LEARNING STATISTICS IN THE FIRST GRADES

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Statistics Education has received some attention in recent years, with particular emphasis in the first grades. We present an experiment that follows an exploratory approach performed in a 2nd grade class. The purpose is to understand how students in first grades undertake the collection, organization and analysis of data. The work presented aims to identify the main difficulties of these students and to understand to what extent the real context may or may not be a facilitator in this process. Finally, it will also be discussed, though briefly, the teacher's role during this process. The results show that students have difficulties in representing the data using charts but, as far as the analysis of the data is concerned, the students, in most cases, can read and interpret the data presented. The data that refer back to a real context may facilitate carrying out the task but on the other hand, provides the existence of misinterpretations, often derived from the students' own experience.

INTRODUCTION

In Portugal, the curriculum orientation in the teaching of statistics for the first years has changed in recent years. In the mathematics program for the 1st cycle of basic education (1st CEB) 1990 this issue did not appear explicitly although one of the aims of this document was related to the collection and organization of data using different types of representation. In the National Curriculum for Basic Education (2001) there first emerges the theme Statistics and Probability, although more focused for the 2nd and 3rd CEB, general skills for the three cycles of basic education mention that the students should be able to conduct investigations that use quantitative data which involves the collection and analysis of data and consequent drawing of conclusions.

Program in Mathematics for Basic Education in 2007 approved the issue of Organization and Data Analysis (ODA) as a Mathematical subject, and as in the National Curriculum; the primary purpose of teaching and general learning objectives are to develop the ability to read and interpret data organized in tables and graphs. Also relevant is the importance that is given to studies that involve the collection, organization and representation of data.

Currently, with the new mathematics program of Basic Education, approved in 2013, the theme of ODA also continues to exist from the first four years of schooling, but now with the emphasis on set theory, data representation using various types of charts and frequency tables. It is noteworthy that in this area, particular attention is given to processes that allow to report and interpret the information gathered, and there is no reference to studies involving the previous steps, particularly concerning the collection and organization of data, nor any mention of processes of statistical research.

Internationally the NCTM (2000) presents the work with Data Analysis and Probability since the age of preschool. In Portugal for years, on the 1st CEB, arise purposes related to the formulation of questions that can be worked from the data collection, organization and analysis in order to respond to the initial questions. Besides working with the investigative cycle there arise other purposes relating to the selection of methods for analyzing data and developing inferences and predictions supported by the data. Regarding research on the teaching and learning of statistics for the first years of schooling there are diverse works in this area.

THEORETICAL FRAMEWORK

Statistical literacy is one of the concepts that is transverse to the vast majority of the literature on Statistics Education matters. According to Gal (2004), this concept involves a definition in a broader sense and that exceeds the boundary of the teaching and learning of statistics and therefore relates to a set of skills/capabilities that an adult citizen should have to exert a full form citizenship. Thus, it is proposed by the author that the term statistical literacy refers to two interrelated components: (i) the individual's ability to interpret and critically evaluate the statistical

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information; (ii) its ability to discuss or communicate their opinions / reactions on a set of statistical information. This concept has been defined and developed by several authors, Ben-Zvi and Garfield (2004), Watson (2006), among many others.

Within the scope of the concept arise Statistics Investigations associated with this investigative cycle. Several authors advocate teaching through projects in order for students to experience the full cycle of statistical work, designing investigations, formulating research questions, collecting data from observations, questionnaires or experiments and obtaining conclusions and predictions based on data analysis. For example, to describe the investigative cycle consisting of five basic steps (PPDAC): Problem, Plan, Data, Analysis and Conclusion. According to these same authors, there is still insufficient attention given to the statistical inquiry cycle in the teaching of Statistics.

Pereira - Mendoza (1986) mention that the teaching of statistics in the early years must take into account that: (i) the approach should involve the collection of data that is meaningful to the children; (ii) followed by a set of decisions to be taken to represent the data; (iii) and at the end, the interpretation of such data.

METHOD

This paper presents an experience performed in a class of 2nd grade with the goal of understanding how, from an initial question: *Will we weigh more than last year?* (proposed by a pre-service teacher in this class), to identify the main difficulties of students and understand to what extent the real context may or may not be a facilitator in this process. We also discuss, though briefly, the teacher's role during this process.

The experiment presented here is part of a larger project that involves two researchers, who from the joint lesson observations of several pre-service teachers studying, on the one hand children's learning in the field of Statistics Education (this being the focus of this article) and on the other the professional development within Statistics Education of the pre-service teachers.

This experiment was performed in a class of 24 students from 2nd grade in the school year 2012/2013, 11 girls and 13 boys, aged between 7 and 8 years. Altogether it was a class with good results, very participative and highly motivated to learn. However, it turned out that the class had little autonomy in the work developed, requiring constant validation by the adult in the different stages of work. They were used to working in pairs and in small groups. The class teacher collaborated with the School of Education (ESE), supervising pre-service teachers. This experience consists of two classes (lesson 1 and lesson 2).

Following a research methodology qualitative and interpretative, Bogdan and Biklen (1994), data was collected by the researcher (supervisor teacher from ESE) for the two classes observed using the registration logbook, video-recorded lectures, informal conversations with students during and after carrying out tasks and the students' productions.

