

**TEACHING CONSULTANCY THROUGH DIRECT EXPERIENCE IN RESEARCH:
THE APPROACH OF THE DEPARTMENT OF BIOSTATISTICS AT
THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL**

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Teaching future applied statisticians requires the teaching of consultation skills since the student must learn to interact with research workers, learn to abstract the statistical aspects of substantive problems, to provide appropriate technical assistance, and to effectively communicate statistical results. The approach of the Department of Biostatistics at the University of North Carolina at Chapel Hill is to provide a dual training that includes classroom work, but also involves a 'real' practicum. The objective of this paper is to present various modalities of the experience in training future consultants. These are evaluated by former students of the Department of Biostatistics that are currently involved in consultation and in training in their respective countries. The success of the training is seen through subsequent consultations in worldwide settings.

INTRODUCTION

Teaching statistics at the graduate level aims to provide the next generation of professional statisticians with the necessary skills for jobs in academics, government or industry. In all three settings, statisticians are called to be consultants to other researchers (Bross, 1974; Kirk, 1991), and thus the teaching of consultation skills should be an integral part of any graduate level training.

The Department of Biostatistics at the University of North Carolina at Chapel Hill offers masters and doctoral graduate degrees, but often it is hard to distinguish its contents from that of similar programs offered by many Statistics departments throughout the world. If most of the weight falls on the statistical aspects, what then is the importance of Biostatistics? This question is related to the dilemma often faced with when asked to define Biostatistics. The most sensible answer is that Biostatistics is related to the specification, development and application of statistical methodology to problems generated from the biological sciences. Similar definitions may certainly be considered for other fields of applications. If in many cases, the final result of our work does not reflect the biological components (for example), the sole fact that the specification of the problem stems from a question posed by an investigator in the field of biological sciences is sufficient to highlight the importance of such an interaction. Keeping this in mind, it is not difficult to figure out why statistical consulting plays a major role in our field of activity.

Teaching statistical consultancy involves statistical methodological training as well as learning interpersonal and negotiation skills. There are few textbooks available on the issues involved for successful consultants (Boen & Zahn, 1982; Derr, 1999; Hand & Everitt, 1987). A recent comprehensive bibliography is also available (Sahai & Anwer, 1999). However, an important element is the direct, or 'hands-on' experience that the future consultant receives. Often this is not part of classroom course content except perhaps with role playing, and consulting statisticians get 'initiated by fire' on real consultation and may not be adequately prepared to face them.

The approach of the Department of Biostatistics at the University of North Carolina at Chapel Hill is to provide a dual training that includes classroom work, but also involves a 'real' practicum. This is required of all students and has been part of the curricula of graduate degree programs for the last fifteen years. Under supervision of a faculty member, the student interacts with research workers in the health sciences, learning to abstract the statistical aspects of substantive problems, to provide appropriate technical assistance, and to communicate statistical results. The objective of this paper is

to present various modalities of the UNC experience in training future consultants. These are evaluated by former students of the Department of Biostatistics that are currently involved in consultation and in training in their respective countries.

METHODS

Students enrolled in a graduate Biostatistics degree program at UNC are required to enroll in a 1-credit course on the principles of statistical consulting that emphasizes the non-technical aspects of consultation. The course is typically taken in the second year of the graduate program. It is taught primarily in a lecture format, but with some exercises in role-playing. After completion of the course, students must enroll in a 2-credit course on practice in statistical consulting. This course is not classroom-oriented, but takes place under the supervision of a faculty member. The student interacts with researchers in the health sciences, learning to abstract the statistical aspects of substantive problems, to provide appropriate technical assistance, and to communicate effectively statistical results. This practice is real in the sense that the problems and timelines are real.

The practice can take many forms, from participating in the Biometric Consulting Laboratory of the Department, working directly one-on-one with an investigator, working as part of a center providing biostatistical consultation services to various investigators, working as a graduate research assistant on a funded research project, or other variations. This manuscript presents various experiences over the years from graduates of the Department. The type of experience and success of the training is explored by descriptions of the actual experiences by former students. Former students from various countries present their current consulting training programs in their respective institutions, as well as describe the utility of their training.

RESULTS

Manila, Philippines. The UNC master's degree program provides statistical methodological training through lectures, exercises, examinations and practical applications of the topics learned. The exercises are mostly practice problems on the theories presented in the lectures. Students are expected to work independently. Other courses, such as intermediate linear models, provide students with opportunities to analyze data and to present the results in class. Immediate feedback is given on the exercises and on the presentations. As part of the learning process, early feedback allows students to recognize the mistakes done and to confirm what was already learned. Students also take other courses that are very relevant in the practice of biostatistics, as for example, courses on epidemiology (essentials, study designs).

Courses on consulting were both very enriching and enjoyable. In these courses, lectures are given and practical approaches in consulting are presented. Role-playing is conducted. Students are asked to work on a research problem, to formulate the objectives, and to determine the outcome measures. Collection of data of the identified variables follows. Issues on reliability of measurements are also discussed. Data analysis and results are then presented to the class.

