AN APPROXIMATION TO THE STATE OF THE ART OF STATISTICS EDUCATION IN COLOMBIAN SCHOOLS

Felipe Fernández and Nubia Soler
Universidad Pedagógica Nacional, Colombia
fjfernandez@uni.pedagogica.edu.co

Results obtained from a project carried out with the aim of studying the state of the art of statistics education in Colombian schools are reported. The methodology used was based on collecting, summarizing and analyzing more than forty written productions of Colombian authors, all of them related to statistics or probability education. These included monographs, research projects and lectures presented during Mathematics Education events, and school textbooks. It can be pointed out, as a finding, that there does not exist a consolidated vision of what statistics and probability concepts and methods should be taught and how they should be taught in schools. Further, very few of the reviewed written productions address the relationship between the teaching and learning of statistics and the use of technology.

INTRODUCTION

There are several reasons which motivated an enquiry into the state of the art in statistics education, in the particular context of Colombian schools. The first is represented by the high interest shown by Universidad Pedagógica Nacional to open up the academic space needed in order to include Statistics education as a component of the study programs of the Bachelor of Education in Mathematics, the Diploma and Master in Mathematic Education courses. A second reason is the recognition that can be identified in curriculum documents – both from international and the Colombian contexts– of the importance of promoting the 'data handling and probabilistic' component as an integral part of mathematical thinking (MEN, 2003; NCTM, 2000). The various documents examined emphasise that the education of citizens requires the provision of statistics education throughout the whole cycle of basic education. Our brief review of the curricular documents issued by the Colombian Ministry of Education (MEN) shows that specific statistical topics had been included in the programmes of study for 6-year-secondary-education cycle since 1974. Later, in the curricular-renewal programmes of 1984, the data-systems strand was included in schools for Years 1 to 9. At the international level, for more than a decade, the IASE has recommended the introduction of statistical concepts and problems in the primary and secondary school levels. A third reason is represented by the fact that the data analysis methods and the technological development related to these have shown an extraordinary progress that started since the sixties and seventies of the last century.

In summary, an emergent trend in teacher education and professional development programmes for the Mathematics Department of Universidad Pedagógica Nacional is the consolidation of a broader conception of the didactics of mathematics, in which the data-handling (i.e., statistics) and probability strands acquire the same level of importance that other curriculum strands are given.

METHOD AND COMPILED DATA

The enquiry was carried out in three stages. During the first stage data was obtained from monographs, masters and doctoral theses, educational journals' articles and Colombian research proposals on Statistics education in Colombia. There were several strategies of data collection. One of them was the screening of data bases available on the Internet; another one was to search the corresponding literature from university libraries or institutions that support educational projects financially in Bogotá. Another strategy was to contact people from other universities who were willing to share their academic and/or research experiences.

During the second stage the data compiled was analysed. There was no pre specified data analysis strategy, for the strategy was dependent on the quality and the amount of data collected. The data organization followed an eclectic approach that was built little by little as the enquiry group meetings took place. A matrix was built as a result of the group discussions, The matrix is formed by the following columns of information: 1) Topic, 2) supporting institution(s) and

author(s), 3) Supervisor(s) (in the case of monographs, theses or research projects), 4) date, 5) academic activity in which the work was presented, 6) bibliographic references, 7) role of information technology.

The third stage corresponds to the writing up of results and conclusions of the enquiry.

DATA DISPLAY AND ANALYSIS

In this heading we present the findings from the data complied in relation to the following questions:

- Are there authors and/or educational institutions whose role, regarding statistics education, can be considered distinctive?
- Is it possible to identify particular statistics topics and/or probability which have been given a major emphasis?
- Which academic gatherings or activities (e.g., seminars, conferences, etc.) have played an important role in disseminating the work of Colombian authors who have focused on statistics education?
- Which financial institutions have supported Statistics education projects and what results have shown such projects?
- Which are the bibliographic references showing higher use by the Colombian authors who have focused on statistic education?

