

TEACHING STATISTICS AT HIGH SCHOOL: AN ALTERNATIVE APPROACH

Lorí Viali¹ and Renate Grings Sebastiani²

¹Federal University of Rio Grande do Sul, Brazil

²Pontifical Catholic University of Rio Grande do Sul, Brazil

Viali@puers.br

The main purpose of this work is to verify the learning and the students' interest in Statistics, from a contextual approach with the help of technological resources. To get students attention and their involvement spreadsheet was used in the classes. The work was done with a group from the third year (last year) of High School of a public school from the country side of the state of Rio Grande do Sul, Brazil. The classes were taught in a computer lab, using a data show and the spreadsheet. Prior to the classes, the students were asked to answer a questionnaire in order to verify their previous knowledge about the subject. Straight after the classes the students were submitted to questionnaires and evaluations, in order to get information about their learning, motivation and performance on those subjects.

INTRODUCTION

Statistics and Probability are both inserted in Elementary School and in High School in the mathematics curriculum component. In these teaching levels they can be used as a link between the models and the abstraction of the Mathematics with the real subjects, that is, they are especially designed to obtain contextualization and interdisciplinary. In agreement with the National Curriculums Parameters (NCP+) of High School Teaching (BRASIL, 2002, p. 126), "Statistics and Probability should be seen, then, as a group of ideas and procedures that allow applying Mathematics in subjects of the real world, especially those coming from other areas".

A present fact at schools is that many teachers do not teach the Statistics contents in their classes and the textbooks contribute for this exclusion because they normally present Statistics and Probability contents in the last chapter. Besides, according to Oliveira (2006, p. 90) "the textbooks present the concepts in a non attractive way for High School students, since they are more concerned with the numeric results than with the meaning". In a quickly exam it can be easily noticed that in many texts these contents were added in subsequent editions with the purpose to obey the legislation. It can be observed that there is not integration with portions of the book and this disconnection is noticed mainly by the fact that they are usually in the last chapter of the book.

On the other hand, there is indifference and even bad-will by many students from High School regarding Mathematics and as a consequence to Statistics and Probability too. Consequently the students' performance in these disciplines is not satisfactory. It's common that in an evaluation more than a half of the group doesn't reach a minimum grade, it means, they get little or no learning. This fact is so common that it is already expected by the school community and even considered as a normal result. In fact, it's uncommon when, only few students do not present a good performance on the subject.

Facing this problem the teacher needs to find alternatives to arouse the interest and to motivate the students. It can be done by bringing the knowledge to be acquired close to the student's reality and using teaching methods that can challenge their curiosity. Certainly it won't be obtained by using the typical teaching practiced in the subject, whose method is strongly guided by the algebraic manipulation and by the memorization of concepts and formulas that are usually not understood by the majority of the students. This kind of teaching has little or none relationship with the real situations of work or research.

The present study investigated the students' learning and motivation regarding Statistics, starting from a methodological and contextualized approach allied to the use of computational resources.

METHOD

An exploratory study (Gil, 2008) was conducted in a class with 21 students from the third year of a public High School in the most south state of Rio Grande do Sul, Brazil. Through inquiries applied before and after Statistics classes and through some tests, it was tried to evaluate

the methodology used in Descriptive Statistics teaching. Some of these data was analyzed by using content analysis, which is a group of techniques to analyze communications, in order to describe and to do inferences on the content of the messages (Bardin, 2004).

Initially, a questionnaire was applied to identify the prior knowledge that students had about both Statistics and Probability. After 22 lessons, three questionnaires were applied and three evaluations were performed. The first questionnaire was used to identify the students' knowledge about Statistics after the classes. The second evaluated the methodology that was used during content's development. The third questionnaire, which had closed questions, aimed to determine the students' profile and then determine which variables were involved in this study.

The first evaluation consisted in five questions about data presentation like drafting frequency distributions and graphical representation (drawing diagrams). The second evaluation was consisted in six questions about the measures of central tendency and variability. These two evaluations were performed in the classroom by the students themselves, without using the computer, but with the possibility of consulting the algorithms that were necessary. The third and last evaluation was performed in the computer lab and the activities conducted in pairs. This evaluation had contents about the construction of tables and graphs.

