

# LET'S DO IT AGAIN: A SECOND QUALITATIVE ANALYSIS OF PORTUGUESE TEACHERS' ATTITUDES TOWARDS STATISTICS

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## Abstract

We continue to believe that teachers' attitudes towards statistics can have a significant effect on their own statistical training, their way of teaching statistics, and on the future attitudes of their students. The influence of attitudes in teaching statistics in different contexts was previously studied in several researches, including some of the authors. This work is part of a broader study of Portuguese of attitudes towards statistics of Portuguese in-service teachers. Here we used a qualitative content analysis of survey responses from Portuguese 2nd cycle in-service teachers (students aged 10 or 11), focusing on 9 open-ended items from the EAEE – *Escala de Actitudes hacia la Estadística de Estrada*. The EAEE survey was presented to Portuguese in-service 2nd cycle teachers and all of them were asked to complete the 9 open-ended explanations, and 132 (54% of 246) chose to do this for at least one of those 9 items, but only 41(17% of 246; 31% of 132) did it to all 9 items. The 246 in-service teachers had a mean attitude total score of 97 (SD 9.5), a median of 97, higher than the indifference/neutrality 75 (mid-point of EAEE). Now we present the qualitative content analysis of the EAEE survey open-ended answers from Portuguese in-service second cycle teachers. Among teachers' explanations for positive attitudes in the items considered, is their need for and interest in teaching statistics, and for negative attitudes they emphasize mistrust of statistics presented on television and their manipulation. These analyses allowed us to investigate teachers' attitudes towards statistics in order to devise a way to improve them.

Keywords: Attitudes towards statistics, scales of attitudes, teachers' training, 2nd cycle of Portuguese basic education.

## 1 INTRODUCTION

The full commitment of teachers to the teaching and learning process is fundamental to implementing any significant changes to the ways in which statistics is taught. In addition, apart from improving the cognitive side of instruction, further attention should also be paid to non-cognitive factors such as students' attitudes and motivations, as pointed out by Gal and Ginsburg [1]. We strongly believe that this holds true for teachers as well. Here, we will discuss teachers' attitudes towards statistics focusing on the qualitative reasons and motivations revealed by the explanations given for several items of *Escala de Actitudes hacia la Estadística de Estrada*, EAEE, [2]. We believe that these attitudes are a key aspect of the teaching and learning process, and that it is important to study the reasons and motivations behind them. In this study, we do not present the complete analysis of EAEE scale and its components, as it has been fully discussed in Martins et al. [3] and Martins [4]. We analyse subjective data on the reasons and motivations for the responses given in the open-ended items of a survey of Portuguese teachers working in second cycle of basic education (ages 10 to 11). The main purpose of this survey was to analyse these teachers' attitudes towards statistics. Once we have chosen manageable reasons/motivation categories and provided a basic analysis of some of the qualitative data through an exploratory approach, we synthesise the ideas from the analysis to obtain an initial understanding of teachers' attitudes towards statistics.

## 2 METHODOLOGY

In this paragraph, we briefly present the instrument for the data collection as well as the main topics of the sample description.

## 2.1 Instrument

The survey included items from the EAEE scale [2] translated into Portuguese. This translation was validated by an expert board of judges (1 Mathematician, 1 Statistician, 1 Psychologist and 1 Mathematics/Statistics Educator). All the items included statements in which the respondents scored accordingly to their level of agreement or disagreement on a five-point Likert type scale (from 1: strongly disagree to 3: neither agrees, nor disagrees, to 5: strongly agree). Out of the 25 items, and to avoid apparent acquiescence, 14 were positively worded and 11 were negatively worded. For the 11 negatively worded items, the scale was reversed. In order to discuss teachers' attitudes towards statistics and their reasons and motivations, we also included nine open-ended written explanations of the EAEE scale items [2]. Those items (1, 3, 7, 14, 16, 19, 21, 22 and 23) were selected because they had the lowest mean item scores in the works of Estrada [2] and Estrada et al. [5, 6, and 7]. Furthermore, the items with a lower score will give a better idea of how to plan teachers' training to improve their attitudes towards statistics. Since the main purpose of the open-ended explanations in the survey was to analyse the components of Portuguese teachers' attitudes towards statistics (from EAEE, [2]) in a qualitative way, we used content analysis to provide/identify a more detailed set of written reasons and to analyse their weights among teachers' answers. Two of the authors did the categorisation for each item inductively based on all the written text explanations: words or sentences. Afterwards, the third author independently did another categorisation and when crossed with the first one, the main categories were established, since there were no significant differences between them. For each attitude (positive or negative) the number of categories varied from 1 to 4, according to common categories found by the groups independently. Therefore, this content analysis was applied "to the manifested content, that is to words, paragraphs and sentences written, and we established the content analysis categories based on the common written" [8, p.105] reasons/motivations ("therefore lexical", [9, p.112]) in the open-ended item explanations.

