

A CROSS-CULTURAL PSYCHOMETRIC EVALUATION OF THE ATTITUDE TOWARD STATISTIC SCALE ESTRADA'S IN TEACHERS

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Several attitudes toward Statistic scales have been proposed in the literature by considering samples of university students but specific scales with cross-cultural validity are not known for teachers. In this study we show the psychometric characteristic of the scale of Attitudes toward the Statistic proposed by Estrada (2002) and Estrada Batanero and Fortuny (2003). The scale was applied to 288 in-service and prospective teachers, 140 from Spain and 148 from Peru. Item analysis with a classic perspective and using rating model (Andrich, 1978) was conducted. Results indicate that three items were not consistent with the scale. In addition, the final version of the scale was submitted to an evaluation of its dimensionality and reliability. Results indicate that scale is reliable and presents evidence of multidimensionality.

INTRODUCTION

Statistics in school is taught in Math courses, often neglected in compulsory education of teachers. Some authors say this is due in part to low statistical preparation of teachers in their training having few resources when giving their lectures and, having a tendency to skip this topic, to shorten it or frequently, to present an inadequate methodology. In addition some teachers prefer to not give the contents of Statistics in a Math course. Teachers can not complete their knowledge with a Teaching practice and their Attitudes may be limited or even negative. These negative attitudes of the teachers can have an impact on the on their teaching and the future attitudes of their students.

However the study of attitudes towards Statistics not only arises from concern for the Educational product considered globally, but also when we consider the study on the learning of students, whether high school students or future teachers. Thus, studies on attitudes in schools, for example, confirms the impact of negative attitudes such as affective component in the cognitive learning of students. This point is discussed and treated in the study of Bazán, Espinoza and Farro (2002), which mentions that there is little real integration of the objectives in relation to attitudes to the general objectives of Education.

Furthermore, investigations such as Agne, Greenwood and Miller (1994), ensure that there are relationships between attitudes, beliefs and teacher performance, and also between the attitudes, beliefs and performance of their students. According to Gomez (2000), how to organize teaching and learning activities, selects and reinforces certain attitudes in students, although in most cases there is no explicit purpose of teaching them. Often the implicit character of this process leads to transmit attitudes contrary to the purposes proposed by that educational process, that is called by many authors as the "hidden curriculum". Thus, attitudes, positive and negative, can be unconsciously be transmitted from the teacher to the students and can affect their own learning style. Hence it is of great importance to have valid and reliable instruments for the population of classroom teachers or for teachers and future teachers in training.

This concern for the study of attitudes is reflected in different scales of attitudes towards Statistics that have been proposed to measure it properly (Carmona, 2004). All agree that these scales have been validated among college students or university students but not among in-service and prospective teachers.

In that vein, Estrada (2002), proposed and worked out a Scale of Attitudes Towards Statistics (EAEE), which was applied in the context of in-service and prospective teachers Also, Aparicio and Bazán (2006) have used this scale in teachers in exercise and Aliaga (2009) has applied this scale to in-service and prospective teachers. These studies have reported some basic indicators of the psychometric behavioral scale for their respective populations, but there is no single study, which can show the psychometric characteristics of this scale in different contexts.

This study examines the scale psychometrically. Attitudes toward Statistics from a cross-cultural perspective to evaluate the psychometric performance of items between in-service and prospective teachers of Spain and Peru.

METHOD

The participants of the study are 288 classroom teachers of different specialties: 66 in-service teachers from Spain and 61 from Peru; 74 prospective teachers from Spain; and 87 from Peru. 64.6% of the total were women.

The scale of attitudes toward statistics, Estrada (2002), is constructed by combining three scales: Scale SAS (Roberts & Bilderback, 1980); Scale ATS (Wise, 1985) both considered internationally as the most usual and the Spanish scale of Auzmendi (1992). Based on the above three scales, a list of 36 items was developed, positive and negative worded items to avoid the problem of acquiescence and contemplating various components pedagogical and anthropological, as described in Estrada (2002). These items were submitted to a panel of Expert of judges. After of the evaluation, the final scale consists of 25 items, 14 affirmative and 11 negative. The items and their distribution by components are shown by Estrada (2002).

