Consultancy Can Be of Service to Teaching, Research, and Extension Activities

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INTRODUCTION

Teaching can be understood as helping a student to learn something, and learning is related to gaining knowledge by studying and reading. As always, in the school environment, teachers are worried about knowledge transmission, but they do not pay attention to learning aspects, for many reasons: some think University studies are for some special students, not for all; some other think research is the only worthwhile University activity, so the students must look for acquiring knowledge with their own skills etc.

Society has changed and the school can not remain as an old-fashioned institution. The belief in the knowledge transmission needs to change and this old paradigm is now in the firing-line. Nowadays, students require more action and less passivity inside the school, in order to gain knowledge through experience and learning by doing. In order to change the school structure it is necessary to reject a fragmented curriculum, by integrating the different fields of knowledge. It is time to develop new strategies favouring the knowledge sharing.

According to Probst et al (2000) there are many individual and cultural barriers against knowledge sharing. Those authors are referring to business organisations, but we could, undoubtedly, associate that fragmentation to the school environment: we consider the **hierarchical barriers**, which are the horizontal ones, as the different school years**,** and the **functional barriers**, the vertical ones, as the building of the pre-requisites.

So, we can see the school structure as a set of islands, in which the students are normally lost. Paradoxically, the school system is not prepared to share knowledge due to several reasons, which include system lethargy, organisational facility due to fragmentation, teacher's autonomy regarding his/her discipline, student's alienation (due to the school paternalistic way of life) etc. Integrated disciplines could be the starting point to this sharing, and it could be done by introducing learning through projects.

PROJECTS

The word project comes from Latin (*projectus*), and means intention, plan, proposal, …so to work through projects means breaking barriers, building new ways, throwing oneself to the future, …So in the new century, where the relationships and the expectations have changed, the pedagogy by projects seems to be appropriate. In this context, the word teaching seems to be inappropriate, since it gives an idea of passivity. It must be combined with learning, to give the idea of activity. So, from now on, we are going to write **teaching/learning** instead of teaching. A project based activity is going to be described through a regular discipline, named Applied Statistics, from which we were in charge for several years.

This discipline is offered to final level undergraduate students of Statistics at the University of São Paulo (Brazil) and it is linked to the **Statistics Applied Centre (CEA → *"Centro de Estatística***

Aplicada"). The main activity of this Centre is to work and solve questions posed by researchers from several areas of the University, as well as to analyse their data.

Many people participate in these activities: researchers, advisors, assistants and lecturers of the Department, but the main actor is the student. Usually, there is a selection among several projects, which are chosen through a number of criteria. One important point is to have a clear definition of the problem, that is, the researcher must have a well established question.

In general, the Centre receives more researchers from biological and human sciences than from exact sciences. However, if we think about the differences among scientists' behaviour it is not a surprise. Broadly speaking, according to very known historical movements in science we can find two kinds of scientists' attitudes:

- **empirism** – the researcher collects many, many data and wants to discover whatsoever related to them.
- **rationalism** – the researcher has a theoretical model, developed through the genesis of the phenomenon, and collect data to confirm that model.

Often, people with a strong mathematical background prefer the second group, while those with weak mathematical skills stay in the first one. In addition, those who choose the rationalistic way are generally able to analyse their data, because they also have heavy statistical tools. So, it is easily understandable why physicists are in the second group, while human and biological scientists are in the first one. In fact, taking into account the last seven years of consultancy through the Centre, of 175 projects done, about 80% of them were related to Human and Biological Sciences.

As examples of projects from different areas with a diversity of statistical analysis we have:

- Risk factors for coronary diseases in aged patients – Medicine – **Logistic Model**
- Analysis of the bio-rhythm of fish submitted to a stress condition - Oceanography – **Periodograms**
- Planning of an experiment for inspection of micro-organisms in cheese – I. Adolfo Lutz – **Latin Square**
- Urban Violence in São Paulo, Brazil – Human Sciences – **Violence Indicators**
- Promptness to a stimulus – pre and post training – Faculty of Sports – **Repeated measures analysis.**

Project development

The different stages of the project development, that involve mainly the student and his/her adviser are:

Stage 1 – Understanding the problem

a – The project motivation. It is an opportunity to think carefully about the problem proposed by the researcher. Clarity.

b – Method: the way the investigation was carried out - the observed / measured characteristics : which and how? is there any controlled characteristic?

