v. 2, n. 29, 2022

International Journal of Human Sciences Research

TOY STORY: A DATA HOMEWORK IN PORTUGUESE BASIC EDUCATION

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Abstract: This text presents the statistical activity proposed as homework to a 5th-year student (age 10) from a public school in Portugal. This research aimed to explain how to deal with the initial knowledge of data analysis, where the student could recognize sets of elements to be grouped according to the proposed tasks. It is a qualitative study because it tries to understand social research questions in Portuguese basic education. The choice of this question for analysis is explained because statistics is an area that requires contributions to the formalization of questions in basic education. As a result, the measures of central tendency (mode and mean), as well as frequencies (absolute, relative, and percentages), the understanding was facilitated because the student - dealing with a known scenario – allowed solving the question involvement.
Keywords: Statistics, learning, Portuguese basic education.

INTRODUCTION

Over time several discussions were done about how mathematics classes are carried out so that other methodologies or ways of thinking about the analysis of the possibilities for the occurrence of pedagogical acts can be proposed. Batanero (2009) states that the change in the teaching of statistics in schools will depend on the degree to which teachers can be convinced that statistics is one of the most exciting and valuable topics for their students and that they can acquire some of the elementary concepts.

Another issue that can be successfully argued about is the fact that, over the years, mathematics textbooks themselves have turned to classic memorization and repetition exercises. So, they do not encompass the results of investigations that suggest their integration in the context. In this way, we hope to contribute to mathematics teaching by improving students' success in mathematics and the development of their statistical literacy component, as advocated by Ben-Zvi and Garfield (2004).

This text presents the statistical activity proposed as homework to a 5th-year student (age 10) from a public school in Portugal. The entire development of the question had the sole aim of placing content, student, and data analysis in an environment where the objects used for the counts were of interest to this student. Ideas were built within the student's age group, and her games of interest and knowledge were used to ensure her interest.

An advantage of first carrying out the task and then carrying out the record that is exposed here is the reflection that can be done, sustaining the task and the theoretical component to a proven practical content.

To achieve the work's aim, use is made of the practical task, images that start from the student's reality, and images used routinely in mathematics books to treat such contents in the classroom bias. Thus, this text is methodologically a qualitative description, supported by Minayo (2013). Within that assumption, it can be affirmed that a cut of the social reality – for the 5th-year student - in her first steps of learning data analysis is essential for teachers in training to perceive how much the content needs to be handled by the student within routines, which are visible daily. The difficulty of understanding a statistical concept cannot reside beyond the very needs faced when faced with a new idea in terms of arguments that are unknown. If still, the question develops ideas about subjects unknown to these young students, what is achieved is to establish from an early age how difficult statistics are or even unattractive. Not attracting attention means that these young students can, for example, reach Higher Education with precarious established ideas. In this reduced knowledge,

there are often misunderstandings of senses and meanings. The data treated here have as a collection instrument the images resulting from the production carried out during the activity. The question develops ideas about subjects unknown to these young students, which is achieved to establish from an early age how difficult statistics are or even unattractive. Not attracting attention means that these young students can, for example, reach Higher Education with precarious established ideas. In this reduced knowledge, there are often misunderstandings of senses and meanings. The data treated here have as a collection instrument the images resulting from the production carried out during the activity. The question develops ideas about subjects unknown to these young students. What is achieved is to establish from an early age how difficult statistics are or even unattractive. Not attracting attention means that these young students can, for example, reach Higher Education with precarious established ideas. In this reduced knowledge, there are often misunderstandings of senses and meanings. The data treated here have as a collection instrument the images resulting from the production carried out during the activity. with precarious established ideas and often, in this reduced knowledge, there are still misunderstandings of senses and meanings. The data treated here have as a collection instrument the images resulting from the production carried out during the activity. with precarious established ideas and often, in this reduced knowledge, there are still misunderstandings of senses and meanings. The data treated here have as a collection instrument the images resulting from the production carried out during the activity.