## 2.2 Participants

The survey was presented during September–October 2010 till October–November 2011 to Portuguese in-service teachers in the second cycle of basic education (pupils ages 10 and 11). The teachers were from north and central Portugal and returned 246 scored EAEE. We should emphasise that all the 246 teachers received the same printed survey, and gave all the 25 scores. All teachers were asked to complete the 9 open-ended explanations, and 132 (54%) chose to do this for at least one of those 9 items, but only 41 (17% of 246; 31% of 132) did it to all 9 items. We analysed all those 246 surveys, and we will present some demographic data of those teachers. They were between 23 and 63 years old – their mean age was 43 (standard deviation, SD, 9.5) – and they were mainly women (70%). From these 246 in-service teachers, 4.1% stated that they had no statistical training or had taught themselves, while the others stated that they had learned statistics at school. The EAEE survey returned scores that range from a minimum of 25 to a maximum of 125; the 246 in-service teachers had a mean attitude total score of 97 (SD 9.5), a median of 97, higher than the indifference/neutrality 75 (mid-point of EAEE), ranging from 67 to 117, and an interquartile range of 13 (Q1 = 91 and Q3 = 104). The results are presented, item by item, for all 9 items. Since we were interested in explaining the reasons that distinguish positive from negative scores, we decided to analyse only the responses that showed positive attitude (4 and 5), or negative attitude (1 and 2) as in Estrada [11] and in Martins et al. [3] and Martins [4]. As the aim of the analysis was exploratory, the categorisation of Portuguese teachers' reasons for negative attitudes provided us a first approach to their attitudes towards statistics and some ideas arose in order to know how to avoid transmitting them when teaching statistics to their pupils. The positive attitudes were also explored and categorised. Both will be of relevance in future development of strategies to improve teachers' and, in turn, students' attitudes towards statistics.

## 3 RESULTS

Since the previous studies with EAEE [2] used a mainly quantitative approach, we present in Table 1 a summary with the mean item score, SD and the total number of teachers that gave positive (4 or 5), neutral (3) or negative (1 or 2) scores for each open-ended item (available in [5]). Next, we present the analysis of items and their categories with examples whenever possible. In each item, we exclude from the tables surveys in which teachers did not give their reasons or explanations (either with positive or negative scores).

**Table 1.** General analysis for each item (\*item in the negative form, here with reversed scores).

Item	Mean score	SD	Positive	Neutral	Negative
1*	3.01	1.07	67 (27%)	99 (40%)	80 (33%)
3*	1.87	0.99	18 (7%)	21 (9%)	207 (84%)
7	3.84	0.98	177 (72%)	50 (20%)	19 (8%)
14*	3.06	1.08	96 (39%)	65 (26%)	85 (35%)
16	3.48	0.84	127 (52%)	94 (38%)	25 (10%)
19*	4.68	0.62	238 (97%)	3 (1%)	5 (2%)
21*	4.70	0.84	233 (95%)	0 (0%)	13 (5%)
22	2.59	1.06	56 (23%)	78 (32%)	112 (46%)
23*	4.65	0.79	228 (93%)	10 (4%)	8 (3%)

### 3.1 Item 1

Item 1 refers to the statement “Some statistical information transmitted on television programmes bothers me”, and since this item was in a negative form, the scale scores were reversed. Also 99 neutral scores were not considered (40% of the 246 surveys). Sixty seven (27% of the 246 surveys) were related to positive attitudes – in other words, they contradict the statement of item 1 – and 27 (40%) of them have some explanation for the respective score. On the other hand 80 (33% of the 246 surveys) were related to negative attitudes, so match the corresponding statement, and 47 (59%) of them have some explanation for the respective score. Table 2 shows the categories and their frequencies.

