

## ASSESSING THE INCLUSION OF BIOSTATISTICS IN SCHOOLS OF DENTISTRY IN BRAZIL

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*The National Institute of Study and Research of the Ministry of Education in Brazil states that there are 169 Schools of Dentistry in 2006. At the School of Dentistry of Araçatuba, UNESP, Brazil, this Biostatistics discipline is included in the course with 90 credit hours a year. An interrelationship with other professors has been developed for some years using database of different dental fields. The aim of this research is to get acquainted with the teaching of Biostatistics at schools of dentistry in Brazil. The methodology applied was to send the questionnaire to all the coordinators of the courses. As for the result of 76 questionnaires answered, 45 stated the inclusion of Biostatistics in their program studies. Only in 3 schools Biostatistics is taught all over the year in “61 to 90” hours. The conclusion is that the teaching of Biostatistics must be incentivated in all schools of dentistry in Brazil.*

### INTRODUCTION

Statistics fulfills a substantial role in the scientific method taking into account the organization, description, analysis and interpretation of the data (An & Cuochi, 2004). In 1981, Berquó a Brazilian professor of Public Health had then stated that Statistics is an instrument of analysis, comparison and prediction from observational or experimental data estimating parameters and applying statistical tests according to its use.

Yet, many professionals, mainly those closer to the daily practice and more distant to scientific work, tend to believe that they have little to do with Statistics, as they are not used to working with groups but individuals. At least two mistakes might be related to this behavior. First, this professional won't be able to follow the evolution of research in his/her field of interest correctly, which makes permanent use of Statistics. Second, a few notions of statistical method allow a professional not only to be aware of the variability of data with which he deals with, but also to favour a better understanding of the control of this variability (Gonçalves, 1998).

Grazioso, 2003 states that the statistical information has as a major attribute to diagnose the national environment to be the basis for the formulation of public politics and socioeconomic studies, to build the foundation for academic researches in several levels and, in a comprehensive way, to help society with the construction of a collective citizenship.

Minayo & Sanches (1993), report that the use of distribution of probability to describe biological, medical or social patterns is not recent. Quételet (1835) had already used the properties of Gauss distribution to describe height patterns of human beings. Galton (1889), an English medical doctor, had used the properties of the same distribution in the studies of genetics on natural inheritance.

There is growing interest among university students in studying Statistics (Chanza & Ocaya, 2006). Many authors argue that a student should understand Statistics mainly to develop a statistical reasoning (Silva, Brito, Cazorla & Vendramini, 2002). The teaching of Statistics is not only the learning of formulas and graphics. It is the teaching of a way of thinking, a way to deal with data and to learn how to take decisions (Morin, 2002). In the NCTM (National Council of Teachers of Mathematics, 1989) there's a warning for the students to understand the difference between the characteristic of right/wrong of the mathematical thinking and the nature of the results in statistical analysis, recognizing that Statistics bears an important intermediary role between the accuracy of mathematics and the ambiguous nature of a world widely dependent on individual opinion. In interviews carried out by Wada (1996) with professors of Statistics of the Mathematics and Statistics Institute at Campinas University a lack of statistical reasoning was reported due to the deterministic view disseminated in education from elementary school to university (Silva, Brito, Cazorla & Vendramini, 2002).

Teachers of Statistics should be more attentive to the emotional aspects of the teaching-learning process by trying to identify the student's angst, attitude and frustrations and suggesting strategies which aim to reduce or eliminate those negative aspects (Gal & Ginsburg, 1994). Therefore, if a student believes that studying Statistics is stimulating and useful for his life, he will be likely to show positive attitude in relation to Statistics and will also behave positively towards Statistics, whether in a learning situation, an interpretation of daily information situation or in its application in his professional life. Besides, if a student believes that Statistics is mathematics and if his experience with mathematics at school was frustrating, he will tend to show negative or unfavorable attitude towards Statistics, which can result in resistance to take it as a disciplinary major, choose it as an optional course or even use it as the tool of the trade (Silva, Brito, Cazorla & Vendramini, 2002).