The reasons presented explained the interest in dealing with this issue of Statistics, highlighting it from the others who worked during the 5th year of schooling in the school of this young student. Other ideas are discussed there that also deserve a better approach. However, the choice falls on this focus, as it is noticeable that textbooks that deal with the subject, at this stage of initiation to statistics, require this look for better learning for these students.

We move on to the next topic to expose the statistical situation proposed to the young student. Each moment is used to align the theoretical and practical references used for the pedagogical acts developed during the realization of this exhibition.

UNDERSTANDING CONCEPTS IN STATISTICS

For the situation presented, the young student was asked to carry out an activity in which she counted the furniture in her dollhouse. She was asked to separate them into sets with common elements in the living room, bedroom, and bathroom. So, the desire to build the idea with objects from her reality, her toys were gathered. Thus, to carry out the activity, the following steps were carried out:

1. All the furniture in the house was removed from the toy box (Figure 1).

2. The furniture was organized and counted, taking care to separate it according to the dollhouse places. (Figure 2).

Once this step is finished, the student could fill the data table with the data in the images of the house's dependencies. At this moment, the young student made a table of absolute and relative frequencies and percentages and completed, with the data available to her, the entirety of the nature of each element contained in the dollhouse's dependencies (Figure 3). It only needed special attention to distinguish between what would be an absolute frequency, a relative frequency, or a percentage. The attention to understanding the issue was contained only in this content. She used her reality in front of the house

Figure 1: Dollhouse furniture

Source: Authors.

Figure 2: Furniture separated by house dependencies (bedroom, bathroom, kitchen, and living room)

Source: Authors

Furniture	Score	Absolute frequency	Relative frequency	Percentage (%)
Bedroom	𝍸 |||	8	$\frac{8}{34} = 0.235$	$\frac{8}{34} \times 100 = 23{,}5\%$
Bathroom	𝍸	5	$\frac{5}{34} = 0.147$	$\frac{5}{34} \times 100 = 14{,}7\%$
Kitchen	𝍸 |||	8	$\frac{8}{34} = 0.235$	$\frac{8}{34} \times 100 = 23{,}5\%$
Living room	𝍸 𝍸 |||	13	$\frac{13}{34} = 0.383$	$\frac{13}{34} \times 100 = 38{,}3\%$
Totals	34	34	1,000	100%

Figure 3: Table of counting and recording of frequencies found

Source: Authors

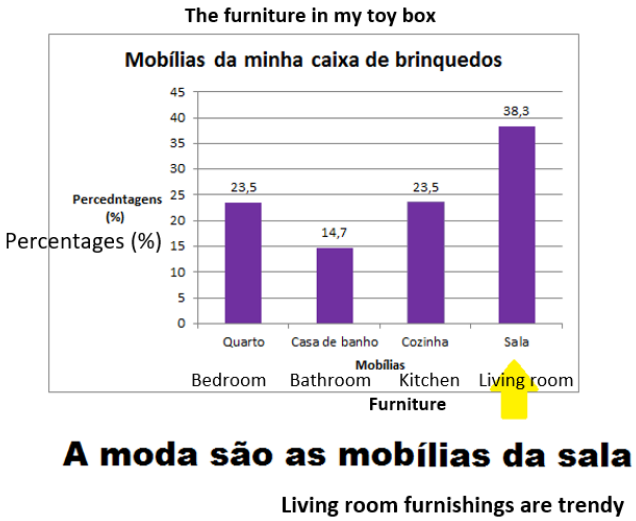

Figure 4: Graphical representation and respective mode

Source: The authors

furniture and learned what an absolute or relative frequency is. In her imagination, an approximation between reality and the content she treated was built in the simple act of gathering her toys. There was no other effort to interpret the question to occupy the space for learning the topic of frequencies (absolute, relative, and percentages) addressed there.

So far, the student, from the 5th year, has made her counts and noted the frequencies without difficulties in establishing the relationships that deal with absolute and relative values and percentages, as she was aware of the objects being manipulated there (Table 1). Her attention was restricted to noting the relationships between one total of objects and another.