**Table 2.** Content analysis of item 1 for positive and negative attitudes.

Positive Attitudes				Negative Attitudes			
Categories Description	n	%	%(Global)	Categories Description	n	%	%(Global)
0 – No information	4	15	6	0 – No information	1	2	1
1 – Without interest in television information	0	0	0	1 – Unable (or without) interest in television information	2	4	3
2 –Without confidence in television information	7	26	10	2 –Without confidence in television information	36	77	45
3 – With confidence in television information	16	59	24	3 – Reality and statistical outcomes do not match	8	17	10
Total	27	100	40	Total	47	100	59

For positive attitudes, the content analysis of category 0 included non-informative answers such as “Does not bother me at all”. For instance, after the teacher scores the item, when he/she writes that do not bother him/her, this does not provide any additional useful/information and explanation. This was the method we used for nonsensical statements included in categories 0 of the analysis. Category 1, that was found in the explanations of teachers in the first cycle of basic education (teachers of pupils aged between 6 and 9) as showed in Martins et al. [3] have no correspondence in this teachers explanations. In category 2, there is a lack of confidence in the information given on television (but not in statistics as a subject). We include in this category replies such as “The information is always relevant but sometimes it is not presented in the best way”. In category 3 we could identify some confidence in statistical information on the television in statements such as “Statistical data are an excellent indicator of reality in several items”. For negative attitudes the category 0 also included non-informative replies, like for example “Presentation”. Category 1 grouped sentences that explained the lack of interest in information given on television such as “Because the media use too much statistics”. Category 2 included demonstrations of lack of confidence in the information displayed on television such as “Misuse of statistical data, intellectual dishonesty”. In category 3 there are sentences that reveal the idea that there’s no match between reality and statistical outcomes such in “Because the target population isn’t always representative and generally only is done in urban zones”. Since the

same category label is used in positive and negative attitudes (categories 1 and 2), we need to clarify our view of this aspect of the analysis. In this item, teachers with a positive attitude did not feel annoyed about the misuse of statistics in television programmes because they assume as a starting point that this information is only partially reliable because of TV people rather than Statistics; on the other hand, those teachers with a negative attitude towards statistics are specifically annoyed about the abuse and the misuse that statistics allows or potentiates (hence, the same labels were used both for positive and negative attitudes). Therefore, as in Martins et al. [3] for teachers of first cycle of basic education, we believe that television (and other media) may be a good field of study for both students and teachers wishing to familiarise themselves with statistics in an attempt to raise their awareness and participation.

### 3.2 Item 3

Item 3 states that “Statistics can manipulate the truth”, and from this item (once again the scale scores were reversed) 21 neutral scores (9% of 246 surveys) were eliminated, while the remaining 18 scores (7% of 246 surveys) were related to positive attitudes, and 6 (33%) of them have some explanation for the respective score. Finally, 207 scores (84% of 246 surveys) were related to negative attitudes and 94 (45%) of them have some explanation for the respective score. Table 3 shows the categories and their frequencies.

**Table 3.** Content analysis of item 3 for positive and negative attitudes.

Positive attitudes				Negative attitudes					
Categories	Description	n	%	%(Global)	Categories	Description	n	%	%(Global)
0	No information	1	17	6	0	No information	1	1	0
1	Statistics as a science	4	67	22	1	Manipulation out of self-interest (e.g. political interests)	20	21	10
2	Manipulation/ /dishonesty	1	17	6	2	Intentional or biased manipulation	53	56	26
					3	Vulnerability of the recipients	20	21	10
Total		6	100	33	Total		94	100	45