To answer these questions the data were organised in three tables presented in the following paragraphs.

Table 1: Names of authors, by institution, of the reviewed written productions on statistics education (*n*=43)

Educational Institution, authors, supervisors, advisers and researchers	*Frequency and percentage*
Universidad Nacional: Gladis Torres de Duarte (DT1); NI (DT3); Espinosa, M. (AM); Muñeton M. (AM); Pinzón, Y. (AM); López, P. (AM); Quijano de Castellanos, M (AM); F. Cepeda (P3); P. N. Pacheco (P4); O. Soto (P4); J. Rodríguez (P2); N. Ceron (P2); E. Estrada (P1); A. Pérez (P1), C. Jaramillo (P1), C. Maryory (P1)	13 (30.2%)
Universidad Pedagógica Nacional: Margarita Rojas de Roa (DT1); Luis Eduardo Espitia (DT1); NI (DT1); Figueroa, G. (AM); Gómez N. y Malagán R. (AM); Orjuela, V. Pinzón, O. (AM); Vergel C. y Echeverry A. (AM); B. Suárez (P1), A. Matallana (P1)	5 (11.6%)
Universidad Distrital Francisco José de Caldas: P. Rocha (DT4); M. Bonilla (DT1); P. N. Pacheco (DT1); Pinzón J.(AM); Coronado C., García D. y Villalba M. (AM); Briceño C, Moncada E. y Vásquez E. (AM); Casas S. y Gonzáles C. (AM); León S. y Peña S. (AM); Cucero A., Vega, M. y López, A. (AM); P. Rocha (P2); M. Bonilla (P1) M. Lizarazo (P1)	10 (23.3%)
Universidad de los Andes: Patricia Perry (AL3) Vilma Mesa (AL3), Felipe Fernández (AL4, P3, AI) y Pedro Gómez (AL3)	7 (16.3%)
Universidad del Valle: R. Behar (AL1)	1 (2.3%)
Universidad Industrial de Santander: G. Yañez (P1)	1 (2.3%)
Universidad Autónoma de Colombia: F. Cepeda (P1)	1 (2.3%)
Colegio Nuestra Señora de Fátima de Ibagué: J. Zabala (P1)	1 (2.3%)
Instituto Pedagógico Nacional: E. Carranza (P1)	1 (2.3%)
CINVESTAV: L. Moreno (P1)	1 (2.3%)
Colegio Kennedy: A. Sánchez (AI), J. Gómez (AI), R. Royero (AI)	1 (2.3%)
NI: J. Medina (P1) J. García (P1)	1 (2.3%)

The first column of Table 1 shows the names of the participating educational institutions, the names of the authors, the researchers, their supervisors. In the second column shows the absolute and relative frequencies corresponding to the number of documents listed. In this table the letters (TS) are assigned to an author that has been a thesis supervisor. This letters are followed by the number of times that this person has performed that role. The letters (AM) are assigned to a student whose thesis relates to statistics education. (P) means that the authors did a presentation of his/her work on statistics education at an academic gathering. (AL) means that the cited name is an author of a textbook of statistics or probability, or of a book arising from a research project. (AI) indicates that the author received financial support to carry out his/her research work.

Table 2: Topics on statistics education focused in the reviewed documents

Stochastics topics	*Frequency and percentage*
Various topics on probability (teaching proposals, textbooks)	13 (30.2%)
Various topics on statistics (teaching proposals, textbooks)	17 (39.5%)
Localisation (central tendency measures)	3 (7%)
Correlation, lineal regression	3 (7%)
Dispersion	2 (4.7%)
Hypothesis testing	2 (4.7%)
Random, probabilistic, statistical and statistical or stochastic thinking	8 (18.6%)
Exploratory data analysis	1 (2.3%)
Use of technology (graphic calculators, statistical analysis packages)	4 (9.3%)
Statistics applications	1 (2.3%)
Curricular guidelines MEN	2 (4.7%)

In Table 2, the first column presents the categorization of the topics on which the reviewed documents or publications focused. The topics were identified either by the title of the publication or by the abstract of the work reviewed. The second column shows the number of reviewed documents. There were some documents which considered several topics of statistics at a time; an example of this is the work related to school textbooks, but there were other type of documents showing this characterization. This type of work is shown in the first two rows of this table. The organisation of Table 3 is similar to the one shown in the first two tables.

