STATISTICS APPLIED TO EDUCATION: AN ANALYSIS OF TEACHING PLANS

Maria Cláudia Cabrini Grácio
State University of São Paulo, Brazil
Érica Aparecida Garrutti
Federal University of São Carlos, Brazil
cabrini@marilia.unesp.br

The aim of this paper is to study questions related to the selection of content, classroom procedures and evaluation in teaching Statistics in Education. We investigated sixteen teaching plans for Statistics in Education in nine public and private graduate schools in São Paulo state. We compared the statistical tools present in such plans with the statistical tools used in papers, as seen in preceding surveys. The results indicate that the emphasis in the organization of the Statistics contents in teaching plans in this area is, as already observed in papers, dissertations and theses from the field of Education, on Description Statistics.

INTRODUCTION

Our teaching practice in Statistics has shown us how statistical knowledge can be far removed from other content taught in courses where it is instrumental in nature, particularly in the area of Human Sciences. It follows that Statistics teaching must treat questions relating to the student's reality, helping them to see how quantification is used in various daily experiences.

Sowey (1995) points out that teaching Statistics coherently means to insert it in a larger context. When students know and understand the statistical techniques taught, perceiving their meanings and implications as a whole where they are used, it widens the possibility of the knowledge becoming part of their cognitive structure and to be lasting.

Oliveira and Grácio (2003) point out that, in this context, the Statistics teacher needs to break with the reproductive model in which he or she has the only function of executing an already ready-made program leading to the construction of courses that prioritize those statistical techniques that are more pertinent to the professional working area of the future professional.

Hence, the Applied Statistics teacher needs to enlarge his knowledge in the development of more contextualized work, integrating the concepts of his own subject with other concepts of the course in which Statistics is used.

In this paper, we aim to treat questions that are connected with the delineation of the Statistics applied to Education subject; that is, with the selection and organization of content, classroom procedures and evaluation for this subject. With this aim, we will investigate teaching plans of Statistics subjects in Colleges of Education.

METHODOLOGY

We selected 47 private and public Institutions of Superior Education with a College of Education, in São Paulo State, by means of systematic random sampling, using the available addresses in the *Guide of Students, April 2004*. Only fifteen institutions answered our request to send the teaching plans to us: six informed us that they do not have Statistics in their College of Education, and nine sent their teaching plans, for a total of 16 teaching plans.

In each teaching plan, we identified the statistical techniques and tools presented in the programmatic content, the teaching methodologies and the evaluation criteria.

RESULTS

On the basis of our analysis of the programmatic content of the statistics subject teaching plans we have Tables 1 and 2.

Table 1: Frequency distribution of the statistics approach in teaching plan, according to the number of teaching plans of Statistics

APPROACH IN TEACHING PLAN	N. TEACHING PLANS FROM INSTITUTION			N. INSTITUTIONS
	1	2	3	
Descriptive Statistics only	2	3	1	6
Inferential and Descriptive Statistics	2	0	1	3
TOTAL	4	3	2	9

From Table 1, the majority of institutions present only Descriptive Statistics, with only three institutions using techniques relating to Inferential Statistics. These Statistics subjects, analyzed by their teaching plans, can be considered only as introductory courses of Applied Statistics in Education.

It is interesting to note that four of the six institutions that treat only Descriptive Statistics possess at least two teaching plans, that is, two semesters of Statistics in its course of Education. The fact that a College offers at least two semesters of Statistics does not determine the teaching of inferential techniques. Two of the three institutions that present the inferential approach in Statistics in their courses offer only one semester of Statistics, and only one institution with more than one semester of Statistics teaches Inferential Statistics.

As we can observe in Table 2, most of the teaching plans present the following categories of statistics techniques: introduction to descriptive statistics, planning of statistical work, frequency tables, graphical presentation, measures of central tendency and measures of dispersion. Thus, the descriptive approach appears in most of the teaching plans. On the other hand, the inferential approach appears in a minority of the teaching plans. These results in this table are consonant with those contained in Table 1.

Table 2: Frequency distribution of statistics techniques categories, by teaching plans

STATISTICS TECHNIQUES CATEGORIES	N. PLANS
Notions of Mathematics	3
Introduction to Descriptive Statistics	8
Planning of statistical work	8
Frequency Tables	11
Graphic presentation	10
Measures of central tendency	10
Measures of quantiles	6
Measures of dispersion	11
Notions of probability	7
Binomial distribution	1
Normal distribution	6
Measures of skewness and kurtosis	3
Introduction to Statistical Inference	2
Estimation of population parameters	2
Tests of Hypotheses	2
Analysis of Variance	1
Correlation and Regression	3

From Table 3, we see that most plans make use of classroom exposition, and that there is a trend toward approaching procedures that demand from the students an active participation in the development of the activities. In this direction, six out of the sixteen analyzed plans mention the use of research activities and seven the use of group study.

