STATISTICS EDUCATION IN VENEZUELA: THE CASE OF ELEMENTARY AND MIDDLE SCHOOL

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The aim of this paper has been to present an short overview of Statistics education in Venezuela, especially at the Elementary and Middle School levels. To this aim, a comparison of Mathematics curriculum at the elementary level (comprising nine grades of compulsory schooling) and Middle School level (comprising either two or three years of secondary education, also compulsory). Programs of study include probability and statistical content for 7 to 17 year-old students. Some of the problems in the teaching of probability and statistics are analyzed and finally, some suggestions for the improvement of statistics education in Venezuela are made.

INTRODUCTION

Venezuelan Elementary (EE, Educación Básica in Spanish) and Middle Education (ME, Educación Media y Diversificada in Spanish) are free of payment and compulsory public services. The former (EE) covers from Grade 1 to Grade 9 while the latter (ME) may take either two or three years, depending on the type of specialization chosen. Most ME students, about 85 per cent the total population at this level, choose the Science and Technology track (specialization) which lasts two years. The teachers who work in the first six EE grades are called "integral" teachers ('maestros integrales' in Spanish) which means that they teach a number of core courses (math, language, science, and so on). These teachers usually have a college degree earned in the five-year teacher education programs offered by most universities. Teachers who work at the highest level of EE (last three years) and at the ME level are usually content-specialist teachers who also normally have earned a degree (also 5 year-programs at the university).

The first institution where a statistics course was taught in our country was the 'Escuela de Preparación Estadística,' established in 1939. This school trained relatively low-rank clerical personnel in the necessary skills to collect and keep official statistics records and also to carry out censuses. The National Statistics and Census Act was passed in 1944, part of which regulated the activities of the school mentioned above. The School of Statistics and Actuarial Sciences of the Universidad Central de Venezuela, a school established in 1953, was the first institution at the higher education level to prepare professional statisticians. Until 1972, the study of topics and issues in statistics and probability were left exclusively to university students, but after that year some probability and statistics content was already included in ME curriculum. Later on, statistical content would be introduced at the elementary school (EE) level.

In the rest of this article, the most salient curriculum changes in statistics education in both EE and ME in Venezuela are described. Then an analysis of these changes, with some recommendations, is presented.

STATISTICS EDUCATION AT THE ELEMENTARY LEVEL (AGES 7 TO 15 YEARS)

Topics in statistics and probability were introduced in Venezuelan Elementary Education in 1985. Before this year no statistics and probability content was dealt with at this level. Curriculum reformers argued that the introduction of such content was "one of the main innovations" in the new programs. A new curriculum change took place in 1996 introducing modifications but only in the first six years of EE and assuming that such modifications would be followed by additional changes in the most senior years of EE (last three years) and also in the two final years of ME respectively, however, this is yet to be done. In Table 1 a comparison of both curriculum designs is shown.

Table 1: Educación Básica I y II etapa (First and Second Stage) 7 to 12 years

Grade	1985 Reform	1996 Reform
1st	Design and application of simple surveys, elaboration and interpretation of tables, bar graphs and pictograms.	Same
2nd	Design and application of simple surveys, elaboration and interpretation of tables, bar graphs and pictograms.	Added: Notion of chance; impossible, sure, and probable events.
3rd	Design and application of surveys, elaboration and interpretation of tables, bar graphs and pictograms.	Added: Notion of chance, random experimentation, elaboration and interpretation of tables with data from a random experimentation.
4th	Design and application of surveys, elaboration and interpretation of tables, bar graphs and pictograms.	Added: Finding of the mode in non-grouped data.
5th	Arithmetic mean, mode, median. Notion of chance; impossible, sure, and probable events. Computation of probabilities based on classic definition.	Remained the same but the mode and median.
6th	Frequency distributions, elaboration and interpretation of tables, bar and circular graphs. Computation of probabilities based on the classic definition. Tree diagrams.	Added: elaboration and interpretation of histograms, computation of the arithmetic mean and the median; basic ideas about counting.
7th	To solve problems applying basic ideas of probability. Tree diagrams. Frequency distribution, absolute and relative frequency. Elaboration and interpretation of absolute frequency histograms.	No modifications so far
8th	To identify independent events, computation of the composed probability of independent events. Computation of the median and the mode of frequency distributions. To solve problems using the median and the mode of a frequency distribution.	No modifications so far
9th	To solve problems applying basic notions of statistics and probability.	No modifications so far

Source: Ministry of Education. 1985, 1997, 1998.

Now some of the most salient characteristics of these reforms will be highlighted:
- The spiral design of the curriculum is maintained;
- Basic ideas of chance are introduced at 2nd Grade in 1996. Before, they were introduced at 5th Grade;
- Some topics were moved over from one grade to another, such as mode (from 5th Grade to 4th Grade), median (from 5th Grade to 6th Grade) and histogram construction (from 7th Grade to 6th Grade);
- Basic ideas of counting are introduced at 6th Grade since 1997.