Category 0 for positive attitudes includes the only reply that does not add any further information such as “Why?”. Category 1 includes statements based on the idea that statistics involve accuracy, which rules out manipulation, and includes statements such as “The Statistics collects data and has a margin of error and standard deviation associated so it does not manipulate reality”. Category 2 gathers statements related to possible manipulation/dishonesty from people and this category includes such explanations as “Sometimes data analysed that does not have great relevance and other data who would consider important is not analysed”. The negative attitudes in category 0 had only one non-informative reply that is “Only address issues that may actually hurt people”. Category 1 groups statements related to the existence and manipulation of biased statistical data, with specific mention of political self-interest as in “Thinking of statistical studies, e.g., by political parties: as government they present some data and the opposition presents other. Which one reflects reality?”. Category 2 includes statements concerning manipulation, either due to the way data are gathered, or because the replies are biased such as in “The way a statistical study is made namely how to ask the questions or the selected sample, can effectively make the difference in the results”. The replies in category 3 emphasize the vulnerability of the statistical information recipients in statements like “Statistical data can influence people’s attitudes and behaviour”. It seems that for those who disagree about the manipulation of the reality by statistics the reason is based in the fact that if there is some manipulation this is due to people and its dishonesty and not to statistics as a science that seeks the truth. As possible explanations for negative attitudes within this item, teachers considered that statistics can be manipulated at various levels in the interests of both the recipients and those who design statistical surveys, and even those who interpret, select and transmit the final results. That is why we think it is very important in the training of pre-service and in-service teachers the emphasis in the rigor and the assumptions of the statistics applicability and also in the ethics for its use.

### 3.3 Item 7

Item 7 states that “I have fun in classes in which I teach statistics”, and for this there were 50 (20%) neutral scores, 177 (72%) positive scores and 19 (8%) negative scores from the 426 analysed EAEE surveys. From the positive scores 73 (41%) presented a justification and from the negative scores 7 (37%) presented a justification. Table 4 presents the categories and their frequencies.

For positive attitudes the category 0 that includes non-informative justifications is empty. In category 1 we considered a group made up of teachers’ own opinions about classes or those suggesting that classes are interesting and/or challenging as in “Because it is an interesting subject and I teach it with computers (spreadsheet)”. In category 2 we also identified explanations stating that statistical classes are playful, easy, important, or motivating in statements such as “I like the students to discuss different interpretations, readings, I like to exercise their power of argumentation”. The negative attitudes of category 0 also included non-informative replies such as “No”. We present category 1 as lack of teacher motivation in the sentence “I can’t see why”. Category 2, that was found in the explanations of teachers in the first cycle of basic education, as showed in a previous work [3], have no replies for this teachers, which in a way was expectable because the richer Mathematics and Statistics background of the most of them.

**Table 4.** Content analysis of item 7 for positive and negative attitudes.

Positive Attitudes				Negative Attitudes			
Categories Description	n	%	%(Global)	Categories Description	n	%	%(Global)
0 – No information	0	0	0	0 – No information	2	29	11
1 – For the teacher classes are interesting/challenging	30	41	17	1 – Lack of motivation	1	14	5
2 – For the students (as the teacher views them) classes...	43	59	24	2 – No statistical knowledge at all	0	0	0
				3 – Classes are a serious matter/thing	4	57	21
<b>Total</b>	<b>73</b>	<b>100</b>	<b>41</b>	<b>Total</b>	<b>7</b>	<b>100</b>	<b>37</b>

In category 3 are grouped those who considered that classes are taken more seriously in statements such as “No because I like statistics and if I had fun students will not understand the subject”. In this item 7, teachers who displayed a positive attitude had a promising attitude in their classroom practices. For the few whom had a negative attitude appeared to have a lack of motivation or, for the majority of them, to have difficulties to get into Statistics with enthusiasm and to transmit it in that way. Therefore, in order to improve their negative attitudes the use of real data and projects in their training is needed.

### 3.4 Item 14

In item 14 the statement is “I do not use statistics outside school”, and from it (also with reversed scale scores), 65 neutral scores were removed (26% of 246 surveys). From the 246 total surveys, there was 96 (39%) with positive attitude and 85 (35%) with negative attitude. Teachers with positive attitude in this item that gave justification for it were 37 and with negative attitude were 28. Table 5 presents the categories and their frequencies.

