

STUDENTS' OPINION ON THE SUBJECTS OF STATISTICS AND PROBABILITY IN SECONDARY SCHOOLS OF LISBON, PORTUGAL

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Nowadays, Statistics and Probability take an important role in Secondary Education Mathematics curriculum. This work aims at analysing students' opinion about these subjects. During the third term of 2007/08 school year, we conducted a survey on 1128 students—7th grade to 12th grade—from public schools in the area of Lisbon and Vale do Tejo. Students filled in the questionnaire at math classes and they reported on their beliefs about Statistics and Probability. The questions were mainly closed and we used the 5-point Likert type scale. Analysing the inquiries, we conclude the majority of the students recognise that the subjects of Statistics and Probability are interesting, and admit that, on the overall, their contents are neither easy, nor difficult.

INTRODUCTION

Nowadays, there is an emphasis on the role of Statistics and Probability in Secondary Education Mathematics curriculum. Although at different rates, this feature is felt in most countries around the world. This strategy is mainly based on the idea that citizens get more informed if they have more statistics and probability at secondary level (Moore, 2000 or Carvalho, 2001). In Portugal, the subject of Statistics is taught at the 7th, 8th and 10th grades. At these school levels, students do not study Probability. The subject of Probability is taught at the 9th and 12th grades.

There is the general idea that students dislike mathematics. Having in mind that the Statistics and Probability curriculums are focused on problem-solving situations based on daily life, we want to know students' feelings about these particular subjects. To attain this goal, we developed an evaluation questionnaire with the objective of analysing the students' opinions in relation to the subjects of Statistics and Probability, in general, as well as their contents. Students from a wide range of schools in the area of Lisbon and Vale do Tejo were asked to participate in the survey. Therefore, we also investigated the extent to which students' opinions are related with the schools where they are enrolled.

METHOD

The Sample

The sample is composed of 1128 students enrolled in public schools in the area of Lisbon and Vale do Tejo. They belonged to five different school grades: 7th grade - 361 students from six schools (median of ages=13years); 8th grade - 319 students from six schools (median of ages=14years); 9th grade - 258 students from four schools (median of ages=15years); 10th grade - 129 students from four schools (median of ages=16years); 12th grade - 61 students from two schools (median of ages=18years). For each grade, the number of boys and girls is roughly equal.

The data were collected during the third term of 2007/08 school year. Students answered the questionnaire in math classes and they did not spend more than 10 minutes, which did not hinder the planning foreseen for those classes.

The Questionnaires

The questionnaires applied to students of the 7th and 8th grades were composed of 11 questions each, whereas the 9th grade students completed the 10-item questionnaires. The questionnaires applied to students of 10th and 12th grades consisted of 14 questions each. Students reported mainly on their beliefs about maths, maths scores and teachers' behaviour in math classes. The questions were mainly closed and we often used the Likert type scale (Chisnall, 2005).

In the paper, we analyse only two of the above questions. In the first question, the students evaluated the subject of Statistics/Probability on a 2-point scale (0 = not interesting, 1 = interesting). In the second question, the students evaluated the contents of Statistics/Probability on

a 5-point Likert type scale (1 = very difficult, 2 = difficult, 3 = neither easy nor difficult, 4 = easy, 5 = very easy). A detailed analysis of the remaining questions can be found in Caldeira (2009).

DATA ANALYSIS AND RESULTS

Due to the nature of the variables under study, several contingency tables were constructed. The Chi-Square test was applied to each table. This test allows us to evaluate the null hypothesis that there is independence between students' opinion about the subjects under consideration and schools where they are enrolled. Full details on these analyses can be found in Caldeira (2009).

Afterwards, one and two population proportion tests were applied to the nominal variables (Zar, 1999, Chapter 24). In regard to the ordinal scale variables, the binomial test was carried out (Conover, 1999, Section 3.1). The goal was to make inferences about the probability of a student randomly selected from the population under analysis falling into a particular category of the 5-points Likert scale. Hereafter, this probability is represented by p , whereas $1-p$ is the probability of falling in the remaining categories. Unless stated otherwise, two-tailed tests were performed.