Stage 2 – Preliminary analysis

a – In few weeks, the student will present to the class (with both the researcher and the advisor present): the project itself, the planning of the experiment with material and methods, the classification of the involved variables and the complete descriptive analysis

b – The entire class group will be involved, and it is an occasion to share ideas about the data and the analysis

Stage3 – Inferential Analysis

a – Usually, there is more than one only way to choose, and the searching process is stimulating It is time to use either well established tools or a special technique – so the student needs a theoretical reference basis: books, journals etc.

b – there is a second presentation to the entire class, now with all the formal aspects of the analysis – in that occasion, the student's advisor can pose some questions and even complete, to the audience, some of the student's explanation. It is time to discuss also ethic aspects.

Stage 4 – Final results

a – the final report is prepared, with the technical details placed in the appendix, as well as the complete set of data.

b – a final presentation to the complete group takes place, with the presence of the researcher and his adviser, who are asked for to interfere in the discussion.

EVALUATION

During all the project the student goes through an evaluation process, taking into account: attitude, search for knowledge, initiative, capacity to expose ideas, argumentation, respect for divergent ideas, the presentation and the written version of the report.

How can we summarise the link between the project and the role of the University, which are Teaching/Learning, Research and Extension Service? The main points follow below.

TEACHING/LEARNING

From this point of view, consultancy develops maturity and ability to listen to the problem , understand the problem, ask the essential, put aside irrelevant aspects, face up to challenge, avoid recipes, improve scientific writing and deal with software.

In addition, to deal with unusual techniques or with a situation that does not conform with some assumptions, the students are required to give private seminars, to be in touch with the newest procedures. So, the learning approach is considered with strong motivation: solving a real problem and learning by doing.

Another important aspect of this activity is that the teacher is a facilitator in the learning process, promoting discussion before giving the solution.

RESEARCH

Sometimes, the proposed problem has not a simple solution or even a solution. Many times we are faced with situations where the assumptions are not met or many restrictive assumptions are imposed. Also, computer programs are not always available for certain techniques so the students have to create even a *macro*. Many programs of scientific initiation have begun with problems of such kind, and the students can also have the opportunity to investigate new procedures. Some examples: diagnostics in regression analysis, robust methods, covariance matrix structure for longitudinal data, sampling size determination with a special stopping rule etc.

EXTENSION SERVICE

The main side of this third aspect is the integration of the student with professionals of other areas. The positive aspect is that it put in evidence the respective academic competencies of both sides, where the student (a future professional) learns to respect a scientist to whom statistics is not very familiar and the researcher recognises statistics as a complete academic professional field and not as a mere auxiliary. This last aspect is due to the unbalanced energy between computer advances and understanding of the statistical method, by people in general. Increased attention should be given to help consultants to make decisions and to present a report with understandable terms to the other area of knowledge.

FINAL REMARKS

What makes the difference? The process. The real importance to the student is the process by which the student starts from a completely unknown stage and goes on, making contacts with a new area for him, understanding the client's problem, developing his knowledge of data analysis and improving his tools of inferential analysis. All these actions are done to solve the researcher's problem, that is a genuine problem.

If we wish to break barriers, this kind of activity is the best way, mainly if we introduce the beginners (students from the initial years). According to Moore (1997) the ASA recommendation for a modern statistics undergraduate is to foster active learning, through the following **alternatives** to lecturing: Projects, group problem solving and discussion, laboratory exercises, written and oral presentation. The above described project based activity considers all these items, followed by strong student's and teacher's motivation. The challenge is to succeed in doing the same with other disciplines, and our suggestion is to make the entire course more integrated, by letting all the students participate of these projects, even if they are not independent intellectually – probably he will be much more interested in learning because he understand the meaning of what he is learning.

If this activity can be developed through a mutual respect, the students will become their advisers' partners, being part of a continuous process to acquire knowledge, which is the University vocation.

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RESUME

Dans l´Université les principaux étages d'activités sont entendus comme l'enseignement, la recherche et les services a la communauté. Dans cet article on va montrer comme ces trois piliers peuvent être presents dans une discipline de statistique à l'Université. La discussion doit être sur les activités de consultation comme une discipline regulière qui portera l'amélioration sur les relations entre les trois aspects déjà mentionnés: l'enseignement, la recherche et les services a la communauté.