**Table 5.** Content analysis of item 14 for positive and negative attitudes.

Positive Attitudes				Negative Attitudes			
Categories Description	n	%	%(Global)	Categories Description	n	%	%(Global)
0 – No information	1	3	1	0 – No information	0	0	0
1 – Used/needed with/ /according to everyday situations	8	22	8	1 – Do not use statistics because ...	15	54	18
2 – Statistics is everywhere in everyday life	26	70	27	2 – Only uses indirect information	4	14	5
3 – Uses statistics in work but does not recognise it in everyday life	2	5	2	3 – Sometimes uses statistics in everyday life	9	32	11
				4 – No statistical training or Not enough statistical knowledge	0	0	0
Total	37	100	39	Total	28	100	33

Category 0 for positive attitudes includes just one non-informative explanation such as “To present data”. For category 1 the statements are related to the use/need for statistics in everyday situations such as “Every time that is necessary will do statistics. E.g.: shopping, selling, stock markets”. In category 2 we included statements about the common use of statistics such as “Every day we come across Statistics in the media. Our life depends a lot on statistical studies (purchases influenced by statistical studies, habits influenced by statistical studies ...)”. The 2 statements in category 3 reflect the disagreement with the item statement but only in the professional point of view rather than in the everyday life like “I do several statistical studies with the students’ grades”. In the negative attitudes from category 0 the non-informative replies were not found. In category 1 we included sentences based on the reasons written by teachers concerning an absence of need, use, will, lack of time or interest in using statistics, like for example, “My personal life is not ruled by statistics”. Category 2 grouped the use of indirect information is in either media or scientific work as in “Only in the users view, in any of the media”. In category 3 are represented those teachers who referred the use of statistics only in a sporadic way, and one of sentences that reflects it is “We do not always need to use it”. Finally, and consistently with the last item (see 4.3), there are no replies for this teachers in the category 4 that was found in the explanations of teachers in the first cycle of basic education, as showed in a Martins et al. [3] and in Martins [5]. The problem of statistical literacy among teachers arose in this item, as a substantial part of their explanations made a clear distinction between teaching statistics and their everyday life – using statistics. Since it seems that some teachers do not realise the importance of statistics generally as well as its potential use in classroom work, it is important to include this statistical literacy aspect in their training.

### 3.5 Item 16

Item 16 states that “I adore/love statistics because it helps me see problems objectively”, and for it 94 neutral scores (38% of 246 surveys) were eliminated of this analysis and 127 scores (52%) were related to positive attitudes, while 25 (10%) were related to negative attitudes. From those with positive scores 38 (30%) have a justification and those with negative scores have a justification in 10 (40%) of the cases. Table 6 shows these categories and their frequencies.

**Table 6.** Content analysis of item 16 for positive and negative attitudes.

Positive attitudes				Negative attitudes			
Categories Description	n	%	%(Global)	Categories Description	n	%	%(Global)
0 – No information	2	5	2	0 – No information	0	0	0
1 – I like maths/statistics	4	11	3	1 – I don't like maths/statistics or no statistical training or not enough statistical knowledge	2	20	8
2 – It is unbiased	12	32	9	2 – It is biased	6	60	24
3 – It is useful and helpful	20	53	16	3 – Manipulation	2	20	8
Total	38	100	30	Total	10	100	40

Category 0 for positive attitudes included words which did not add information such as “I agree”. In category 1 we merged the participants that revealed their passion or liking for either mathematics or statistics, as stated in “For those who teach and have the taste for Mathematics or university education with this area it is logical some passion or enchantment”. Category 2 merges replies that provide evidence for the objectivity and understanding of reality made possible by statistics such as “If used without a sense of distorting information is undoubtedly a way of seeing problems more objectively”. In category 3 we got together replies concerning the usefulness of statistics, e.g. “Data analysis facilitates readings. Allows working with other disciplinary areas”. For negative attitudes category 0 is empty. Category 1 includes replies by teachers who do not like statistics, such as, “Not so much, on the contrary”. Like for the item 7 (see 4.3) and item 14 (see 4.4) in this one there’s no reference to no statistical training or no statistical knowledge, otherwise that in the case of the teachers in the first cycle of basic education [3]. In category 2 teachers evaluate each item in terms of the relativity and subjectivity of statistics as in “Is not always objective. It is necessary to consider other factors that condition the work, especially when the human factor has to be considered”. Finally, category 3 includes replies based on manipulation of statistical data, e.g., “The results are not always realistic”. The teachers with a positive attitude towards statistics in this item revealed that they liked mathematics and statistics, but mostly appeared to perceive it as an objective and useful discipline that allows a better understanding of reality, despite admitting they do not use it too often. Those with a negative attitude did not like mathematics or statistics, and explained their dislike with the possible subjective nature and uncertainty of statistical information, but the manipulation of statistical data was their main element of suspicion.