The practicum I did was a study conducted in my own home country before I left for the master's training. The investigator in the Philippines and I communicated with each other via e-mail regarding the study. Aside from doing the analysis, the data were used to explore sample size aspects of classification and regression trees. Sufficient literature review on the theoretical basis for the methods was also done. Programming skills were honed while doing the data simulations. I presented results of this study as a thesis. These experiences were not possible without the frequent consultation, supervision and discussion with my adviser who willingly spent his time to give his valuable advices. I believe that the excellent training that UNC provided has prepared me to face the challenges that a future consultant biostatistician would encounter. It also gave an exposure to an environment by which a consultant biostatistician would mentor a future consultant.

It has been 8 years since I graduated from UNC and came back to my home country. I got a faculty position in our university and worked with epidemiologists, social scientists and health economists. As a faculty member, I teach biostatistics and give statistical advice to students with regards to their thesis. The department to which I belong offers statistical consultation services to the resident physicians and fellows of the teaching hospital of the university. Faculty members of the

university also consult on their researches. Moreover, other institutions avail of these services. I believe that the success of any biostatistics consultant largely depends on his/her involvement in research projects. In the past 8 years, I was involved in numerous clinical researches, in various fields, utilizing various designs, with a variety of responsibilities. I was given an opportunity to invite biostatistics students to join me in some of our research projects. These students were asked to perform different tasks in the project such as data management, data analysis and statistical report writing. They were also asked to observe in the consultation sessions held and I discussed with them different issues that were tackled during the consultation. I believe that these will prepare them for their future work as consultant biostatisticians.

Nagpur, India. My association with UNC's Department of Biostatistics as a visiting scholar during the year 1997-98 proved to be very beneficial personally, both on the academic and non-academic fronts. Besides upgrading knowledge, it provided opportunities for professional development. A faculty member served as mentor, and played an important role in shaping and guiding students in their professional career. The collaborative research activities initiated during the one-year training period have resulted in presentations at national and international meetings as well as publications in peer-reviewed journals. As a result of good mutual understanding, several academic and research projects have been jointly undertaken that are mutually beneficial.

The one-year training of the Robert-Wood Johnson Clinical Scholars Program Core Curriculum (CC) at UNC's School of Medicine provided insight about the application of epidemiological methods to real life situations, and a platform for interaction with the same group of clinicians throughout the year. One of the activities under the CC required the students to write proposals as if they were in response to Requests for Proposals (RFPs) from the USA National Institutes of Health, with periodical assessment of the protocol by two independent peer-group reviewers and the chair of the CC. The exposure to such activities enhanced the capacity and strengthened the skills of the participants. In my case, the protocol developed as an academic exercise for the CC was externally funded by USAID. Thereafter, two more grant proposals for organizing training workshops were supported by the International Clinical Epidemiology Network (INCLEN). The efforts were further rewarded by my nomination as a member of the Capacity Building Subcommittee (CBS) of the Indian Clinical Epidemiology Network.

São Paulo, Brazil. Although at the time I was a graduate student (1979-1984), the Department of Biostatistics did not have a formal training in statistical consultancy, the idea that this was a major issue in the education of statisticians was already rooted in the minds of faculty and students. This was evident from the many research projects conducted by faculty members as well as from the activities of the Biometric Consulting Laboratory, where I had the opportunity to work during my stay in Chapel Hill. In this context, the most striking contribution of the Department to my education was the idea that consulting and methodological research activities must walk side by side. In fact, during my career, I have hardly ever dealt with two problems requiring exactly the same solution and this is where the combination of ability in research and application is most fruitful.

In developed countries, consulting skills may be acquired on the job, since, in general, the new graduate will work under the supervision of senior statisticians who may complete his/her training in actual practice. In countries like Brazil, however, this is not true. There are not enough senior statisticians in the job market and many times the new graduate will be responsible for all statistical analyses. Unfortunately, formal academic education may not be sufficient to support such responsibilities and some alternative means of providing actual consulting experience is required. At the Department of Statistics at the University of São Paulo, this is one of the activities sponsored by the Statistical Laboratory, created in 1974. Besides providing statistical support to investigators from the University and other institutions, the Statistical Laboratory offers a two-semester course similar to what is done at present at the Department of Biostatistics at Chapel Hill. The course is offered to senior students who must have successfully completed the methodological courses in the Department. They must analyze real world problems under the supervision of a faculty member, keeping track of the underlying methodological issues. Formal training in report writing, presentation skills as well as

consultant/client interaction management is also considered. During the past five years the Statistical Laboratory completed the analyses of 150 projects from 50 institutions and involved around 90 students and 20 faculty members. More information (in Portuguese, for the moment) is available at www.ime.usp.br/~cea .

Bogotá, Colombia. The master's program in Biostatistics at UNC gives students not only the possibility to learn good theoretical and methodological aspects, but also to have the chance to learn using applied problems. After 8 years of finishing my training, I would like to mention two of the most important courses that helped me a lot after I came back home: One on statistical consulting that was a problem-based course in which each student had to play the role of statistical advisor of the project. In that course, we had to start by analyzing the research question from the statistical point of view, helping in the formulation of the final objectives, working together with the main researcher in the definition of the study variables that were to be measured, define the collection and cleaning data processes and define the data analysis. At the end, the results of all of these activities had to be presented to the class.