Continuing to elaborate on the initial concepts, he was asked to represent the mode relative to the objects (Figure 4).

To reinforce the frequency ideas, the young student was asked to perform a new count of the number of animals present on the street where she lives (Figure 4).

The student was asked to calculate the measures of central tendency already discussed, which resulted in the following procedures to compute the average:

- Dogs in these six houses is $\frac{4+1+0+0+2+0}{6} = \frac{7}{6}$ =1.17 dogs.

- Cats in these six houses is: $\frac{7+0+0+0+3+0}{6} = \frac{10}{6}$ =1.67 cats.

- Animals in these six houses is: $\frac{11+1+0+0+5+0}{6} = \frac{17}{6}$ =2.83 animals.

Conclusions in the words of the young student: "In house number 2 is the house that has most animals, so the number of animals in this house (11) is the mode, both for dogs (4) and for cats (7). The average number of dogs in these six houses is 1.17 dogs. The average number of cats in these six houses is 1.67 cats. The average number of animals in these six houses is 2.83 animals".

Still, the young student made another table with the absolute frequency (count) of the number of houses with dogs and cats (Figure 5) and then represented them in a graph.

The data expressed in Table 2 were also presented in a graph (Figure 6). In the words of the young student: "The mode for the number of animals in my street is that there are no animals, there are three houses that do not have dogs and 4 that do not have cats, as can be seen in the graph below".

ANALYSIS OF THE ACTIVITY CARRIED OUT FROM THE POINT OF VIEW OF THE PEDAGOGICAL ACT

It should be made clear that all the graphs and tables presented here were done by the student as her homework on her laptop. She should study and socialize with her colleagues the contents that refer to the concepts of frequencies (absolute, relative, percentage) and central tendency (average and mode). How the activity would be carried out was at the student's option. However, working directly with her objects - the furniture of the dollhouse - would not present her difficulties in understanding in terms of format and utility, for example. Her aunt, a statistics teacher, suggested this option. In this way, all the student's attention would be focused on arranging the furniture, thus considering the idea of grouping according to the criterion "house dependencies." And this task would not raise any difficulty. Therefore, after counting each amount of furniture per room, there would also be no fear during the task performance.

The idea of treating the study of frequency starting from what is known established a safe ground so that the young student had to

House number	2	4	6	8	10	12	Totals	Average
Dogs	4	1	0	0	2	4	7	$^{7}/_{6} = 1{,}17$
Cats	7	0	0	0	3	7	10	$^{10}/_{6} = 1{,}67$
Totals	11	1	0	0	5	3	17	$^{17}/_{6} = 2{,}83$

Figure 4: Table of the frequency of the number of animals per household and average

Source: The authors

Number of animals	Number of houses with dogs	Number of houses with cats
0	3	4
1	1	0
2	1	0
3	0	1
4	1	0
5	0	0
6	0	0
7	0	1
Totals	6	6

Figure 5: Table with the animal counting.

Source: The authors

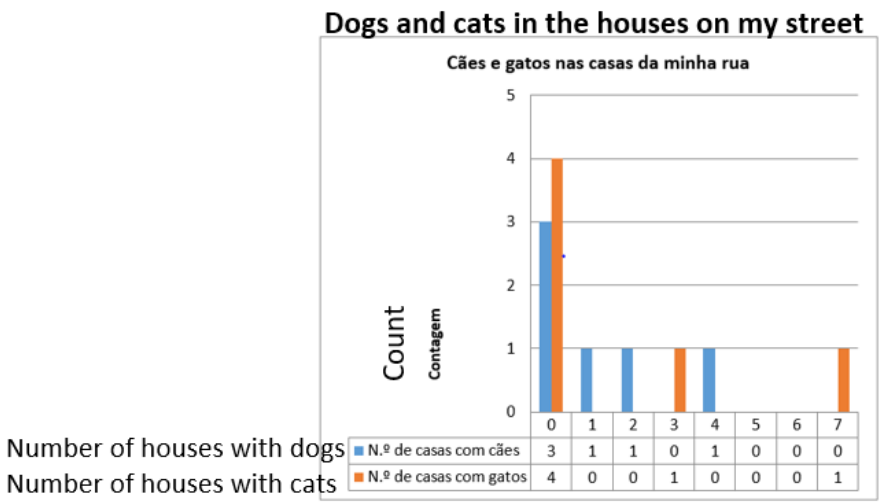

Figure 6: Mode representation

Source: The authors

use her effort to understand what the idea of frequency was, what it was to be absolute, and what it was to be relative.