### 3.6 Item 19

Item 19 states that “Statistics is only valid for scientists”, and from it (also with reversed scale scores) 3 neutral scores were eliminated (1% of 246), while 238 (97%) were related to positive attitudes and 5 (2%) to negative attitudes. From the positive scores 97 (41%) presented a justification and from the negative scores 1 (20%) presented a justification. Table 7 presents the categories and their frequencies.

In this item category 0 has only one reply that provided no information. Category 1 includes generic reasons based on necessity and the importance of statistics for everyone, not only for scientists, like in “Every citizen should know the basics of Statistics in order to be considered an informed citizen”. Category 2 includes statements which highlight the presence of statistics in several fields, not only in scientific ones, as in “It is used in all areas”. Category 3 includes statements based on the use of statistics in everyday life such as “Every person in their daily lives does Statistics: water consumption for each month of the year, school expenses for different years, etc.”.

**Table 7.** Content analysis of item 19 for positive and negative attitudes.

Positive attitudes				Negative attitudes			
Categories Description	n	%	%(Global)	Categories Description	n	%	%(Global)
0 – No information	1	1	0	0 – No information	0	0	0
1 – Everybody needs it	27	28	11	1 – Unnecessary in everyday life	0	0	0
2 – Present in various fields or in teaching	46	47	19	2 – Only valid for sciences	1	100	20
3 – Present in everyday life	23	24	10				
Total	97	100	41	Total	1	100	20

For the negative attitudes the category 0 does not have any non-informative reply. The same happen in Category 1 that was considered in the similar study of teachers in the first cycle of basic education [3]. Category 2 includes only one statement based on the idea that statistics only apply to scientific fields, that is “It is generally used by scholars in the field and has professions attached to it. But there are exceptions”. In this item it’s clear that teachers have a real and strong conviction that Statistics is not only for science proposes or science people, more even, they are conscious that Statistics is used in many other fields, beside the statistics teaching, but also in everyday life by everyone who want it.

### 3.7 Item 21

Item 21 contains the statement “Statistics is useless”, and from it (also with reversed scale scores) none neutral scores was founded, while 233 (95%) were related to positive attitudes and 13 (5%) to negative attitudes, whose participants decided not to make any comment. For the participants with positive attitudes 80 (34%) of them gave a justification for the score in this item. Table 8 presents the categories and their frequency.

**Table 8.** Content analysis of item 19 for positive and negative attitudes.

Positive attitudes				Negative attitudes			
Categories Description	n	%	%(Global)	Categories Description	n	%	%(Global)
0 – No information	1	1	0				
1 – Useful, relevant and/ or objective	51	64	22				
2 – It exists because it is useful	3	4	1				
3 – Useful for everyday life	25	31	11				
Total	80	100	34	Total	0	0	0

For this item and for the scores related to positive attitudes in category 0 the only words that did not add any information were “To me that’s a lie”. In category 1 the explanations refer to the usefulness, objectiveness and importance of statistics in the perception of reality (but sometimes stating the need to ensure technical accuracy and the appropriate use of statistics). In category 2, statements were included based on the idea that if statistics exists, it is because it is useful like in “Without her [statistics] National Institute of Statistics would make no sense”. In category 3 there are explanations for the usefulness of statistics in everyday life such as “It is important in our daily life”. In this item, there were no scores related to negative attitudes that present an explanation. In item 21, reinforcing what was discussed in item 19, teachers strongly and clearly stated that statistics is useful for everyone. They also considered statistics to be an accurate science, using adequate techniques and theories, and a useful and important discipline for people in many ways, including in the daily life.