As pointed out earlier, most changes were rather superficial ones though the spiral design of the curriculum has been maintained. The same content is included in both curriculums but in different grades.

Another aspect worth mentioning is that of the methodological suggestions for teachers. Both programs of study include various pedagogical suggestions but the main difference is again of manner or style. In the 1985 curriculum such suggestions are quite detailed and presented in a

topic-by-topic basis, while in the 1996 curriculum they tend to be more general in character. However, in both cases the emphasis has been on trying to improve students' comprehension of statistics and probability content by relating such content to the students' own environment and social context. The use of concrete materials and drawing upon students' experiences as a starting point for teaching is suggested in both curriculums in order to promote more active participation in classroom activities.

STATISTICS EDUCATION IN MIDDLE SCHOOL (AGES 16 TO 17 YEARS)

The last two curricular reforms in Venezuelan ME took place in 1972 and 1990 respectively. In the 1972 reform, influenced by the "new math" movement, for the first time statistics and probability content at this level of the school system was included. New changes were introduced in 1990 in math programs and also in the study of statistics and probability topics. These changes are summarized in Table 2 below.

Table 2

Grade	1972 Reform	1990 Reform
1st	Statistical variable. Measurement scales. Sampling. Population. Frequency distribution. Absolute and relative frequency.	All statistics topics were eliminated.
2nd	Probability, counting methods, combinatory methods, probability of co-occurrence of two independent events, conditional probability, application of Bayes' rule.	Added: Applications of Newton's binomial. Computation of the arithmetic mean, mode, median, amplitude, variance, typical deviation, quartiles, deciles percentiles. Normal curve.

Source: Ministry of Education (1972), CENAMEC (1990)

Now, it can be said that the main characteristics of these changes are:
- All statistics and probability contents are grouped in the 2nd Year of ME.
- A number of topics were eliminated from the curriculum, such as statistical variables, measurement scales, sampling, and population.
- Some new topics are included: application of Newton's binomial, computation of the arithmetic mean, mode, median, amplitude, variance, typical deviation, quartiles and deciles, and normal curve.
- ME Teachers, like EE teachers, usually point out that they do not have enough time to impart all the probability and statistics content included in the curriculum.

The 1990 program of study included a special section devoted to methodological suggestions for teachers, while the 1972 program listed only a handful of activities that teachers were encouraged to use in the classroom. In the former program, there is a relevant change which is the inclusion of relationships between statistics and probability topics and the students' own experiences, clearly a continuation of the pedagogy behind the EE curriculum. In this program it is suggested that students recollect, organize, and represent data from their environment and social context. In this way it is expected that they will be able to develop instruments to interpret and understand the world of today.

CONCLUSION

The changes introduced in the last curriculum reform were mainly formal, such as moving over topics from one grade to another, eliminating some and adding new ones. At the EE level the most significant changes were the introduction of basic ideas of chance in Grade 2 and elementary notions of counting in Grade 6. At the level of ME, all statistics and probability topics have been eliminated from Grade 1 in the mathematics curriculum of the 1990 reform. This

decision seems to open a gap between the teaching of statistics and probability at both levels (elementary and middle school).

Venezuelan education officials acknowledge the great importance of learning fundamental concepts in statistics and probability in the education of today's citizens. Proof of this is the inclusion of such topics in the school curriculum since 1972 in ME and since 1985 in EE. However, our experience tells us that there are some serious problems in the teaching of statistics in our schools, with lack of time usually pointed out as the main reason for teachers not to deal with all the topics in the curriculum. Clearly, we need to do additional research to find out whether this is actually true but we now know for sure that students' achievement in statistics is very low. For instance, the 1998 annual report of the National Educational Measurement System shows that our students get the lowest scores in the items related to statistics and probability content.

Although the Venezuelan curriculum includes a broad range of key concepts of statistics and probability, in my view some additional topics should be included in order to give students a broader picture of these disciplines. For example, the curriculum should include the following topics:

- Stem and leaf diagrams, box plots and dispersion diagrams
- Correlation analysis
- Tendency identification in bivariate data
- Use of functions (linear, exponential, quadratic) as models for data sets and to estimate their parameters
- Basic concepts of sampling. Relationship between sample and population in statistical inference
- Assessment of statistical information published in newspapers and other media
- Subjective probability
- Geometrical probability

It should be noted that technology use (calculators and computers) should be also included in the curriculum. Moreover, students should carry out research projects related to topics included in the curriculum. Additionally, it is necessary to do research on the teaching and learning of statistics in EE and ME in order to be able to improve such teaching and learning. It is also important to improve teacher education and professional development in the area of statistics and probability. To reach this goal, it seems necessary to combine efforts from different professional groups interested in statistics education in Venezuela in order to further the development of this important field of knowledge.

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