To Vieira (1999), teaching Statistics becomes a challenge to the teachers, as this matter isn't usually included on the list of technical subjects of the service courses given and due to it, it faces the disregard of many students resulting in school failure. Sowe (2006), "whether they are studying Statistics as a disciplinary major or through one or more service courses, students will be more motivated towards what they are learning, and will retain through time a richer recall of it, if they feel they are doing something worthwhile. What gives students the sense that studying Statistics is worthwhile?" According to Sowe (1995), three elements in teaching are salient in developing this sense of worthwhileness: showing that Statistics is interesting, useful, and substantial.

The use of new technologies in the teaching/learning of Statistics and Data Analysis is currently increasing in this technological information and communication society (Vallecillos and Moreno, 2002). Newbrun (1992), points out the importance of computer in dentistry, not only in researches but also in clinical use. Doing a methodologically correct research with clear objectives, coherent methodology and appropriate evaluation of results is a very old formula.

#### AIM

To verify the inclusion or non-inclusion of Statistics or Biostatistics and assess its importance in Schools of Dentistry in Brazil.

#### METHODOLOGY

All Schools of Dentistry in Brazil were searched on the internet. They were divided in 5 groups, according to their geographical region: North, Northeast, Southeast, Mid-West and South.

Before the questionnaire used for this research was sent to universities, a search on the internet for their program of studies was made to check if they covered the Biostatistics or Statistics discipline as a few sites didn't provide this information, it was advisable to send it to all universities.

A questionnaire was compiled asking about: the inclusion or non inclusion of Biostatistics or Statistics in the schools of Dentistry program of studies; the credit hours of the course; the theoretical and/or practical class activities; the use of computers in class; the number of staff in the course; the availability of training to the undergraduates; the extension project development; the research project development; the length of the course: a semester, a year or it's part of another discipline, students and/or trainees in presentations of Biostatistics paper in scientific events.

In 2005, this questionnaire was sent to coordinators of all the schools of dentistry requesting to send it to the professor or responsible for that information. After a few months it was sent again to those who hadn't answered it, and in 2006 the same information was requested via fax.

This project was approved by the Ethics Committee of Research sponsored by National Commission of Research (CNPq – PIBIC). EpiInfo 2000 tabled the data and some comparison was made with the Biostatistics discipline at the School of Dentistry of Araçatuba – UNESP, Brazil.

## RESULTS AND DISCUSSION

The National Institute of Study and Research of the Ministry of Education in Brazil states that there are 169 Schools of Dentistry in this country in 2005. It is known that their program studies don't always cover Biostatistics. On the internet sites 48 of them cover Statistics in their program.

The distribution of Schools of Dentistry in different regions of Brazil is quite heterogeneous and they are shown in table 1.

Table 1.

*Distribution of 169 Dentistry Schools of Brazil, which cover Biostatistics in their program of studies. Confirmation of the Biostatistics in their program of studies and the total of answers received. 2005-2006.*

Region	Schools of Dentistry	Biostatistics Included on the site	Confirmation of Biostatistics	Total of answers
North	13	02	02	03
Northeast	26	09	08	17
Southeast	88	21	20	31
Mid-West	11	03	03	05
South	31	13	14	20
Total	169	48	47	76

The North boasts 13 schools with dentistry course. On their sites only 2 of them covered Biostatistics in their program of studies and we received 2 out of 3 answers confirming the inclusion of Biostatistics in dentistry course. The Northeast boasts 26 schools with course, on their sites 9 schools cover Biostatistics in the program of studies and we received 17 answers with 8 confirmations of Biostatistics in their courses. The Southeast boasts 88 schools of dentistry and 21 of them cover Biostatistics on their sites. Twenty schools include this discipline in their dentistry course, being optional in 2 of them and compulsory in 18. We received 31 answers of this region altogether. The Mid-West boasts 11 schools with dentistry course. On their sites, 3 of them cover Biostatistics and the 3 confirmed the actual inclusion of it in their course. The South boasts 31 schools of dentistry. On their sites 13 schools state they cover Biostatistics in their program of studies. Fourteen out of 20 answers ratify the inclusion of Biostatistics in the dentistry course. We received 76 answers to the questionnaires from the schools of dentistry in Brazil.