Statistics in the Mathematics curriculum

By analysing the data from the questions reported below, and considering the significance level of 1%, we found out that there is no association between students' opinion and the school where they are enrolled. The independence allows us to discard information about the schools.

- Question 1: What is your opinion regarding the subject of Statistics?

Figure 1 displays the results from comparing the dichotomous variable under consideration (performed properly, interesting versus not interesting). We verify that 70% of students from 7th grade find Statistics an interesting subject (one population proportion test, $Z_C=-0.357$, p -value=0.721). This percentage increases to 75% for the 8th and 10th grades (one population proportion tests. 8th grade: $Z_C=-0.100$, p -value=0.920; 10th grade: $Z_C=0.344$, p -value=0.731).

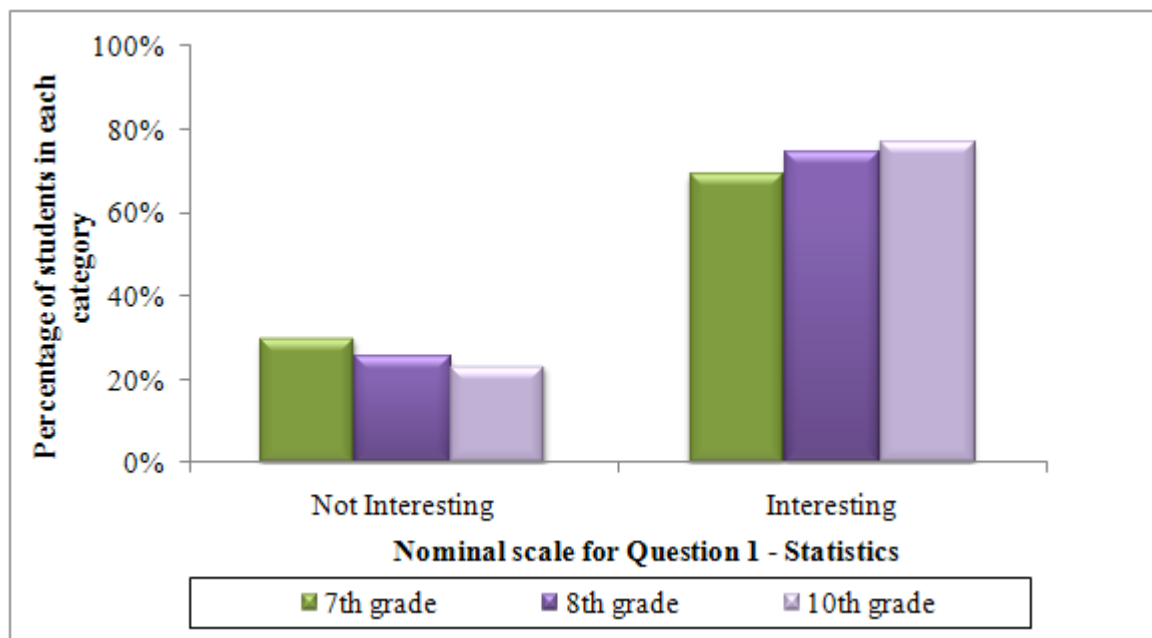


Figure 1. Percentage of students considering Statistic interesting, or not interesting

- Question 2: How do you evaluate the contents of Statistics?

Figure 2 displays the main results. The majority of students of the 7th, 8th and 10th grades admit that, on the overall, the contents of Statistics are neither easy nor difficult (binomial test, null hypothesis: the probability of selecting the category 3 is equal to 0.5, i.e., $H_0: p=0.5$. Results: 7th grade: p -value=0.566; 8th grade: p -value=0.022; 10th grade: p -value=0.034).