From the initial phase, as presented in the methodology, data analysis was performed taking into account the different stages of the process developed in the context of the classroom: lesson 1: (i) data collection, (ii) data organization in tables and graphs; lesson 2 (iii) construction of a graph with data from the whole class and data analysis.

RESULTS.

The task, which ran for two lessons, began with the contextualization of the research question by the pre-service teacher, hereinafter called teacher. Students were organized in six groups of four elements. As already mentioned, this was the first time that these students worked with Collecting, Organizing and Data Analysis (CODA), although they already had contact with the reading of bar graphs and pictograms.

Before beginning data collection, the teacher handed each student a worksheet with data relating to the weight of the students in the previous school year, and contextualized the study issue that would be based on an experience of the previous school year, which involved determining the weight of each student within a project to combat childhood obesity.

Teacher: I know you weighed last year.

John: Yes, it was the end of the year.

Teacher: I wonder if you still remember about how much you weigh. (...) Tell me Sophie?

Sophie: 25
Teacher: You think it was around 25 kilos. Andrea, and you?
Andrea: 29
Teacher: 29? Do you think it was that much? (...)
Teacher: Okay, so it seems, and if we were to check if today you had been gaining weight or not?

Before beginning data collection the researcher, also in the classroom and watching the work of each group, began to question some students in a group, for a possible prediction of the results that would obtain.

Researcher: And do you think that will weigh more or less this year?
Students: More.
Maria: Less.
Researcher: Why? [Interrogating directly Maria]
Maria: Because I tried to slim down a little (...)
Researcher: You think you're equal again? [Speaking of Andrea and Bruno who had the previous year both 22kg]
Maria: Andrea weighed 22 and is now so fat .... Now she should weigh more.
Andrea: You'll see.

Then the teacher establishes a plan for collecting data and presents them to his students:
Teacher: Okay now let's see if we increased our weights or not, (...). If we increased much, if we increased slightly. (...) I will now distribute to each group a sheet. (...) We have here the names of the entire class, and the weights of last year [except Thomas who was not here last year]. (...) [The teacher is going to distribute digital scales by several groups].
Teacher: To weigh you have to remove their shoes.

The fact that the teacher has submitted the plan for data collection already outlined, particularly with regard to weighing themselves and removing their shoes raised some questions regarding the students' understanding parts of that plan.

Researcher: And why is she taking her shoes as she weighs?
Maria: So that the bathroom scale does not get dirty or break. (...) Because that is glass and can not stand with our weight. (...) Humm, and because tennis shoes weigh too much.
Maria: At home I weight with shoes. (...)
Researcher: You at home also weigh with shoes or without shoes? [Questioning the other elements of the group].
Daisy: I sometimes weigh me naked... sometimes without shoes.
Researcher: And why are you naked?
Daisy: I do not know (...) to see if the weight ... is even ... real.
Researcher: Why is it the real weight?
Daisy: Because we do not have clothes, we have nothing.

In this extract some students demonstrate an initial difficulty in understanding the reason to remove their shoes during data collection. Initially they begin to justify this requirement, on the part of the teacher, to external causes, such as Maria when she manifests a concern not to smudge or break the balance, which may also be related to their experience, given that she weighs at home always wearing shoes.

However, with the small group discussion they eventually reach interesting conclusions as to the need to obtain the "true weight", which is obtained when the student has neither shoes nor clothing. In addition, even a different conclusion, that the weight of the shoes is greater than the weight of the laundry.

Data Organization

After collecting the data, each group was asked to organize such data through a table, a drawing or a diagram. All opted to use a table. The difficulties presented in this organization were related primarily to the recording of current weight, since the previous weight was a fact that was already rounded to. However, for most students the need to do rounding was not obvious.

During the discussion with the group about how to start the construction of the graph, since it was the first time they did one, the teacher decided to give some very precise information on the

origin of the graph and the need for placement of the title. Also he drew attention to the fact that the number of squares on the record sheet is less than the maximum amount of data needed to represent the data and so the choice of a scale would be quite important. Although not giving any information regarding the type of graph you could build, he mentioned in his speech the word "bar" which reinforced the pick of the group. This information was then transmitted by the teacher to the other groups, verifying that all the other groups opted also for building the graph with bars, perhaps best known by the students in this class.

Data Analysis

The discussion of the data presented in the table was held by the researcher along with some groups. It was found that the analysis of table data appears to be facilitated by the fact that the data came from a real context.

DISCUSSION

Given the fact that the teacher gave no opportunity to the students to participate in the formulation of the initial question, then, in preparing the plan for data collection, there was a need to analyze the understanding regarding these first two steps of PPADC (Wild & Pfannkuch, 1999). It was found that being a real context and with which they identified themselves and sometimes resorted to their own experience ended up making these two steps easy to understand. On the question that was presented to them, they even managed to make some predictions (even individual), justifying them prior to data collection.

The fact that the data remit to a real context seems to facilitate task accomplishment and involvement of students but on the other hand, there are misinterpretations from their experience and that are not present in the data.

Finally it appears that the role of the teacher is too important in conducting this kind of tasks. Sometimes it is necessary to give some very clear directions and some other times to let the students make their choices freely. In this study the teacher proved to be quite directive in the early part and was gradually giving more freedom to the work done by students.

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