ACTIVITIES AND TYPES OF STATISTICAL GRAPHS IN TEXTBOOKS OF PRIMARY EDUCATION IN PERÚ

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In this investigation, we present the partial results of a study about the representation of statistical graphs in three series of mathematics textbooks (18 books) of Primary Education in Perú. Following a methodology of qualitative type and through an analysis of content, we identified the types of statistical graphs represented and the activities that the students should do from them. The results shown that the bar graphs is the most frequent in all primary grades, followed by line graphs and pictograms; calculating, constructing and exemplifying are the most frequently activities. Also, all the statistical graphs mentioned by curricula guidelines are represented, although some of them are presented before the grades declared.

INTRODUCTION

The ordinary citizen, in a society in constant change, is constantly making decisions, so that he/she needs to have first-hand, appropriate and truthful information. But, frequently, this information comes from different fields; some of these ones are alien and not familiar to citizens. It requires that this information must be transformed into clear and precise terms; so through tables, graphs, indicators or statistical summaries this information acquires sense. Watson (2006) and Ridgway, Nicholson and Mc Custer (2008) declare that, the construction and reading of statistical graphs are the essential part of *statistical literacy*; that consist of critically interpreting and evaluating statistics information from various sources and, to communicate an opinion about them (Gal, 2002).

So, it is in Primary Education where the future citizen is facilitated with the tools for their incorporation into society. Through daily situations, the child can value the graph language as a way of representation and communication of events in his family and school life, judging critically the information obtained:

> educating people capable of achieving their [...] appropriate and critical integration to society in order to exercise their citizenship in harmony with the environment, as well as the development of their abilities and intelligence to connect their lives with the world of work and to face the incessant changes in society and in knowledge (MINEDU, 2009, p.10).

Therefore, the objective of this study is *to analyze the statistical graphs and the activities proposed in the textbooks of Primary Education in Perú*. With the results of this study, we hope to contribute to develop the ability to read and to interpret, critically, the information obtained from a statistical graph and to use this representation as an instrument in the daily work or professional work. The role of the textbooks becomes important, coinciding with the study of Díaz-Levicoy (2014), due to its great influence in the process of teaching and learning mathematics (and Statistics). Robitaille and Travers (1992) cite textbooks as a "significant factor in determining students 'opportunity to learn and their achievement (p. 706), facilitating the transfer of educative contents in function of the current curricula guidelines, and constituting a mean to learning (Tran 2016).

METHODOLOGY

A qualitative methodology and of the descriptive level was used, based on the content analysis (Cohen, Manion and Morrison, 2011) of a sample of intentional type of three complete series of textbooks (18 books) from 1st to 6th grade of Primary Education, from great educational tradition publishing houses in Perú *(Santillana* and *Bruño)* and those published for *MINEDU*.

RESULTS

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As shown in Table 1, the activities proposed by the textbooks where the most frequent is *calculating* (61%) with a greater presence in the 2nd school year, which implies the use of certain mathematical operations (add, subtract, compare, etc.). The second activity is *constructing* (22.7%) that proposes the elaboration of a graph from the information collected or provided, or summarized in a frequency table; by this activity, awareness, recognition and appreciation of the environment, and diversity are promoted (for example: what makes them proud to be Peruvian, number of vaccines applied in a region, etc.). In third place, the activity of *exemplifying* (18%) that sets the guidelines for elaborating a graph, interpreting the data, calculating through the information of a graph or analysis of proposed graphs. The fourth activity, *explaining* (10.3%) that develops the argumentation, inquiry and communication, thus as understanding the use of statistical graphs in the daily life. In fifth place, *looking for information* (9.7%) that allows the students to collect data from their environment and recognize and interact with their reality through statistical graphs, thus integrating statistics with their environment. In sixth place, the activity of *reading* (9.3%) that comprises the literal reading of the graph information, to indicate which conclusion is correct, which information is true or false, or to give a value or quantity from the graph by simple mathematical operations. The seventh activity, *translating* (8.7%) that implies the transfer from a graph representation to another one or to a one or double way frequency table, which reinforces the graph comprehension in the students being the transnumeration worked in both directions. Finally, the activity of *completing* (5.3%) that requires to complete the construction of a given graph with the information provided, in most cases, from a frequency table that promotes the rigorousness of the data analysis, as the students observe the characteristics of the data distributions that are represented in a table.

Table 1. Type of activity by educational level

Types of Activity	1° (n=18)	2° (n=19)	3° (n=64)	4° (n=78)	5° (n=62)	6° (n=59)	Total (n=300)
Calculating	33.3	78.9	62.5	73.1	54.8	52.5	61
Constructing	27.8	10.5	12.5	19.2	32.3	30.5	22.7
Exemplifying	27.8	21.1	7.8	16.7	27.4	16.9	18
Explaining			10.9	12.8	3.2	20.3	10.3
Reading	5.6	5.3	9.4	10.3	6.5	13.6	9.3
Looking for information	16.7	10.5	6.3	10.3	9.7	10.2	9.7
Translating		10.5	17.2	12.8	4.8		8.7
Completing	16.7	21.1	7.8	3.8	1.6		5.3

