THE MATH TEXTBOOK, A SUPPORT FOR THE ISLP?

Audy Salcedo
Central University of Venezuela, Venezuela
Audy.salcedo@ucv.ve

The aim of this study is to analyze the statistical activities in a series of mathematics books to evaluate their possible support to the ISLP. The researcher applies the international competition's judging criteria of poster, in the selected series of books, to analyze the 49 statistical activities proposed for all 5 years of Venezuelan secondary education (12 to 17 years old kids and teenagers). The results indicate that the book's activities follow some of the requirements from the poster competition. It seems advisable for the country committee to develop supplementary material for students to help meet competition requirements that are not in the textbook.

INTRODUCTION

One of the goals of the International Statistical Literacy Project (ISLP) is to support and develop statistical literacy activities all over the world. The poster competition, one of the activities organized by the ISLP, aims to collaborate in the development of the statistical literacy of the students. The posters should reflect or illustrate the use, analysis, interpretation, and communication of statistics or statistical information and their discoveries. Students who participate must develop a research project and it is important to take into account the valuation rules of the competition. According to ISLP (2016), those criteria are:

1.   Clarity of the message.
2.   Collection of data
3.   Analysis and conclusions
4.   Graphs and Tables
5.   Presentation
6.   Creativity/importance

The objective of this work is to establish whether the math textbooks could be a support for students who wish to participate in the poster competition. Some of the assessment criteria are less relevant to the textbooks than others. For example, criteria 5 and 6 are basically about characteristics of the posters, that is the reason why this study focuses on the first four criteria.

BACKGROUND

Textbooks are the representation of the curriculum in the classroom: It is the learned knowledge transformed into knowledge to be taught, which in many cases is the one that determines the curriculum to be taught, the real curriculum. They are the means by which it is possible to reach educational standards and recommendations to the classroom; they are an instrument of a great influence on education as well. Textbooks are the learning resource of greater presence in Latin American schools. More than 86% of the classrooms of 3rd and 6th grade of primary education in Latin America have textbooks of mathematics (LLECE, 2013).

Generally, the teacher is a mediator between the student and the textbook. They often rely on it to make their presentations in class, doing a symbiosis between their experience and the intentions of the author. Several studies (e.g., Fan, Zhu & Miao, 2013; Lepik, 2015) indicate that teachers use the textbooks of mathematics to plan and prepare their classes but also as a source to select student activities (Rezat, 2012).

The teaching of mathematics in the classroom focuses mainly on the tasks, and their implementation usually involves teacher-student interaction in order to facilitate learning (Hsu, 2013). One of these tasks are activities, which offer a space for the student to work on the contents studied or to study, is the activity used as a motivational element or as a form of introduction to new content.

The activities can be problems, exercises, questions that encourage research, etc. They are statements that are use to make the student work on the contents studied or to be studied. To Henningsen and Stein (1997) the activities proposed to students in mathematics classes have a significant impact on the type of knowledge that can be achieved and in the understanding of the

mathematical ideas that could be accomplished. Grevholm, Millman and Clarke (2009) assert that what students learn, to a large extent, is determined by the activities proposed to them. They consider that the ones that intend to develop higher-order thinking are more likely to produce that kind of thinking than those actions aimed at providing practical skills. Stein and Smith (1998) say that the activities of the students in the learning of mathematics not only determine what they learn, but also how they learn, and influences how they get to think, develop, use and give meaning to mathematics.

For all the above reasons, the activities of the math textbooks can be an indicator of where the teaching of statistics focuses on and, therefore, if they can be a support for the poster competition; consequently, the development of the statistical literacy.

METHOD

The operationalization of the ISLP criteria for the assessment of poster to categorize activities in the math textbooks is presented below. Then, it is shown how the series of books, to which the criteria noted above were applied to, were selected; and finally, the process followed for the classification of activities.

Development of judging criteria

The first criterion for the evaluation of the poster is the *clarity of the message*. In this approach there are two components. First, the communicative aspect: the information in the poster should be comprehensible; and the second one is statistical: the objectives or the research questions of the problem described in the poster should be well defined. Therefore, the books should have activities to encourage the student to raise problems likely to be solved using statistics. This would help to ensure that students develop the competence to raise questions and objectives in the context of a statistical research. These types of activities are classified as *To Ask Questions*. But it is also necessary that the textbooks count with activities that demand from the student to communicate the results found in their statistics work: activities, in which the student must discuss their results with their classmates, present them in class or develop some written material about the results. These activities are classified as of *Communication*.