RESULTS

To obtain psychometric properties of the Scale of Attitudes analysed, we used item analysis by considering the Rating Scale Model implemented in the WINSTEPS software (Wright and Linacre, 1998). First, we examined the adjustment to the model of both items and participants.

In Table 1 we present the results of item analysis of the scale considering the classical perspective and the perspective of the Rating Scale. We found that three items, 3, 23 and 21 are the items that present no significant correlation with the rest of the scale. Even the item 3, "Reality can be manipulated using statistics" is negatively correlated with other items indicating that this is an item that does not measure the same concept as the others. On the other hand the rating scale analysis, by considering Outfit and Infit statistics and the criterion of Bond (2001) regarded as unadjusted cases with higher or lower values to 1.3 and 0.7 respectively in samples smaller than 500 cases, indicate these same items do not fit this model. Based on this evidence it is appropriate to exclude these three items that are also considered to discriminative (by considering point biserial correlation). We consider the case of the item 5 despite presenting a relatively low Outfit this evidence is not sufficient to exclude it. Consequently, we conducted a second analysis excluding the three items with inadequate psychometric behavior. The results indicate that with the exception of item 19, with low item total correlation, all items are appropriate to psychometric performance. We believe that evidence of low item total correlation of item 19 is insufficient to discard the item in the scale and then decide.

A factor analysis with principal components method and varimax rotation using the Systat software was conducted on the 22 items by considering spearman correlation matrix.

The results indicate that the scale is multidimensional, featuring four factors of more than one item and two factors shaped by an item. The first factor, with a 16.7 percentage of variance explained is formed by items 20, 22, 18, 17, 8, 10, 13, 11 and may be named Competition and Academic Evaluation of Statistics. The second factor, with a 10.6 percentage of variance explained, is formed by items 4, 2, 6 and 24 and may be named the Appreciation of the Role of Statistics. Factor 3, with a 9.1 percentage of variance explained, is formed of items 7, 16, 19 and 5 and can be named Usefulness and Personal taste for statistics. Factor 4, with a 8.9 percentage of variance explained, is formed of the items 9, 11, 25 and 15 and may be named Understanding Statistics. The items measuring 14 and 1 are unique aspects of External Use of Statistics, and they represent 6.2% and 5.7% of variance explained. Note that item 11 appears in two factors and item 12 does not appear in any factor.

Finally the scale can be considered with high reliability features by considering both classical perspective (Cronbach's alpha = 0,826) and Rating Scale Model (Item reliability = 0.97, Person reliability = 0.79).

DISCUSSION

In general the results of our analysis on the 25 item Estrada Scale of Attitudes to Statistics in a cross sample of Peruvian and Spanish teachers shows suitable psychometric properties for a final scale of 22 items.

The item analysis allowed the identification of three items with inadequate psychometric behavior considering a classic analytical perspective and considering the adjustment to the Rating Scale model. Additionally considering that factor analysis is exploratory in nature, the scale could be grouped into four main factors (45% of the variance) which allow us to indicate that there is

preliminary evidence of multidimensionality of the scale as was proposed in their development. We consider that new studies with samples between countries, may confirm these factors in the future. In addition the results show that the scale is reliable by considering both classical and rating scale item analysis.

The results provide a scale with cross cultural evidence directed at teachers, providing important implications on the attitudes they have on Teaching and Thinking about Statistics in both Spain and Peru which can be duplicated in other countries. It is important that the study on Attitudes to Statistics can be extended to teachers and compared with the Attitudes of the students. We believe that the study of Attitudes can globally give insights to help teachers better understand the difficulties their pupils have in this area; since as is well known, the influence of the classroom teacher is a primary factor in the success or failure of students at school.