The survey and the spreadsheet were the resources that made difference during the Statistics classes. They were used in the place of the exercises from the textbook and the notebook, respectively. The classes were presented in the computer lab instead of the traditional classroom. The blackboard and the chalk gave place to the data show projector and to the computer with presentation software and a spreadsheet for handling and organizing data.

For a better understanding of the Descriptive Statistics contents that were addressed, it was proposed that the students should design a survey and they should determine variables that they were interested in knowing. This was made with the purpose of obtaining a database with which the contents could be presented later. So, the work with Statistics contents had started from the students' own reality through the use of data that were taken and organized by themselves.

RESULTS

The analysis of the answers obtained in the questionnaires that were used to identify students' knowledge about Statistics before and after the classes showed that there was a significant increment both in the conceptual understanding and in the applications of Statistics. It was also observed that the language was improved after the classes and started to be more technical, like "analysis of data" instead of "analysis of numbers", "research method" instead of "the chance to discover something". The evaluations results showed that the students' accomplishment was satisfactory.

The results that were obtained in the questionnaire applied to evaluate the methodology showed that it sensitizes the students, because 95.2% of them answered that they felt motivated. Just one student said he was not motivated. Some answers obtained from the question "Did you feel motivated in learning Statistics with the new methodology?" were:

Student A: *"Certainly, this methodology made the Mathematics class much more interesting".*

Student B: *"Yes, because I thought the technique used very interesting. I think the performance is better in the spreadsheet than in the notebook because I didn't like to do it in the notebook, it is a lot of work".*

Student C: *"Yes, I motivated myself in learning Statistics. My performance was good, I understood the subject and I was good in the test".*

From these declarations it can be considered that the methodology used could develop in the students the appreciation for Statistics learning, bringing advantages like increasing students' participation and also having more time in class since it is not necessary waste time by copying the content. The use of the technological resources turned most of the classes into something more practical; it propitiated better attendance and understanding of the content. Besides, the methodology used, that is not present in the current educational practices, provided a new way of learning.

The spreadsheet was attractive to the students because it exchanged the manual work of extensive calculations into tabular and graphic construction by the development of intellectual

abilities, producing reliable and organized results. It is important to highlight that the spreadsheet allowed the students to increase their creativity during the tables and graphics construction. It was observed by the use of several resources of cells formatting that stressed the similarities and the differences in the terminology used in the frequencies distribution.

In Table 1 some aspects emphasized by the students about the use of the spreadsheet as a resource for Statistics learning are shown.

Table 1. Positive and negative aspects in learning Statistics with the spreadsheet

Positive Aspects	Count	Negative Aspects	Count
Faster	7	Machines with defects	6
Easier	6	A little difficult for those who didn't know how to work in a spreadsheet	5
More Practical	6	Slow machines	5
It doesn't need a ruler and a calculator	2	Obsolete Machines	2
Learning how to work with the spreadsheet	2	Extensive Spreadsheets that took time to copy to the computer	1
More Organized	1		
Efficient	1		
Very Interesting	1		
Very Useful	1		
It's not necessary to calculate, it does everything by itself	1		
Increasing the Learning Process	1		

During the graphics construction the students explored several types of diagrams and also the possibilities to format them. Figure 1 shows one of the activities that were done by the students. Some students considered the fact of learning how to work with the spreadsheet as a positive aspect because its utility is not limited to Statistics.