Only, in what was exposed above, three questions specific to Statistics are already present. There was no need to explain the room dependency at any time. All this allusion is made to clarify that a matter of statistics can be approached using elements of the knowledge environment of those who learn it.

Abandoning the essential references that place the learner in a new situation of knowledge, which is strange to this student, is at least doubling the degree of difficulty so that certain content can be understood. This activity suggestion questions the approach used in the exercises suggested in textbooks, particularly in mathematics and statistics concepts of this schooling level. Therefore, other ways of teaching statistics are proposed, even in Basic Education.

In Portugal, as in other countries, this analysis is as real as it is necessary because all that a problem or situation needs to be helpful in the classroom is that it be understood. If some content, such as its abstraction, escapes this range of opportunities to be tangible, there are many opportunities to intersect reality and learning issues in Portuguese Basic Education. Or, then, we will be keeping our students in teaching that advocates not knowing how to interpret what turns out to be as simple as the example presented, within the daily richness of life, of each group, of each school.

Borba and Penteado (2001) explained a property that remains current: their ideas about the comfort zone and the possibilities and difficulties of leaving this zone. This idea was not discussed from the student's point of view but from the teacher's point of view when facing specific needs within their pedagogical practice. So, we enhance students' learning opportunities if we offer them creative activities framed in their context and considering the content to be developed.

It was not by chance that the statistics teacher suggested the spreadsheet to build the graphs to the student, and the student used the word processor to make the tables. Nevertheless, and before any mention of the idea of technologies, Kenski (2008) refers to the aspect that the use of technologies can cause changes in the way of thinking and doing education.

In this author's bias, let us think about technologies as a set of scientific knowledge and principles that apply to the planning, construction, and use of equipment in a particular type of activity (Kenski, 2008). From the idea that Kenski (2008) uses about technologies, we refer to the moment when she thinks not about the equipment but the mode of action to make good use of it. This mode of action, the technique itself, was the path adopted to deal with the concept of frequencies and measures of central tendency (mean and mode). The method consisted of driving the idea of using furniture known by the young student.

Here the technique is in the way the activity planning is operated. Also, according to Kenski (2008), we think about the use of technologies, differentiating them from one another only by the form of language they use. Transposing this idea - without wanting to make sense of furniture - we started to treat it as a resource for building ideas for the proposed content. In this activity, we realized that the difference between expositive teaching is also present in the language. The student's activity expressed the scope of statistics where concepts were mentioned with reality and allowed its accomplishment by the student as described. The language used to achieve the aim of counting the objects contained therein, always going from the known (the count) to a new element (grouping it according to the established criterion).

Understanding that obtaining the frequency (relative in fraction or percentage) passes through these referrals was the issue that required the most significant effort. The ease of carrying out the activity was linked to handling the elements in the dollhouse dependencies. It did not add difficulty but rather a recognition of what should be in the context - the dollhouse. There was an act of thought. Senses and meanings were mobilized within the logic of the young student.

And in this regard, Portuguese textbooks concerning the statistics content do not reach the levels studied for a long time that challenge the curiosity and connection to the daily lives of young students.

If we move between sense and meaning in a dialogue that points to a statistical activity, we can also deal with the semiotic aspects of this activity.

REGISTERS OF SEMIOTIC REPRESENTATION IN A STATISTICAL LEARNING ACTIVITY

Representing in one way and then trying to transpose to another is routine in mathematics. In Statistics, when a student is asked to work on table data and then make a graph, it is intended to observe if the student understands the variations of the elements of the sets with which he is to deal. Therefore, not every activity that seems to move meanings and senses can be understood preliminarily as a task under the semiotic focus.