Data collection is the second criterion. It refers to the relevance of the to be collected or already collected data that answers the question or problem. This is also related to the methods of data collection and their quality. This is why, for the implementation of this second criterion, it is considered appropriate that the activities instigate the use of different research designs, as well as problems that require the collection of data in order to find a solution. These types of activities were identified as D*ata Collection*.

The third criterion is A*nalysis and Conclusions*, it refers to the analysis of the data in correspondence with the question or problem arisen, and if the analysis is appropriate to the type of data collected. It is appropriate, then, that the textbooks activities require the student to interpret the results found after the raise of the problem, making use of the context of the situation. The activities from the *Interpretation of Results* correspond with this criterion.

The proper use of Graphs *and Charts* and statistical measures are the central point of the fourth criterion. This means that the graphs, charts and statistical measures selected for the poster should be appropriate to present and summarize the collected data. As a result, the activities in the textbook should promote the use and understanding of graphs, tables and statistical measures. Also, should promote their selection according with the variables to be solved in the problem. *Presentation of results* is the category in which the activities that correspond with this criterion were located.

There may be activities that will involve all processes described above, that would be the most appropriate, since that would give the students the opportunity to understand the various stages of the resolution of statistical problems in the same situation. The activities that satisfy this feature were located in the category *Research Activity*. The activities must be of different cognitive demand and presented gradually, to help the student achieve their literacy statistics.
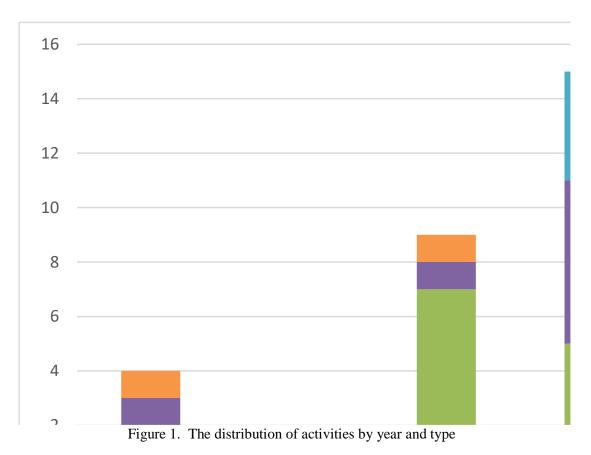
Selection of textbooks

To implement the criteria described above it was used the five textbooks for mathematics in secondary education in Venezuela that belongs to the Colección Bicentenario. The investigator selected mid-level education since it is the one that ISLP is thought-out for. The books of the Colección Bicentenario were selected since they are developed by the Venezuelan Ministry of Education, therefore, must be the ones that better reflect the goals of statistical training aimed to be achieved by the Venezuelan citizens. In addition, according to the government of Venezuela, these books are used by the majority of Venezuelan students.

Classification of the activities of the text books

Three professors of statistics at university level, with experience in training teachers from primary and secondary education, were invited to classify the statistical activities of the selected books. Each teacher used the evaluation criteria described above and a copy of the textbook. Each one of them made their classification of activities individually, and then the three classifications were compared. We identified the agreements and disagreements of the three classifications. A meeting was held with the three professors to discuss the classification of the activities in where there were disagreements, and the final classification was agreed.

RESULTS AND DISCUSSION

The following chart shows the distribution of the statistical activities of the mathematical textbooks in the collection Colección Bicentenario de Venezuela.

Figure 1. The distribution of activities by year and type

The series of textbooks that were analyzed, which covers the five years of secondary education (for 12 to 17 year-old students approximately), contained 49 statements included in the spaces supposed to be dedicated exclusively for activities. Nine of these statements were eliminated because they were not activities for the student. The results of the classification of the 40 remaining statements are shown in Figure 1.

The first thing that stands out is the disparity in the number of activities for each year. While in the first two years there are six activities, in the third year there are 9 statistical activities.

However, as a whole, there is a tendency to increase the number of activities as it goes further through high school.

The presence of activities from category *Presentation of results* stands out as well for it is the only one that is present in all the books that were considered in this research. In this category it is expected be found activities of selection and use of charts, graphs and statistical measures, but almost all of the ones that were found in the textbooks focused on the calculation of statistical measures. The charts activities are basically about reading and construction, while the ones devoted to graphics are only included in the topic of correlation. Statistical measures activities are of low-cognitive demand; the textbook often suggests which measure to calculate: "What is the most repeated age among the students?" (Third Year, p. 212) or "Will we be right if we say that half of the students, in this case, are 14 years old or less?" (Third Year, p. 213). The activities included in this category would contribute little in the student's statistical training and in their possible participation in the poster competition.