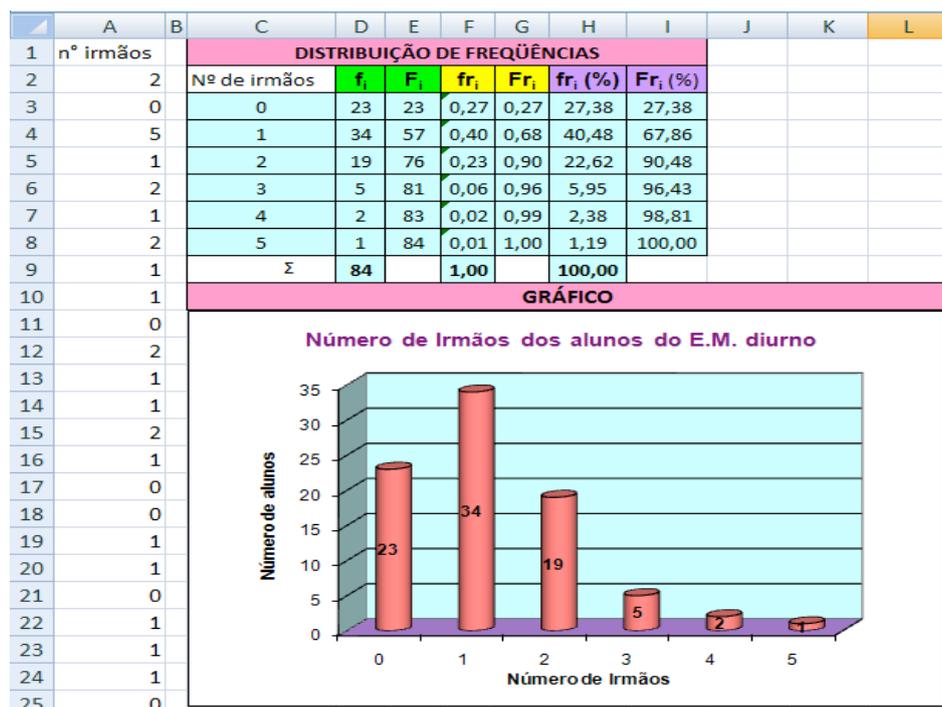


Figure 1. Activities performed by the students on discrete variables

DISCUSSION

Considering the Theory of the Significant Learning by Ausubel (Moreira & Masini, 1982) it can be inferred that the new contents had some relationship with aspects of the students' knowledge structure. In that way, there was integration between the previous knowledge and the ones that were learned by adding new designations for Statistics definition. Furthermore the addition of several applications to that already existent could evidence the occurrence of significant learning.

The classic focus that goes through definition, examples, application and repeated exercises, in which the participants of this research were submitted since they started school, is not appropriate to stimulate the motivation and the contents learning. The need for a change into teaching practice was evidenced with the accomplishment of this work. Start using resources like surveying data and the spreadsheet during the activities developed in class helped to give motivation and to get the interest of the students. Therefore the students were more involved in the proposed tasks, improving the understanding of the concepts involved.

Other important aspect is that the students did not ask the reason why they were learning Statistics, which normally happens in traditional classes. With the proposed activities was possible to show the applicability of the contents were being seen. These contents were favorable to develop contextualized activities that are an essential aspect to student's motivation. Then, the teacher has to explore activities that clearly show the contents applicability in everyday situations, bringing Mathematics classes closer to student's reality. This is a fact that contributes to develop the students' appreciation for Mathematics.

It is important to emphasize that the students are still very accustomed to "traditional" classes with paper, pencil and a calculator. Student E said: "It is faster to practice Statistics in the spreadsheet, but we should know how to do it with paper. I particularly learned better writing". The Mathematics classes in the computer laboratory were an unusual experience to the students because they were not familiar with the use of this resource in Mathematics classes. Therefore, many students had felt the need of making manual calculations, using small groups of data in order to keep the content.

This work was a positive experience because it brought the possibility of developing dynamic and involved classes. The explanation of the content became easier with the use of data show projector that allowed showing the slides and the examples being executed in the spreadsheet at the same time. Into the classroom, where the available resources are blackboard and chalk, there is no possibility of changing the screen, it means, to go from theoretical explanation to a practical example. Whereas, with the use of the computer, a mouse click is enough. This fact avoids the students being distracted by parallel conversation that happens while the teacher erases and writes on the blackboard. Besides, the construction of tables and graphics on the blackboard is a slow and tired task that does not motivate the teacher neither the student. The spreadsheet also could show students some real examples with variables that they chose instead of exercises and examples from books that were written to assist a wide public and that have a huge distant from the student's reality imagined by the author of the book.

Some difficulties and limitations were found during this work. One of them is the impossibility to accomplish the activities with two groups simultaneously for a future comparative study between the traditional approaches and the computational ones. Besides, the reduced number of weekly Mathematics classes (3 hour-class) does not allow that each topic was explored with more detail.

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