TEACHING STATISTICS BY RESEARCH: THE ORGANIZATION OF A SURVEY

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In this paper we focus on the part of the compulsory mathematics education curriculum in Greece, which concerns the collection, analysis, organization and presentation of information, namely statistical data. Statistics can be used as an organization tool for class activities aimed at the understanding of statistics, and/or as a methodological frame for the organization of activities for other subjects within the class. Statistics should be seen as a tool for the creation of an interactive environment. A project-based course in Statistics was introduced in the Department of Education, whose graduates become teachers in elementary education in Greece. This paper explains different aspects of the course, emphasizing the important role of the interactions between the students and the results obtained.

INTRODUCTION

Teaching Statistics by using projects, is not a new idea. Several authors deal with this approach. In this paper we comment upon the problems and the advantages of this particular method in comparison with others.

1. The lesson's structure is orientated on the general targets and skills that every pupil should have met through the teaching of statistics in Grades 5 and 6.
These targets do not correspond with the time assigned by the curriculum, and mainly refer to the pupils' understanding of the procedure and importance of organizing, doing research and processing data and information, skills that allow a critically thinking citizen to evaluate information. Although this is very important, limited time is assigned by the curriculum (four and five hours for grades five and six, respectively). Furthermore, the teachers do not have proper training in statistics.

2. One of the catchphrases to emerge in recent years is the "information explosion". Nowadays, we can widely define statistics as, "the science that has to do with collecting, evaluating and processing information". Because of the ready monitoring and public measuring of ratings, political parties, people, education parameters, the economy etc., now more than ever, society demands quality information without "noises" that are deliberately or inadvertently included.

3. The limited access of statisticians to the educational planning processes, the confused belief of some researchers that they know statistics because they use some statistical methods and techniques in their research, together with the limited use of official data in education, lead to the stereotype that statistics has to do only with using statistical software, listing and indexing results and graphically presenting data.

4. Pupils in school do not use projects/assignments. As a result they do not have the capacity to:

- identify and locate sources and information;
- acquire and select data;
- organize, process and present data and information.

Thus, pupils are not able to combine information.

5. Teaching statistics is necessarily a decentralized process. It depends on the audience to be taught. It refers to teaching methods and processes and not to different exercises and examples. Generally, it is accepted that there are three main approaches for teaching statistics, as listed below.

a) Statistics through its theory.

This approach is based on:

- the good knowledge of statistical and stochastic concepts, and,
- the good knowledge of combinatorics and calculus.

b) Statistics through the organization of projects.

This approach is based on:

- the analysis of the context of the project,
- the use of calculating machines, and,
- the background of the learner

c) Statistics through paradigms and "laboratories".

This approach is based on the choice of paradigms and the laboratory frame.

6. In this paper we refer to the second approach and describe its use in the organization of a course for the students of the Department of Education of Aristotle University of Thessaloniki. These students consider themselves mathematically and

statistically uneducated. Most of them have a theoretical background and the proportion of females is 80%.

THE COURSE

Defining the Subject

One of the most important steps in the process is choosing the subject. The subject must be of interest to the majority of students; it should be decided on through guided discussion with them and they should be familiar with it. Also we should take into account the number of students. The same subject was chosen for all students (173), in order to have the collected data and information analyzed extensively. We decided to examine the problems of the *Youth in Thessaloniki*.

At this level, our objectives were that students through their participation in this research, would be able to describe a subject in general, knowing its bounds, and be able to make assumptions for the concepts and characteristics that are involved in this process.

Describing the Monitoring Method

At this step, the design of the sampling survey was chosen from the possible methods. It is known that there are three main methods, namely:

- executing a sampling survey,
- using databases and bibliography, and,
- organizing (designing) an experiment.

The main aim was to present the aforementioned methods and to choose the one appropriate for the problem being studied.

Population Definition

In every survey it is necessary to describe the population under consideration before defining the sample. At this stage it is important to consider the significance of the sources (official statistical data) and the importance of using a common code so that any patterns will be understood.

It is generally impossible to describe the population extensively. So, indirect description of the population was chosen by defining “observation spots”, places where someone could meet young people; for example, schools, cafes, gyms, libraries. It was decided that the first stage of the research would be the recording of all these

places/establishments. The city was divided into recording zones, based on administrative divisions (municipalities, suburbs, neighborhoods) with the use of analytical maps of the National Statistical Service of Greece (NSSG). Each student was assigned a specific area, and by considering the suburb identified by their area, grouped into teams in order to understand the importance of teamwork. In this step, students gained an understanding of the concept of the sampling unit.

The population of observation units was assigned into greater geographical areas. A sample was drawn from each division. In describing the population, students realized the concept of distribution and the use of contingency tables as a descriptive tool.

In addition, some results were obtained on indices such as, population density and Aurbanization", which represent socio-economic characteristics in accordance with the official records. For this, we designed a recording paper. The recording paper is an interim step in creating a database and it must be simple, sharp and easy to use. In the recording paper data such as the address and title were recorded. This task requires personal participation of the researcher. It also requires unified code patterns for the variables involved. Approximately 5,000 establishments were recorded throughout the whole city. In this step the students realized the difference between a recording paper and a questionnaire.

Formation of the Database

A database was designed and created, having the "observation spots" as records. The students learned the structure of a data-set organized as a database in which each row (record) stands for a case, and each column stands for a variable (characteristic). Furthermore, they organized the data as a geographical data base with the use of a geographical information system (GIS).

Description of Population - Sample

Defining a sample is a difficult step. Usually the concept of representativeness is confused with the concept of randomness. Although the main purpose should be the choice of the sample according to specific variables (characteristics) which should then be used as independent variables in the analysis, usually, most of the attention is given to technical details of cross-sectional methods.

Sample Questionnaire

The final questionnaire was formed. It referred to characteristics of the Youth and included independent and dependent variables. The aims of the questionnaire were identified and the underlying assumptions were clearly stated. The difference between independent and dependent variables was realized. The students understood the use of the sample statistics in the estimation of population parameters according to the measuring scale. It was decided that 15 questionnaires would be collected per observation spot, and a total of 3,000 questionnaires were collected and computerized.

Data analysis

The final stage comprises the data analysis. Students, divided into teams, presented the specific data for every geographical unit. The aims of this analysis were an understanding of the concepts of :

- weighted mean value and confidence interval;
- statistical significance;
- choice of the proper test for an analysis, according to the measuring scale;
- use of the independent variables in the definition of sub-populations;
- use of official statistics;
- forming a population as anchor points, joining sub-populations.

Problems

The main problem was that the majority of the students failed to “generalize” (from examples to abstract models). In addition, it has proven difficult to reverse the students’ need for specific “rules” and “procedures”, which arises from the traditional educational system.

Generally, the students’ progress was assessed by a test, given at the semester’s end. The results showed that their progress has been improved in relation with their progress after a semester of classical teaching. Working with two teams (in different semesters) we were clearly successful in teaching statistics through research planning with respect to most of the teaching objectives. Of course, this is due to some extent, to the informal nature of the course. Finally, it is important that we should train these students

in how to teach. They must realize the significance of the method (project), in conjunction with the subject matter of the course (statistics).

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