Table 3: Frequency distribution of teaching methodologies, by teaching plans

METHODOLOGY	N. PLANS
Expositive classroom	12
Exercises	4
Research activities	6
Computing laboratory	4
Group study	7
Seminars	3

Below follows the evaluation procedures, based on analysis of the teaching plans.

Table 4: Frequency distribution of evaluation procedures, by teaching plans

EVALUATION PROCEDURE	N. PLANS
Written tests	13
Group work	9
Individual works	7
Exercise lists	4
Research works	3
Participation in classroom	3
Seminars	2

Table 4 indicates that there is variation in the use of evaluation procedures. However, the procedures present in most teaching plans are written tests and group work.

DISCUSSION

The programmatic content presented in the teaching plans, in general, emphasizes techniques of Descriptive Statistics such as frequency tables, graphical presentations, measures of central tendency, quantiles and measures of dispersion. The exception relates to an institution that in its third teaching plan presents only the use of inferential statistics techniques.

Grácio and Garrutti (2003, 2005) analyse papers in international and national journals and in theses and dissertations in the field of Education, in the period from 1996 to 2000, in order to identify a Statistics programmatic content adequate for and relative to this field. The authors point out that a small percentage (18%) of papers use statistics methodology in the treatment of the questions raised, and 55% of dissertations and theses use statistical methodology for the analysis of their data. Among the papers, dissertations and theses that use statistics, all use tables of frequency distribution in presentation of their data.

Inferential statistics techniques are used rarely (below 10% of the analyzed research) and are predominantly of non-parametric nature.

Comparing the statistics techniques categories found in the analysis of teaching plans with those from Grácio and Garrutti, both the teaching plans and the research make greater use of descriptive techniques. Among the nine analyzed institutions, all plans present use of Descriptive Statistics, while only three institutions mention Inferential Statistics techniques.

Concerning teaching methodology, we look to the development of ampler pedagogical work, with objectives related to the educational context, and to a critical perspective beyond the content which emphasizes the relevance of teaching procedures as a bridge linking contents and objectives.

In the research presented here, one teaching plan does not approach the methodological question at all, and another three only present principles that guide the selection of activities, or

only mention that the teaching work will consider interests, potentialities and difficulties of the students when programming the activities.

The other twelve teaching plans provide teaching methodologies used that, in general, are diversified: classroom exposition, exercises, research activities, group study, seminars and dialogue.

Only one teaching plan does not present the evaluation procedures used. Among the plans that describe the procedures used, we observe that they vary among the use of written tests, individual and collective works, exercise lists, research work and participation in classroom activities.

FINAL CONSIDERATIONS

Often the teacher of Statistics comes across a situation where it is not easy to conduct the work in the classroom. Among the reasons for this, we emphasize a lack of interest in quantitative approach on the part of students. Facing this situation, the teacher must search for new ways that contribute to the students' motivation.

In this process of organization in the teacher's work, we emphasize the importance of the contents of the Statistics subject, with an interdisciplinary perspective for the development of a contextualized study.

Based on the results of Grácio and Garrutti, we have seen the statistical approaches used in educational research. These results lead us to consider that the organization and the content of the Statistics subject for Education students must emphasize the development and the interpretation of Descriptive Statistics, but must not omit the presentation of Inferential Statistics. We must point out to the students the importance of the use of hypothesis tests when one works with samples and want to extend the results to a population.

REFERENCES

Gracio, M.C.C. and Garrutti, E.A. (2003). A disciplina Estatística na área de Educação: Seleção e organização de conteúdos. *Educação Matemática em revista - RS*, 5, (12-20).

Gracio, M.C.C. and Garrutti, E.A. (2005). Seleção de conteúdos estatísticos para a educação: Uma análise de dissertações e teses. *Educação Matemática em revista - SBEM*. (In Press).

Oliveira, E. F. T. and Gracio, M. C. C. (2003). A Estatística no curso de Pedagogia da NESP/campus de Marília. IN: *Seminário IASI De Estatística Aplicada – "Estatística na Educação e Educação em Estatística"*, 9, Rio de Janeiro. *Annals*... Rio de Janeiro: IBGE. 1 CD-ROM.

Sowey, E. R. (1995). Teaching statistics: Making it memorable. *Journal of Statistics Education*. 3(2), http://www.amstat.org/publications/jse/v3n2/sowey.html.