Most of the schools of dentistry, 52.1%, are settled in 4 states of the Southeast: São Paulo state, Minas Gerais state, Rio de Janeiro State and Espírito Santo State, and the others in 22 Brazilian states.

Researches show that Statistics isn't being taught in many schools (Cazorla, 2006). As we can see in table 2, 34 out of 76 answers stated it is compulsory and 2 stated it is optional. In 11 of these schools Biostatistics is taught as part of other disciplines in their program of studies. The other 29 schools stated there don't cover it.

Table 2.

*Distribution of the 76 answers received on the schools of dentistry in Brazil with the inclusion of Biostatistics or Statistics. 2005-2006.*

Included in their curriculum	Frequência	Percentage
No	29	38.15
Optional	02	2.63
Yes	34	44.73
Part of another discipline	11	14.47
Total	76	100.00

As far as the availability of credit hours is concerned, there is a big difference among the schools. Of a total of 34 schools which cover Biostatistics, 5 of them have 30 credit hours a year, 26 (76.47%) 31 to 60 credit hours and only 3 have 61 to 90 credit hours. Paula & Bezerra (2003) point out in their work which assesses the curricular structure of the schools of dentistry in Brazil that the area of scientific formation which enables the students to understand and analyze publications and technological innovations with critical view scientifically grounded has a very heterogeneous distribution, ranging from zero to 400 hours. The author shows that courses that carry the most number of credit hours in the disciplines altogether don't necessarily and proportionally provide the same number of hours to scientific formation. According to the authors, this area of scientific formation corresponds to Scientific Methodology, Statistics, Biostatistics, Information Technology and final schoolwork paper.

In Brazil as well as in other countries, they miss the realization that Statistics is a substantial discipline as stated by Sowe (2006), pointing out "that the consequence of missing this realization may impede students' appreciation of the outstanding worth of statistical techniques, and consequently stifle their motivation towards anything other than superficial study. If a student who grasps that Statistics is a discipline of substance will have a strengthened conviction that it is professionally empowering and, thus, worth the effort of careful study."

The School of Dentistry in Araçatuba, UNESP, Brazil which provides 90 credit hours of Biostatistics a year, has been carrying out some work on the appreciation of this discipline on the attempt of interdisciplinary engagement with the other studies. The result of the effect of this work was carried out in a research with students and teachers, 94.1% of the teachers provided data of their researches to be used in the classroom, which are used as examples in theoretical classes and worked out in practical classes in the computer laboratory (Sundefeld, 2003).

Following the same thought there were also some differences in the type of class: only theoretical, only practical or theoretical and practical. All schools stated that they hold theoretical classes but only 67.65% stated that they hold practical classes. The educational process in both the theoretical and the practical side should become very interactive: There have been made alterations in both education technology and education reform, and so teaching Statistics should encourage students activity, stimulate and guide students learning by personal interaction (Fonseca & Martinho, 2006). Minayo & Sanches (1993) stated that it is the Statistics role to establish the relation between the proposed theoretical model and the data which were observed in real world by providing tools to try out the adjustment of the model.

What is the relationship between students' attitudes toward Statistics and their achievement? This answer was made by Robert delMas, Ann Ooms, Joan Garfield in "Assessing students' statistical reasoning" (ICOTS7, 2006). At the School of Dentistry of Araçatuba, Brazil, they have been able to raise the awareness and interest of the students who work in their practical classes with database on different dental areas and feel encouraged to apply for training in the discipline to be engaged in scientific activities and research projects.

The confirmation of the use of technology by means of computer in teaching was made by 32 schools. The educational technology provides us a greater variety of strategies for teaching/learning Statistics (Godino, Ruiz, Roa, Pareja, and Recio, 2002) but there are a few divergences of opinions when, "many students approach information technology as a "necessary evil," or at least as a required tool that is difficult to use", (Dougherty, Kock, Sandas, and Aiken, 2002). Estrada, (2002) states that "An additional factor that affects learning performance is how students face knowledge. Attitudes as intensive feelings, relatively stable, are consequence of positive or negative experiences over time in learning a topic."