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Table 1. Item analysis of the original version and Principal Components Factor Analysis with varimax rotation for the shortened version

	Classical Index				Rating Scale Index					Factors					
	Media	standard deviation	Item-total Correlation	Alpha of Cronbach if item is removed	DISCR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	1	2	3	4	5	6
pre1	3.29	1.01	0.15	0.79	0.91	1.04	0.6	1.08	1	0.03	0.07	0.01	0.01	0.05	0.83
pre2	3.83	0.88	0.35	0.78	1	0.86	-1.7	0.81	-2.3	0.02	0.71	0.06	0.14	-0.15	0.16
pre3	2.67	1.24	-0.16	0.81	0.09	1.84	9.7	1.92	9.9						
pre4	3.64	0.93	0.34	0.78	1.01	0.86	-1.8	0.87	-1.6	0.08	0.77	0.12	-0.08	0.07	0.02
pre5	3.5	0.86	0.36	0.78	1.03	0.68	-4.7	0.67	-4.7	-0.01	0.29	0.49	0.08	0.15	0.22
pre6	4.13	0.9	0.42	0.777	1.03	1.12	1.2	1.09	0.9	0.20	0.63	0.02	0.21	0.00	-0.05
pre7	3.02	0.96	0.37	0.778	1.13	0.74	-4.1	0.78	-3.4	0.13	0.06	0.74	0.08	0.10	-0.21
pre8	3.32	1.14	0.42	0.775	1.01	1.04	0.5	1.03	0.3	0.64	0.19	0.15	0.00	0.36	0.08
pre9	3.54	0.98	0.35	0.779	0.97	0.9	-1.3	0.89	-1.3	0.09	0.26	0.02	0.68	0.27	-0.07
pre10	3.58	0.92	0.48	0.774	1.1	0.71	-4.1	0.72	-3.9	0.53	0.22	0.19	0.14	-0.04	0.23
pre11	3.47	0.93	0.36	0.779	1.05	0.78	-3.1	0.79	-2.8	0.42	-0.14	0.11	0.59	-0.09	0.03
pre12	3.35	1.04	0.44	0.774	1.01	0.85	-2.2	0.84	-2.2	0.34	0.34	0.38	0.06	-0.34	-0.02
pre13	3.53	1.04	0.53	0.77	1.07	0.84	-2.2	0.84	-2.1	0.43	0.35	0.27	0.05	0.22	0.39
pre14	3.34	1.04	0.17	0.789	0.87	1.09	1.2	1.17	2.2	0.29	-0.05	-0.05	0.30	0.68	0.13
pre15	3.67	0.92	0.38	0.779	1.01	0.83	-2.2	0.86	-1.7	0.00	0.26	0.29	0.51	0.13	-0.20
pre16	3.09	0.99	0.35	0.779	1.02	0.81	-2.9	0.83	-2.5	0.15	-0.04	0.69	0.03	-0.21	0.14
pre17	3.33	1.2	0.45	0.773	1.03	1.13	1.7	1.15	1.9	0.65	-0.05	0.17	0.29	0.17	-0.10
pre18	3.91	0.96	0.37	0.779	1	1.07	0.8	1.05	0.5	0.66	0.18	-0.16	0.25	-0.33	0.03
pre19	3.44	1.04	0.19	0.788	1	1.13	1.6	1.23	2.8	-0.37	0.23	0.52	0.25	-0.42	0.11
pre20	3.62	1.1	0.44	0.774	1.03	1.08	1	1.12	1.5	0.80	0.02	0.03	0.07	0.13	0.07
pre21	3.57	1.15	0.14	0.792	0.97	1.47	5.2	1.55	5.8						
pre22	3.48	1.07	0.44	0.774	1.1	0.96	-0.6	0.96	-0.5	0.77	0.13	0.01	0.11	0.00	-0.04
pre23	3.3	1.19	0.06	0.797	0.76	1.51	6.1	1.6	6.8						
pre24	3.72	0.92	0.43	0.776	1.04	0.81	-2.5	0.79	-2.7	0.16	0.41	0.14	0.36	-0.27	0.17
pre25	3.81	0.98	0.40	0.777	1.04	0.99	-0.1	0.98	-0.2	0.28	0.08	0.02	0.58	-0.06	0.31
Percent of Total Variance Explained										16.69	10.62	9.10	8.92	6.22	5.72