PRIMARY SCHOOL TEACHERS' ATTITUDES TO STATISTICS: A TRANSCULTURAL FOCUS

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Different instruments analyze university students' and pre-service teachers' attitudes towards statistics, but few studies investigate in-service teachers' attitudes. The attitude scale towards statistics (Estrada, 2002) has been used in some countries with in-service teachers and has presented good psychometric values. This study carried out a comparative analysis of global and by-items results of this attitudes scale applied to primary school teachers in Peru, Spain, Portugal, and Brazil derived from prior research. Results suggest that the scale is adequate for the context of Latin America, and differences in the attitudes among the countries were found. These differences are analyzed considering the formative and curricular context of each country. Following this, recommendations are made for the continuous training of teachers.

INTRODUCION

As Homik and Luik (2017) state, "the concept of attitude has been at the center of social and behavioral sciences since 1935. It is a multi-component construct and difficult to understand" (p. 229). Interest in the concept of attitudes has increasingly extended to other areas, such as education, because attitudes potentially predict the behavior of subjects, which is relevant to understanding and acting on reality (Gleitman et al., 2010). In statistics, attitudes are conceived as "intense feelings which are relatively stable, and which result from positive or negative experiences encountered whilst learning a subject (in this case statistics) over a period of time" (Martins et al., 2011, p. 2). They have been extensively studied among university students; however, few investigations aim to understand how in-service teachers' attitudes are presented.

Research on the attitudes of in-service teachers is crucial because they can influence the formation of new attitudes in students. For this reason, Usimaki (as cited in Sweeting, 2011) classified teachers' attitudes as cyclical. In this sense, (re)signifying negative attitudes toward a subject is as important as meeting teachers' instructional needs with respect to the specific content of teaching activity. In the case of statistics, this is justified by the influences that attitudes can have in different aspects of students' lives and in the teacher himself as a data reader and professional in the area of education.

Considering the positive correlation between anxiety in mathematics and statistics, Primi and Chiesi (2018) indicate that "students should be supported with specific training activities to acquire more confidence in their mathematical abilities and reduce their negative feeling toward math" (p. 5) and, consequently, in statistics. However, teachers are not always prepared to deal with students' difficulties related to statistics. Given the importance this construct assumes in the formation of new attitudes, in this paper a comparative analysis of the attitudes towards the statistics of in-service teachers from four countries was carried out. The intention is to discuss elements that approximate or distance the attitudes of these teachers from different contexts aiming at a reflection on the attitudes of teachers who work in primary education.

METHODOLOGY

The 25 items of the Scale of Attitudes Towards Statistics–EAEE (Estrada, 2002) were used in the investigations that were carried out in Brazil, Peru, Portugal and Spain. EAEE includes 14 positive items and 11 negative items in order to avoid the problem of acquiescence. The scale has five response points, where 1 = total disagreement, 2 = disagreement, 3 = indifferent, 4 = agreement and 5 = total agreement. For this to be a comparative analysis, items 3, 21, and 23 were excluded because in the surveys conducted in Peru and Spain, these items presented a low total item correlation (Estrada et al., 2010). The data were derived from previous studies and developed by Estrada et al. (2010) in Spain and Peru, by Martins (2015) in Portugal, and by Martins (2018) in Brazil. Table 1 presents the distribution of the 22 items as a function of the components found in the EAEE scale.

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Table 1. Attitude components' available in the EAEE scale

Pedagogical components	Anthropological components		
	Social	Educational	Instrumental
Affective	1, 11, 25	7, 12	10, 13, 16, 20
Cognitive	2, 19	4, 6, 17	24
Behavioral	9, 18	8, 15, 22	5, 14

Adapted from Estrada et al. (2010).

According to the data presented in Table 1, the scale used has a multifactorial structure, and the components are grouped into two dimensions: pedagogical (or didactic) and anthropological. The didactic part includes the following components: (a) affective or emotional, concerning the way of exposing feelings in relation to statistics; (b) cognitive, concerning the way of exposing the thought, conceptions, and beliefs in relation to statistics; and (c) behavioral, concerning the actions and intentions in relation to statistics. As for the anthropological part, it includes the following components: (a) social, referring to the perception and the valorization of statistics in the sociocultural scope of the citizen; (b) educational, referring to the aspects related to education in this area; and (c) instrumental, referring to the attribution of utility of statistics to other matters as a form of reasoning and as a cultural component. The analysis procedures adopted in this research consisted of identifying the levels of validity and reliability of the scale in different countries and comparing the results overall and by scale items. The analysis also considered the inversion of the negative items in order to establish a relation with the obtained score.

A COMPARISON OF ATTITUDES TO STATISTICS BETWEEN COUNTRIES

Table 2 presents the Cronbach's alpha values for the four countries analyzed and the respective sample sizes. The data were derived from previous studies by Estrada et al. (2010) in Spain and Peru, by Martins (2015) in Portugal, and by Martins (2018) in Brazil. Because Cronbach's alpha is greater than 0.75 for each country, the results suggest a good internal consistency of the scale in these studies because values of 0.70 or more are indicators of acceptable reliability (Maroco & Garcia-Marques, 2006).

