Guilford.

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing MI. *Structural Equation Modeling, 9*, 235-55. doi: 10.1207/S15328007SEM0902_5

Edmunds, R., Thorpe, M., & Conole, G. (2012). Student attitudes towards and use of ICT in course study, work and social activity: a technology acceptance model approach. *British Journal of Educational Technology, 43*(1), 71-84. doi: 10.1111/j.1467-8535.2010.01142.x

Fancovicová, J., & Prokop, P. (2008). Students' attitude toward computer use in Slovakia. *Eurasia Journal of Mathematics, Science and Technology Education, 4*(3), 255-262.

García, I., Escofet, A., & Grof, B. (2009). Students`attitude towards ICT learning uses: a comparison between digital learners in blended and virtual universities. *European Journal of Open, Distance and E-Learning,* Retrieved from: http://www.eurodl.org/?p=special&sp=articles&inum=5&article=624

Harasim, L. (1990). Online education: An environment for collaboration and intelectual amplification. In: L. Harasim (Ed): Online education. *Perspectives on a New Environment* (p. 33-66). Preager: New York.

Kar, D., Saha, B., & Mondal, B. C. (2014). Attitude of university students towards E-Learning in West Bengal. *American Journal of Educational Research, 2*(8), 669-673. doi: 10.12691/education-2-8-16

Kubiatko, M. (2010). Czech university students`attitudes towards ICT used in science education. *Journal of Technology and Information Education, 2*(3), 20-25. doi: 10.5507/jtie.2010.042

Little, T. D. (1997). Mean and covariance structures (MACS) analyses of cross-cultural data: Practical and theoretical issues. *Multivariate Behavioral Research, 32,* 53-76. doi: 10.1207/s15327906mbr3201_3

Mclsaac, M. S., & Gunawardena, C. N. (1996). Distance Education. In D. H. Jonassen (Ed) *Handbook on Research for Education Communications and Technology.* McMillan: New York.

Rhema, A., & Miliszewska, I. (2014). Analysis of student attitudes towards E-Learning: The case of engineering students in Lybia. *Issues in Informing Science and Information Technology, 11.* 169-190.

Siragusa, L., & Dixon, K. (2008). Planned behaviour: Student attitudes towards the use of ICT interactions in higher education. In: *Hello¡ Where are you in the landscape of educational technology? Proceeedings ascilite*, Melbourne, Australia.