For the past few years we have realized a change in Brazilian university students' behavior who are stressing the use of computers in the teaching/learning process mainly Statistics. Júnior (2003) considers that Statistics software should be used as a means of tool to Statistics in its scientific work but they must be registered and have a true origin.

Joan Garfield (2006), for the past 25 years has been involved in collaborative research on teaching and learning Statistics. He summarizes and reflects on three interconnected areas of research: synthesizing and building on research studies across diverse disciplines, developing and using good assessment instruments to evaluate and improve student learning, and studying the role of technological tools in developing students' reasoning about specific concepts.

Following the same thought, one of the categories describing students' conceptions of teaching Statistics presented by Petocz & Reid (2002) is " *Providing materials, motivation, structure*. Here, students expect lecturers to provide them with good quality materials such as course guides or lecture notes; interaction, motivation (be enthusiastic, not boring); or structure (eg lectures for theory and labs for practice)" and another is, "*Linking statistical concepts and guiding learning*. In this conception students expect that lecturers will link statistical concepts by clarifying, explaining, elaborating on ideas, especially in unusual or different situations, and making connections between areas of the course".

As for the presence of trainee students in the Biostatistics discipline as a specific discipline in 34 schools of dentistry in Brazil, only 8 schools state they offer training. Although 16 of them allow the students to develop extension project and research project and 26 of them allow them to participate in research project.

At the School of Dentistry in Araçatuba, the trainees are co-authors of the papers published or presented in scientific events. The demand for training has increased every year, a fact which never occurred before Statistics was taught with the database of dental area. This new teaching method has sparked students' interest in learning Biostatistics even in a course of health area.

Twelve to 16 undergraduate students per year are trainees, and they do research on applied-Statistics and some of them present their work in scientific events and carry out attendance activity applying knowledge of "Statistics and health" in 12-year-old students of public schools, using a CD-Rom developed by themselves (Sundefeld, 2006).

Concerning the number of teaching staff in Biostatistics discipline in Brazil, it is considerably small as 26 schools stated they have only 1 professor for the discipline, 4 stated they have 2 professors and 3 stated they have 3 professors.

Out of 48 schools of dentistry in Brazil which confirmed to cover Biostatistics in their courses, 29 teach it a semester long and only 5 teach it a year long.

At the School of Dentistry in Araçatuba, UNESP, Brazil, the Biostatistics discipline is taught a year long and has had a significant number of undergraduates going through training and developing research projects as well as extension projects. It is believed that this teacher/student interaction is the best teaching/learning approach. The Biostatistics discipline at the school of dentistry has active participation concerning presentation of academic papers in lectures and/or congresses of scientific initiation.

As for projects, 47.06% develop extension projects and 76.47% research projects. The engagement of students and/or trainees in scientific events accounts for 50% in different areas of the course.

In ICOTS7, it was mentioned that when studying a problem in Statistics education, it is important to hunt across many disciplines for relevant research. Although articles in different disciplines may look at the problems differently, build on different theories and prior research, use different methods, and focus on different types of subjects, together they can provide a rich background for future research studies (Garfield, 2006). Anderson & Loynes (1987) and Smith (1998) suggest student projects and assignments for convincing students of the practical utility of Statistics.

## CONCLUSION

Taking the 76 answers into account with 47 of them confirming the inclusion of Biostatistics or Statistics discipline and only 3 schools with 61 to 90 credit hours and only 67.65% holding practical classes, we can state that Biostatistics lacks the due appreciation it is worthwhile in the schools of dentistry in Brazil. Considering the interest in this discipline shown by the students of the School of Dentistry in Araçatuba, UNESP, Brazil, we concluded that they realize it is substantial in the Schools of Dentistry in Brazil, confirmed by the active engagement of the trainees. Some students carry on with their training in Biostatistics in the years ahead after the completion of their credit hours in the first year and some carry on until they finish their dentistry course. We strongly feel that this experience should be divulged so that we can spark the interest of other schools of dentistry in Brazil concerning the inclusion of Biostatistics discipline in their program of studies.

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