### 3.8 Item 22

Item 22 states that “I usually explain statistical problems to my colleagues if they do not understand” and 78 neutral scores were removed (32% of 246 surveys). In the others there were 56 (23%) associated to positive attitudes and 112 (46%) to negative attitudes. From those positive scores 11 (20%) presented a justification and from the negative scores 32 (29%) presented a written reason. Table 9 presents the categories and their frequency.

From the positive attitudes in category 0 there were no non-informative sentences. For category 1 there were statements from teachers trying to help as much as they could or whenever requested, as for example “When necessary and in more complex problems that I master, then I explain”. In category 2 we included the only statement about sharing whenever needed, “I use data from graphics and tables to explain some opinions”. In category 3, that was considered in an analogous study of teachers in the first cycle of basic education [3], no explanations were founded for this second cycle of basic education teachers.

**Table 9.** Content analysis of item 22 for positive and negative attitudes.

Positive attitudes				Negative attitudes			
Categories Description	n	%	%(Global)	Categories Description	n	%	%(Global)
0 – No information	0	0	0	0 – No information	0	0	0
1 – I try to help as much as I can/whenever requested	10	91	18	1 – Seldom happens because...	17	53	15
2 – I try to share whenever needed	1	9	2	2 – Not enough statistical knowledge in my training	3	9	3
3 – I did it only when I was a student	0	0	0	3 – I only use statistics in my classes	0	0	0
				4 – Everyone (or almost ...) understands statistics	12	38	11
Total	11	100	20	Total	32	100	29



For the negative attitudes category 0 do not include any non-informative replies. Category 1 was based on the sporadic occurrence presented in explanations like for instance in “There is still little exchange of experience in schools”. In category 2 teachers assume that don’t have more statistical knowledge than their colleagues, and one example of this kind of explanations is “Lack of pre requisites and interest”. In this study there were no justifications in category 3 that was considered in the already mentioned study of teachers of the first cycle of basic education [3]. Finally, we included in category 4 those explanations that considered that everyone understands statistics and so there no help is needed in this topic, as is shown in the explanation: “Colleagues know how to solve the statistical problems they need for their job”. From the few teachers showing a positive attitude, we gained the impression that they were available for cooperative work in statistics. Beside the few explanations presented by the teachers, it seems that exist a generally negative attitude towards this item, which indicates awareness of their own lack of cooperative work in statistics, showing an uncommon sharing about with the colleagues this topic and a devaluation of the statistics (correct) uses, in particular in the classroom.

### 3.9 Item 23

As regards item 23 (“We should not teach statistics at school”, also with reversed scale scores), 10 neutral scores were removed (4% of 246 surveys). There were also 228 (93%) positive attitudes and 8 (3%) negative attitudes. From the positive attitudes 88 (39%) presented a justification and from the negative attitudes 2 (25%) presented a written reason. Table 10 presents the categories and their frequency.

**Table 10.** Content analysis of item 23 for positive and negative attitudes.

Positive attitudes				Negative attitudes					
Categories	Description	ni	% % (Global)	Categories	Description	ni	% % (Global)		
0	No information	0	0	0	No information	1	50	13	
1	Usefulness	59	67	26	1	Do not want pupils to feel the same frustration as the teacher (as pupil)	0	0	0
2	It is not so important but should be taught	17	19	7	2	Too soon to be taught (to pupils of the first year in school), there are others more important topics or statistics is manipulative	1	50	13
3	Likes statistics	12	14	5					
Total		88	100	39	Total	2	100	25	

From the positive attitudes in category 0 there were no replies. In category 1 the statements were about need, utility and wanting to know more about statistics, and one example is “It is essential for the students to understand some problems, the situations they meet in everyday life, as well as predict or make guesses about their evolution”. In category 2 statements were included based on the idea that statistics maybe is not so important for everyone, but should be taught as in “It is essential for teaching”. In statements for category 3, teachers pointed out that either pupils like statistics, or that it is liked by both teachers and pupils, such in “I like statistics very much and pupils too”. For the negative attitudes we present as the only reply in Category 0 of the non-informative explanations: “With no historical data predictions cannot be done”. In category 1, also was considered in the similar study of teachers of the first cycle of basic education [3], no explanations were found. For category 2 we included the only one reason: “There are other more important topics”. In this item most of the teachers seemed to report their awareness of the need for statistics in teaching and learning at school. Nevertheless, an attitudinal trend is not yet available from those showing a negative attitude, since there were only two informative explanations.