Table 3: Organisation of the compiled data, regarding the academic activity or event where the academic productions were presented

Mathematics Education events, monographs and others	*Frequency and percentage*
Distrital Coloquium on Mathemathics and Statistics	13 (30.2%)
Colombian Mathematics Education Meeting	5 (11.6%)
Incorpoarting new technologies into the mathematics cuirriculum of school in Colombia (MEN)	2 (4.7%)
Monographs	15 (34.9%)
IX CIAEM, PME , RELME, CIBEM, ICOTS	3 (7.0%)
Research projects (COLCIENCIAS Banco de la Republica, IDEP)	2 (4.7%)
Textbooks	3 (7.0%)

FINAL COMMENTS AND CONCLUSIONS

The following are the results that we would like to highlight from this enquiry. In the first place there is a scarcity of research projects dealing with statistics education, and from the few that were identified only one had had financial assistance from educational institutions as can be seen in Table 1. This is an indicator of the lack of attention given to statistics education in our country. In the second place, too few people in Colombia work permanently in academic production regarding the area of statistics education. The most distinguished authors are F. Cepeda, P. Rocha, P. Pacheco y O. Soto. We would like to mention here that these authors have been the supervisors and advisers of number of the written productions listed in the previous tables.

"Random thinking" is a topic that was the centre of the work of several authors. This topic was referred too as "statistics thinking", "probabilistic thinking" and/or "stochastic thinking." It seems that there is an eclectic use of these terms and, several of these productions are dedicated to define this concept. From our point of view, we find more appropriate –although not more standardized – to use the term "stochastic reasoning" as it carries in its etymology the statistical and the probabilistic components and a more identifiable type of thinking. There are also specific topics which have received some attention, such as localisation, dispersion, correlation and regression, and hypothesis testing. We think that these topics deserve more attention on the part of educators.

There is very low number of writings related to the use of technology and its role in statistics education in Colombia. It is almost unquestionable that within the diverse applications that technology can have, the stochastic education area is identified as one of the first and, as it seems, that this area of work has not had the importance that it deserves in our country.

It is also necessary to highlight the difficulties that we faced during the course of this enquiry. For example it was frustrating to have dedicated a great amount of time to search the Internet and to find out that students thesis and/or academic productions from the majority of universities of the country are not available on their web sites; this meant that we had to travel to the libraries of each university that allowed us to have entry to be able to obtain the information. Further, we never received an answer to our requests of cooperation with our project from the librarians of Universities with faculties of education.

In summary, we cannot guarantee that all existent work on statistics education was reviewed. However, we think that the work reviewed is representative of the monographic work that is being carried out on the topic, in different universities, as well as of the (related) interests of academics. As a final conclusion, two facts related to the future of statistics education in Colombia can be mentioned: (i) the influence that official policy from the Ministry of Education seems to be effecting regarding the inclusion of statistic education in Colombian schools. (ii) In Carmen Batanero and colleagues' work we identify numerous materials that can useful in the effort to include and give attention to statistics education at the school level in Colombia (see, for example, http://www.usgr.es/~batanero/).

REFERENCES

Ministerio de Educación Nacional. (1983). *Programas Curriculares*. Bogotá: MEN.

Ministerio de Educación Nacional. (2003). *Estándares para la Excelencia en la Educación*. Bogotá: MEN.

National Council of Teachers of Mathematics (NCTM). (2000). *Principles and Standards for School Mathematics*. Reston, VA:. Author.