Therefore, representing and recording must be well situated in the pedagogical act. However, the trivialization of representing can raise doubts about the object of study. As Moretti (2012) questions: how can subjects acquire mastery of mathematical treatments necessarily linked to semiotic representations if they do not have a conceptual apprehension of the represented objects?

On the representation issue, Moretti (2012) also mentions the object must not be confused with its representations and that it - object - is recognized in each of its possible representations. In these two conditions, a representation truly works as a representation. That is, it gives access to the represented object.

For Duval (2009; 2012), a record of representation of a semiotic activity must fulfill three cognitive aspects: an identifiable representation, treatment, and conversion. In the activity, the student performed an identifiable representation, as she identified and recorded - a table - the furniture contained in one of the dollhouse dependencies (first investigation). Also, count the number of dogs and cats in every house on your street (second investigation). To carry out this activity, the student went through an object description. In the second stage, when carrying out the data analysis, she carried out an internal transformation, since what was an image became frame data, to be filled in according to the premises of the house indicated there. Nonetheless, according to Vieira (2008), the resolution of statistical problems involves the transformation from one record to another and the simultaneous use of these different records to obtain the most significant possible number of information.

Coutinho et al. (2012) show references related to thinking, literacy, and statistical reasoning. However, in this activity, we only want to highlight that the context of the situation to be taught can contribute to learning concepts in Portuguese Basic Education.

CONCLUDING REMARKS

We hope to have fulfilled the initial purpose, which was to expose the contents in the context of recognizing the student and their difficulties. The ideas presented involved the study of frequency (absolute, relative, and

percentage) and measures of central tendency (mode and average) studied in the 5th year of Portuguese Basic Education. Regarding the semiotic approach, the question fulfilled some of the elements of this approach, as explained in the text. However, the work contribution lies in a student-recognized context activity, which also helped as a space for learning. The same could happen using a game or other toys, or toy stories known by students.

Anchoring the initial knowledge of statistics in a scenario in which the student can interact without having to put them facing figures or ideas that he is unaware of was the focus of these arguments that we now conclude.

REFERENCES

Batanero, C. (2009). Retos para la formación estadística de los profesores. *Actas do II Encontro de probabilidades e estatística na escola*,7-21.

Ben-Zvi, D. & Garfield, J. B. (2004). The challenge of developing statistical literacy, reasoning and thinking. Dordrecht, Kluwer Academic Publishers.

Borba, M. & Hairstyle, M. (2016). *Computing and Mathematics Education*. (5th ed). Authentic.

Duval, R. (1993). Registres de représentation sémiotique et fonctionnement cognitif de la pensée. *Annales de Didactique et de Sciences Cognitives*, 37- 64. IREM - ULP.

Kenski, V. M (2007). Educação e tecnologias: O novo ritmo da informação. *Educação e Tecnologias: o novo ritmo da informação*. Papirus.

Lopes, C. E. & Carvalho, C. (2000). Literacia Estatística na Educação Básica. In Nacarato, A. & Lopes, C. *Escritas e Leituras na Educação Matemática*. Autêntica, 77-92.

Minayo, M. C. de S. (2013). *O desafio da Pesquisa Social.* Pesquisa social. (33. ed.). Voices.

Moretti, M. T. (Trans.). (2012). RRegistros de representação semiótica e funcionamento cognitivo do pensamento.. *Revemat: R. Eletr. de Edu. Matem*, *7*(2), 266-297.

Vieira, M. (2008). Análise Exploratória de dados: Uma abordagem com alunos do Ensino Médio, Master's Dissertation, PUC-SP.

Coutinho, C., Almouloud, S. A. & Silva, M. J.. (2012). O desenvolvimento do letramento estatístico a partir do uso do Geogebra: um estudo com professores de matemática. *Revemat: R. Eletr. de Edu. Matem*, *7*(2), 246-265.