Table 2. Reliability of the EAEE scale between countries

Countries	(*N*) Teachers	Cronbach alpha
Spain	66	0.753
Peru	80	0.839
Portugal	1098	0.874
Brazil	201	0.817

Regarding item statistics for each country, Table 3 shows the items, their average scores, and the standard deviation for each item. Spain was the country that presented more items with values greater than or equal to 4, namely items 2, 6, 12, 18, 20, 22, and 25. In addition, this country did not present any item with averages below 3, pointing out that, in general, Spanish teachers present more positive attitudes compared to teachers in other countries. By contrast, Peru only presented one item with a score greater than or equal to 4, namely item 6. And it was also the country that presented the most items with scores below 3, namely items 7, 8, 14, 17, 20, and 22. In Portugal, there were only two items above or equal to 4 (items 6 and 19) and two items below 3 (1 and 14). Finally, in Brazil, four items were above the score 4 (2, 6, 13 and 19) and five items were below 3 (8, 14, 15, 17 and 22).

It can be observed that items 8, 17, 19, 20 and 22 were those that presented the greatest disparity among countries in terms of scores. On the other hand, very close values are observed among the four countries in relation to items 1, 4, 5, 6, 14 and 24. Upon analyzing these items on the different components of the EAEE scale, we see that, in the anthropological dimension, there is a greater similarity among teachers' attitudes towards the instrumental component. Also, the items with the greatest disparities are in the educational dimension. In terms of the pedagogical or didactic dimension, it was observed that the results among the countries are aligned at the cognitive level,

whereas the items with the greatest disparities are distributed in a way that does not form a predominant tendency in any pedagogical component.

Table 3. Statistics for each country for items from the EAEE scale

	Items of EAEE - Estrada (2002).	Countries							
		Spain		Peru		Portugal		Brazil	
		Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD
#	Social Items								
1	Some statistical information transmitted on TV programs bothers me. (*)	3.21	1.01	3.35	1.02	2.95	1.01	3.10	1.21
2	Statistics help me understand the world of today.	4.0	0.60	3.98	0.92	3.58	0.99	4.01	0.96
9	I do not understand the statistical information that appears in the press. (*)	3.85	0.74	3.31	1.06	3.82	1.02	3.71	1.02
11	I feel intimidated by statistical data. (*)	3.91	0.62	3.05	0.99	3.71	1.03	3.47	1.08
18	I understand better the election results when they are shown with graphics.	4.36	0.77	3.51	1.13	3.85	0.98	3.88	1.03
19	Statistics is only valid for scientists (*).	3.12	0.59	3.93	1.03	4.3	0.9	4.01	1.09
25	When I read, I avoid the statistical information (*)	4.12	0.77	3.59	1.13	3.7	1.03	3.86	0.98
	Educational Items								
4	Statistics is fundamental in future citizens' basic training	3.73	0.79	3.88	0.89	3.89	0.89	3.88	0.92
6	In school, we should not teach statistics. (*)	4.24	0.74	4.05	1.13	4.21	1.03	4.32	0.89
7	I have fun in the classes in which I teach statistics.	3.18	0.67	2.83	1.20	3.3	1.07	3.3	1.04
8	For me statistical problems are easy.	3.94	1.01	2.41	1.06	3.27	1.01	2.92	1.11
12	I find the statistical world interesting.	4.0	0.74	3.58	0.95	3.68	0.87	3.83	0.92
15	I like serious work where statistical analysis is used.	3.85	0.93	3.36	1.09	3.71	0.87	4.02	0.85
17	Statistics is easy.	3.79	1.17	2.4	1.02	3.19	1.10	2.78	1.12
22	It is normal for me to explain to my colleagues statistical problems that they do not understand.	4.33	0.73	2.83	1.08	2.53	0.99	2.77	1.06
	Instrumental Items								
5	I solve day-to-day problems using statistics.	3.52	0.82	3.54	0.96	3.34	0.95	3.5	1.02
10	I like statistics because it will help me to understand fully the complexity of certain issues.	3.82	0.97	3.35	0.98	3.56	0.86	3.76	0.96
13	I like serious work where statistical analysis is used.	3.85	0.93	3.36	1.09	3.71	0.87	4.02	0.85
14	I do not use statistics outside school. (*)	3.79	0.81	2.7	1.15	2.79	1.10	2.91	1.13
16	I adore statistics because it helps me see problems objectively.	3.0	0.99	3.14	1.17	3.16	0.97	3.42	1.07
20	I like to solve problems when I use statistics.	4.49	0.66	2.88	1.08	3.57	0.87	3.27	1.08
24	Statistics help in making better decisions	3.97	0.76	3.65	1.00	3.7	0.85	3.82	0.93

Free translation by Martins et al. (2012). (*) Negative items.

According to Ramirez, Schau and Emmioğlu (2012), different studies indicate people with more previous experience in statistics reported more positive attitudes. Spain presents more initiatives in the statistical training of teachers. In contrast, Brazil still has challenges to implement a solid teacher training program. These results suggest that investments in the continuing education of teachers who teach statistics are important to promote positive attitudes. Considering the lowest averages are in the instrumental dimension, we indicate that training programs of teachers in these countries should focus on practical activities to allow teachers to feel capable of solving situations by mobilizing statistical knowledge.

CONCLUSION

The results of this study point to teachers' positive attitudes towards statistics in the four countries analyzed. This relates to visibility and social valuation of statistics. The analysis of the items suggests certain similarities among teachers' responses at the instrumental and cognitive level and educational disparities. Estrada et al. (2010) have already pointed out disparities in the attitudes of Spanish and Peruvian teachers. For them, Spanish results can be explained in part by the greater work in teacher training, curriculum, and didactics of statistics in Spain compared to Peru, where there are quite new challenges to face as indicated by Bazán (2006). In turn, the results between Portugal and Brazil follow a closer trend. However, the number of items below 3 suggests that Brazilian teachers may have had different interpretations of some items compared to Portuguese teachers.

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