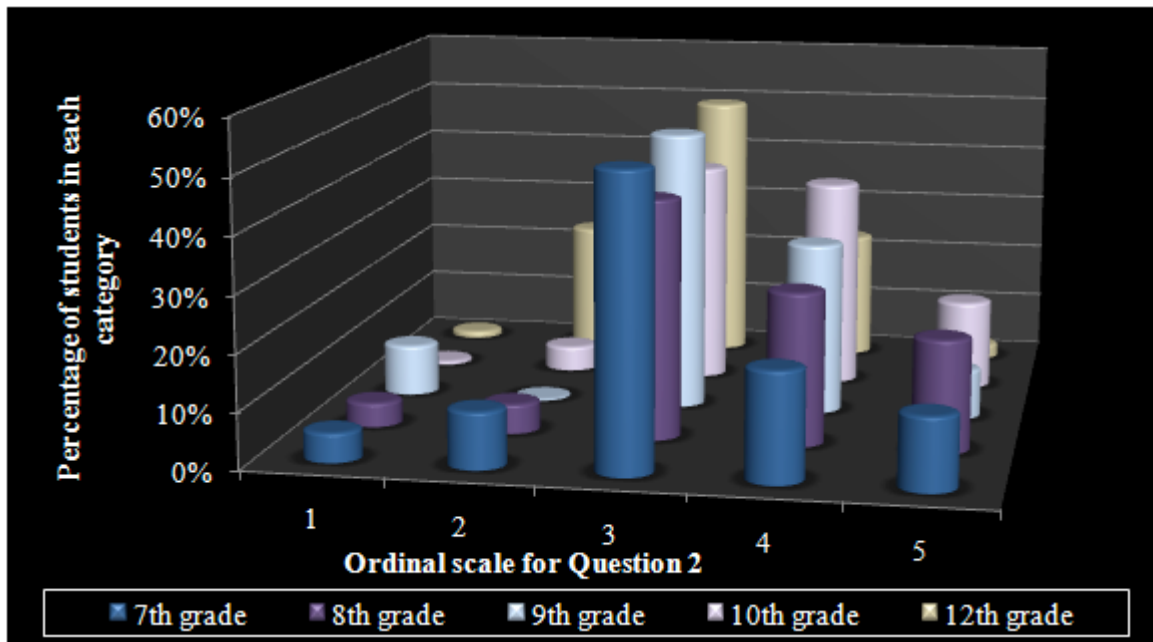


Figure 2. Proportion of students responding to each category of Question 2: 7th, 8th and 10th grades - Statistics; 9th and 12th grades - Probability

Probability in the Mathematics curriculum

- Question 1: What is your opinion regarding the subject of Probability?

In 9th grade, students' opinion is independent of the school where they are enrolled (chi-square statistic, $X^2 = 8.718 < \chi^2_{0.01;3} = 11.345$, $\chi^2_{0.01;3}$ is the 0.99th quantile point of the chi-square distribution with 3 degrees of freedom). However, in the 12th grade the opinion of students depend on the school where they are enrolled (chi-square statistic, $X^2 = 15.503$, p-value = 8.237×10^{-5}).

Figure 3 shows the main results from this question. The majority of students of the 9th and 12th grades recognise that the subject of Probability is interesting (9th grade: 80%, one population proportion test, $Z_c = -1.074$, p-value = 0.283; 12th grade: 86% and 48%, for schools A and B, respectively).