The activities of *Interpretation of results* were found in four out of five of the textbooks for Venezuelan high school. There are a total of 12 activities, a little less than the category *Presentation of Results* (19), and the majority of them consist on the reading of the data, for example: "What are the federal entities for the year 2001 had the largest number of people between the ages of 19 and 23 years old?" (Fourth Year, p. 23). To solve these activities, the student will only have to read the table where the data is located. Besides, the activities of this category do not belong to a process of research, they come after the application of a statistical measure, therefore provide a partial view of the interpretation of statistical results. They are activities that are of little help to the Statistical Literacy of the student, since they only reach the most basic levels of the production of information from the statistical results. The emphasis in the analysis and interpretation of data is also reported by Newton, Horvath and Dieteker (2011) and Jones and Jacobbe (2014).

Two interesting aspects are the presence of *communication tasks* and *Research Activities*. The first appears in the textbooks of the last two years, for example, "In your notebooks, write the agreements made by the team, after discussing these questions…" (Fourth Year, p. 22) or "Make a presentation about the results that you got in class and discuss the implications that they might have on school performance…" (Fifth Year, p. 17). These types of activities allow the student to expose the results and explain them, which is one of the goals of the Statistical Literacy. These are activities that can help students to value the importance of communicating the results found.

The R*esearch Activities* are those where the student has the opportunity to apply several of the procedures that the solution of problems by means of the statistics involves. There were found four activities of this type. In three of them, the student is oriented about what to do, while in the one remaining, it leaves the student to propose the problem. For example, "Make a list of the activities carried out on a daily basis by the members of your house: mom, dad, siblings, grandparents, among others, indicating the time in minutes used in each one of them. Organize them and show them in a frequency table, and calculate the mode, median and average. What can you say about the value obtained from the arithmetic mode, median and average?" (First Year, p. 217). In this activity, the student is required to collect data, organize, present, calculate measures and finally offer an interpretation of the meaning of the calculated measures. All the student need to do is asked in detail. The R*esearch Activities of* fourth and fifth year are similar to the example.

In the following year, there is an activity that indicates: "Propose other subjects of interest to the statistical inquiry in which you could strengthen the learning acquired in this lesson." (First Year, p. 211). Here, the student should trace a problem likely to be solved with statistics, and solve it. The question that arises is that whether the student has been offered enough learning to do this activity. This seems a more appropriate activity for the last years of high school.

The inclusion of *Research Activities* is a positive aspect of the textbooks analyzed since it can help students develop skills to participate in a competition like the poster of ISLP. However, since virtually all of them are activities with the same level of cognitive demand, that make a direct indication of what it needs to be done, there is little that helps in the formation of the student. It seems necessary a higher number of activities of this type, where the student confronts, in a progressive way, new challenges in solving problems with statistics.

There were not found activities specifically aimed at the *Formulation of Questions* or *Data Collection*. This absence would not be a major problem if you continually find broader activities that included these two processes. Except for the above mentioned *Research Activities*, no other activity gives the student the chance to ask a research question or to collect data. Yanık, Özdemir and Eryılmaz Çevirgen (2017) also found few activities to formulate research questions and data collection. The absence of this type of activities is a weakness of the analyzed textbooks with a view to the statistical training of students.

The results shown here indicate that the textbooks of the Colección Bicentenario from Venezuelan high schools include some of the activities required for the development of ISLP poster competition, but also that those activities seem to be weak for the development of the statistical literacy of students and, therefore, for their possible participation in this competition.

CONCLUSION

If you want to participate in the poster competition organized by the ISLP it is convenient that the teachers review the math textbooks that they use and they value them depending on the help they can be to students in that competition. The evaluation criteria of the poster can be guidance for evaluating the textbooks. Here we have developed the four most relevant evaluation criteria for the textbooks; this may be of help to teachers at the time of evaluating textbooks in statistical subjects.

The evaluation of the statistical activities of the mathematics textbooks from the Colección Bicentenario of Venezuela indicates that they are a weak tool for the preparation of students for the ISLP poster competition. The books primary emphasis is on procedures for the calculation of statistical measures, and a little emphasis on the information extraction processes from the measures, the charts and graphs. In addition, most of the activities provide a partial view of the implementation of the statistics. The *Research Activities*, which can help to achieve a global vision of the resolution of statistical problems, are few and low-cognitive demand.

It seems advisable that the committee of the country develops supplementary material for students to help them meet the demands of competition that are not in the textbook. Also, it may be necessary to hold activities with the teachers to teach them how to handle the materials for students.

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