## 4 CONCLUSIONS

This work is part of a broader study of the attitudes of first and second cycle Portuguese basic education teachers towards statistics (pupils aged 6 till 11) and is complementary to Martins et al. [3]. The goal was not to generalise our findings, but to draw attention to how teachers explain their attitudes towards statistics. Since this was a second exploratory study – let’s do it again –, we can

discuss the results and look back over them in order to plan future actions with this second cycle teachers. Referring to the mean scores, the results of this survey did not seem to be very different from those of Estrada [2] and Estrada et al. [6, 7] concerning Spanish and Peruvian teachers. Nevertheless, comparison of the mean scores (Table 1) shows that items 1, 3 and 22 from this work are slightly lower; item 14 mean score is between the Spanish mean score and the Peruvian one; and items 7, 16, 19, 21 and 23 have slightly higher mean scores. In order to contextualise these differences, we have to remember that Estrada [2] and Estrada et al. [6, 7] focused on future teachers as well as in-service teachers, since in this study we have only included in-service mathematics teachers. Since scoring does not reveal the reasons of teachers, the qualitative approach in this paper was motivated by Estrada [7], Estrada and Batanero [5] and Estrada et al. [11] but it was more detailed like in Martins et al. [3] and in Martins [5]. According to those researches, teachers' explanations for positive attitudes in the items considered, we may emphasise their view of the need for and interest in teaching statistics. These attitudes reinforce the idea that "statistics is not only valid for scientists": statistics is useful for everyone. In this work, the second cycle Portuguese basic education teachers (pupils aged 10 and 11) revealed that they generally like learning and teaching statistics, and they see it as a tool to face objectively real-world problems. As regards teachers' explanations for negative attitudes in the item 1 – "Some statistical information transmitted on television programmes bothers me" – they emphasize mistrust of statistics presented on television and their manipulation through methodologies used and/or in analyses presented, and this is confirmed along with the results in item 3 – "Statistics can manipulate the real". Once again, in line with Estrada [10], Estrada and Batanero [5] and Estrada et al. [11], the other negative attitudes from the second cycle of Portuguese basic education teachers surveyed suggests that they hardly use statistics in their daily lives, either because it is something they do not need, or are not interested in. Also they are not used to share statistical problems with their colleagues in a cooperative work. We think that looking back over teachers' attitudes written in the open-ended items may draw attention to the importance of assessing their attitudes towards statistics and lifting the veil on their reasons/explanations. As these explanations begin to be known, they may give hints to support, either in-service, or future second cycle basic education teachers' training. Based on this second analysis and in order to accomplish teachers' training, we believe that in future television (and also other media) news must be a didactical tool providing materials for learning and get used to statistics, as well as emphasising the statistical thinking components and the phases of a statistical study. Day-to-day study cases and projects should also be used to enhance the need of statistics and its phases in a study – the statistical viewpoint of the problem solving approach –, as well as used to strengthen cooperative work. This second exploratory work has some aspects that may be improved in future studies. First of all, research should compare these in-service teachers with teachers of others school levels. Eventually in a next research the explanations of the teachers neutral scores could be included, and some teachers interviewed for all the scored items, as well as crossing this analysis with some of the demographic variables (e.g., gender, age, number of years of teaching experience and statistical training). Furthermore, means of increasing the respondents' explanations should be devised, and other items should also be included as open-ended. However, our effort to complete this exploratory qualitative analysis of some items of the EAEE [2] allowed us to understand teachers' attitudes towards statistics in a more deeply way, thereby confirming and complementing conceptions based on previous works [e.g. 5, 6, 7, 11] and in our own researches [e.g. 3, 4, 12].

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