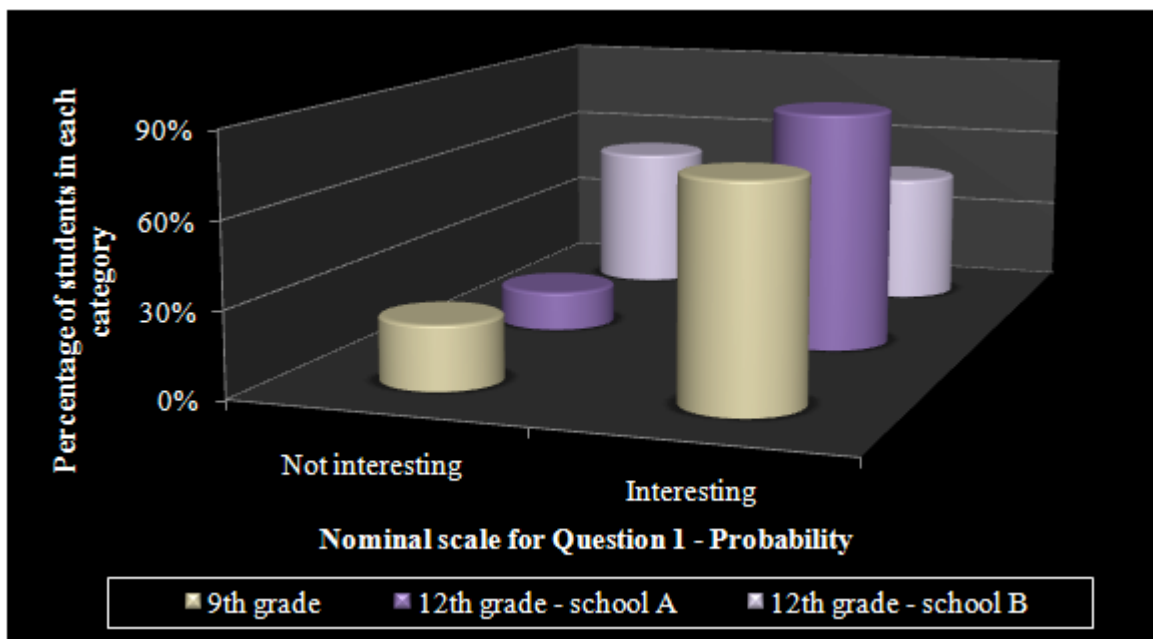


Figure 3. Percentage of students considering Probability interesting, or not interesting

- Question 2: How do you evaluate the contents of Probability?

Using the significance level of 1%, we found out that there is no association between students' opinion and the school where they are enrolled, which allow us to discard information on the schools.

From Figure 2, we verify that the majority of students of the 9th and 12th grades admit that, on the overall, the contents of Probability are neither easy nor difficult (binomial test, null hypothesis: the probability of selecting the category 3 is equal to 0.5, i.e., $H_0: p=0.5$. Results: 9th grade: p-value=0.950; 12th grade: p-value=0.999).

Statistics versus Probability

We investigate if students of the secondary school prefer the subject of Statistics over Probability. In order to make reliable comparisons, we only analyse students from the high secondary level, that is, we compare the subject of Statistics from the 10th grade with the subject of Probability from the 12th grade. We may also stress that the Statistics curriculum for grades 7 and 8 is focused on very elementary concepts, which could distort the results.

To attain the goal cited above, we performed the one-tailed test for comparing the two population proportions (Zar, 1999 or Daniel, 2005). On the overall, students from the secondary school prefer the subject of Statistics to Probability ($Z_C=2.825$, p-value = 0.002).

CONCLUSION

In this study, we analysed the opinion of students from secondary school about the subjects of Statistics and Probability. According to our results, students recognise that these subjects are interesting, and admit that, on the overall, their contents are neither easy nor difficult. This is somehow in accordance with the idea that students are more enthusiastic on studying applied fields of knowledge, which could describe real world problems, than dealing with abstract concepts.

The questionnaire study also revealed that students prefer the subject of Statistics to Probability. This conclusion was also expected because the 12th grade Probability course gives great emphasis to Combinatory Analysis (Silva, et al., 2002). The majority of students find this subject an awkward task. On the other hand, it is interesting to note that the subject of Statistics leads naturally to cooperative learning and group activities. In general, students are very keen on these types of activities.

The present study provides a starting point for a future in-depth population-based survey at schools in Portugal. In future, the survey should also include a few questions focusing on techniques and tools, developed at the classroom, to enhance students learning. This will certainly help teachers to handle the demands of teaching these subjects.

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