The second course was on survey sampling, and each student had to play a specific role not only in the design, but also in the development of a sampling problem under the direction of the instructor. This course also gave me the chance to work as a member of a research team that had specific tasks from the whole process. The team members were students from very different cultures and environments. This fact improved our work since each student had his/her own experiences to relate to some aspect of the process of the research. There were also different opportunities in which, as a Biostatistics student, I had the possibility to participate in the review and evaluation from the statistical point of view of different proposals presented by my classmates who were students doing their training in clinical epidemiology. Once I came back home, I continued working as a faculty member of the Clinical Epidemiology and Biostatistics Unit at the School of Medicine at Universidad Javeriana. Some of the activities that I have been involved with as a current associate professor include teaching, advising various research projects, collaborating with investigators, and providing statistical consultation.

Temuco, Chile Even though I had prior consulting experience at my home institution (Universidad de La Frontera) before coming to UNC in 1990, the consultation training I received allowed me to completely change the way I was doing it before. I was the only biostatistician with a master's degree in my home institution, and had two other former students starting their career as biostatisticians under my tutoring. Most of the time I spent in consultation was creating databases, either for storage or analysis. The scarcity of technological resources did not allow me to allocate time for providing consultancy on design and methods, but only for data management and analysis.

At UNC, I learned a new way, for me, to do consultancy. I learned to have more time allocated to talk to the researchers, understand better the real life problem they are facing, and explore alternative analysis techniques. This I believe allowed me to give a much better quality type of consultancy. Once back in Temuco, I applied what I learned not only in statistical methodology, but also in providing consultation. I first trained my other junior colleagues. Consultation was provided mainly to researchers coming with their research question. Very few consultations were done that were only requests for data analysis. We started consultancy at the international level, since a Latin American Masters Program in Clinical Epidemiology was initiated and graduate students came from various Latin American countries. A relationship with the National Eye Institute of the National Institutes of Health (NEI/NIH) of the USA was also initiated due to an introduction made by my mentor at UNC. Our center is currently the "Data Management and Statistical Coordinating Center" for studies in various countries on refractive error being funded by WHO. Another important study, the "World Studies of Abuse in the Family Environment" (WorldSAFE) is also being coordinated (data management and statistical analysis) by us for Chile, Egypt, and the Philippines.

Bangkok, Thailand. When I was a student, I had the great opportunity to help my faculty supervisor review protocols submitted to the General Clinical Research Center (GCRC), work directly

with investigators regarding study design and data analysis, and prepare manuscripts. The protocols submitted to the GCRC varied from an investigator-initiated to an industry-sponsored one. The design ranged from a simple (e.g., pilot study, prevalence study) to a complicated one (e.g., cross-over, interim analysis). I had learned a lot from my supervisor, for example, topics to be reviewed, how to write a review comment, how to present it to the other reviewers and investigators, how to effectively communicate with clients and how to write a manuscript. Since I'm now working at Clinical Epidemiology Unit, Faculty of Medicine, Mahidol University and the work I'm responsible for is very much like the work at GCRC, the experience at GCRC was extremely beneficial to my career.

Santiago – Chile. Since 1944, the School of Public Health of the Universidad de Chile has given a high priority to biostatistical training and to consulting within that discipline. As such, one of the most relevant groups within the School is the Division of Biostatistics, responsible for teaching in all undergraduate as well as graduate departments of the Faculty of Medicine. In 1981 the masters in Public Health was created and in 1983 the one in Biostatistics.

The training I received at UNC has been very important in many respects. First I would like to note the professional quality and the extraordinary personal traits of those with the important mission of imparting knowledge. My one-year tenure at the Collaborative Studies Coordinating Center, the knowledge I acquired from the Biometric Consulting Laboratory, and the evaluation strategies in most of the formal courses I took at UNC, were very relevant to update the teaching methods used for many years at my institution. Together with these, the knowledge acquired in the different courses and specifically in the biostatistical consulting course has been important in modifying our curricula. We now give a greater emphasis to applications, especially those that deal with our own consulting experience in various projects. An additional outcome of the training has been the creation, jointly with UNC, of the “International Center for Coordination and Conduct of Collaborative Studies” (CICEEC). Its objective is to provide consultation in epidemiological research and in clinical trials to investigators in pharmaceutical companies as well as in the public sector.

DISCUSSION

The experiences from the various students at UNC's Department of Biostatistics varied considerably. Factors influencing the experiences included their specific training program, whether financially supported by a graduate research assistantship or not, the number of years in residence, and the date of their training at Chapel Hill. Regardless, all noted the need for consultation training. Many if not all have implemented similar training programs in their institutions in their respective countries. It should be an integral part of any training program for future biostatisticians or any other field of applied statistics. Practical consultancy (hands-on) is a critical issue in training biostatisticians for success.

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