As shown in Table 2, the types of graphs worked through textbooks. Firstly, there is the bar graph (43.7%) that is worked throughout Primary Education from a simple bar graph to a grouped data graph (double and triple bars) even if the National curriculum declares it from 2nd to 5th year. This gradual development is observed in only two of the texts studied (*Bruño* and *Santillana*), however, in the books edited for MINEDU, in the upper grades (4th and 5th) it work the simple bar graph with deterministic information which allows the students to realize that the change in the information (situation) is given by the effect of the environment variables. Secondly, the line graphs (23.3%), which is worked from the 3rd year even if the MINEDU declares it for from 4th year. In the higher grades the work is combined with simple line graphs and double to triple lines, in the 6th year textbook (Bruño), it is highlight the use of the line graphs to show the change, variation or tendency of a situation through time. Thirdly, the pictogram (14%) works according to MINEDU in the 3rd and 4th year, even one of the publishers (Santillana) skipped it to the 2nd year; by the use of icons it promotes the counting and the significance of the multiplication from consecutive sums in order to calculate the frequency of the variable. Fourthly, the sector graph (13.3%), MINEDU declares it from 5th year, but one of the publishers (Bruño) skips it to the 2nd year, but then stops working in the 4th grade. This graph serves to show information by the use of fractions, percentages, rule of three calculator and proportion. There are few activities with two or more graphs (3.7%) that highlight the advantages of a graph type and the choice of the best graph according to the nature of the variable, which promote critical thinking. Finally, as for the

Histogram (2%), only one publisher (*Bruño*) skips its work to the 5th year of Primary Education, even if it is declared for the 3rd year of Secondary Education (MINEDU, 2009) and for the 1st year of Secondary Education (MINEDU, 2017). The activities proposed for this type of graph are limited to its reading and interpretation, but not to its construction; but it allows the students to appreciate the grouped data distribution, not previously worked in previous grades.

Table 2. Percentage of graph types analyzed according to school year

Type of Graphs	1° (n=18)	2° (n=19)	3° (n=64)	4° (n=78)	5° (n=62)	6° (n=59)	Total (n=300)
Bars	100	52.6	35.9	46.2	27.4	45.8	43.7
Sectors		15.8	7.8		32.3	20.3	13.3
Histograms					9.7		2
Lines			20.3	26.9	30.6	28.8	23.3
Pictogram		31.6	32.8	19.2			14
Two or more graphs			3.1	7.7		5.1	3.7

DISCUSSION

Regarding the proposed activities, the predominant activity is *calculating*, but publishers should not restrict the approach to graphics only for the application of mathematical algorithms learned throughout Primary Education, but for developing citizen competences because it connects the school with the environment (society); "the graphs are predominant tools to detect important and unusual characteristics from the data" (Spence and Lewandowsky, 1990, p.20), that it would allow to approach and engage the child with the environment. The activities of *looking for information, explaining and translating* should be reinforced, in order to the student be able to connect with their environment, to be sensitive to changes, to interrupt their routine, and to realize that there are other factors that do not depend on their control and for their best action, they need first-hand information that they find in a statistical graph, to interpret and to model out of the classroom (NCTM, 2000). More activities of data collection are required for the construction of graphs and to collect data from the environment; the activities from the textbooks are so preprocessed (Lehrer and Romberg, 1996), leaving to one side the building of graphs that would promote in the student the statistical thinking, reasoning and literacy. As well as the activity of *translating*, which allows the transfer from a type of graph to another one or to a frequency table, and despite the transition from a representation to another one, the information does not lose its essence before the eyes of the student.

Regarding the type of graphs, the three publishers consider all the graphs of the National curriculum, even if all the publishers show the graphs earlier in the grade contradicting thus the guidelines, such is the case of the bar (2°), lines (4°), sectors (5°) and pictogram (3°) graphs, which goes against the principle of the integrality of learning, one of the foundation of the National curriculum elaboration, by not acknowledging the cognitive development of the child.

It would be prudent that the National curriculum establishes evaluation guidelines with the statistical graphs, because publishers take charge of setting the pattern in the activities with the statistical graphs. While that is true, there are activities to promote the integration of statistics with the environment, critical thinking, communicate ideas, transnumeration, and collaborative work. But it is also important that teachers have the competences to develop and cultivate in students the reflection, metacognition, self-knowledge and the attitude of learning throughout life by the valuation of statistical graphs (MINEDU, 2009). For, it is the statistical graph which provides first-hand information for making decision for their pertinent and appropriate citizen participation (Arteaga, 2011).

The correct construction of the graphs included in the textbooks is highlighted. The errors in its construction are minimum, although the ideal would be that they do not present errors, which are transmitted to the students when the teacher lacks the necessary expertise.

It is recommended to work with a greater variety of graphs, those that are found in the media in the Peruvian context such as the thematic map and the dispersion graphs, even if it is superficially in Primary Education. As well as it is suggested to improve the way of working by the

three publishers under study, as for example, the statistical graphs are in the last units of the textbooks of MINEDU, which implies that the appropriate time is not taken for their teaching (Huayanca, 2008). The proposed activities should be given in the same proportion but at different doses throughout Primary Education in the three publishing houses (see Table 1).

Finally, the statistical graph represents a means by which the students, as a user and direct producer, can clearly express their feelings, ideas and experiences, to reaffirm their interests and aspirations; as an indirect user, the one who actively and critically listens to statistics can channel their actions.

It is important to continue with this type of studies in mathematics textbooks of other publishers, in other educational levels and in other countries, considering these and other units of analysis, because it allows to obtain information that will be input for the design of a Statistical Instruction Process in Primary School Education at the country level.

It is highlighted, that research in the alignment of textbooks with the curricula guidelines are scarce (Tran, 2016) and the current research look for contribute to the literature.

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