

GRADUATE STUDENTS AND THEIR USE OF STATISTICAL KNOWLEDGE IN EDUCATIONAL PSYCHOLOGY

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This work describes the use of statistics made by graduate students in the field of Educational Psychology at the National Pedagogical University, when writing their theses or dissertations in support of their candidature for a degree of professional qualification. The results show that, in general, the thesis writers used statistical analyses when their investigation required them; however, it was found that students mainly have the following difficulties: a) their choice of a suitable statistical test concerning their objective of research; b) the way of interpreting data; c) selection of the design consistent with their objectives; d) in their comprehension of the meaning of some statistical concepts; e) in their decision use of charts or graphs. Finally the work concludes by discussing the pertinence of the contents, strategies and procedures of instruction and evaluation of courses in statistics.

INTRODUCTION

In the last years, statistics has become part of basic, secondary and higher education curriculum, intending to make of it a useful tool for the students, fostering their personal development, so that they are able to handle information, to process and to predict data. In this sense, the teaching of contents in relation to statistics has increased in curricular plans of various countries. Batanero (2001) raises the issue that the main goal of teaching statistic is not to make future citizens statistical fans, but rather to enable them to apply statistics reasonably and efficiently to problem solving.

Batanero (2000) states that if the teaching of statistics begins in higher education, students will find it difficult to learn all content, and they will be induced only to memorize it. This kind of learning will be of no use for any application in their professional jobs. The author reveals in other research the difficulties that students display when they use statistics; that is, not being able to understand the meaning of a concept (Batanero, 1998), interpreting and understanding in an incomplete or incorrect way charts and graphs (Batanero, Godino, Green, Holmes, and Vallecillos, 1994; Shutter and Well, 2000). Other authors show the importance of teaching statistics, and simultaneously illustrate the difficulties students face to learn it, mainly higher education students who try to use statistical tools in their subjects of academic study.

In a study made by Murtonen and Lehtinen (2003), graduate students in the fields of education and sociology were asked what they considered the main cause of their difficulties in learning statistics and quantitative methods. It was found that students attribute their difficulties mainly to: a) having received a superficial education, b) not linking theory and practice, c) not being familiar with related concepts and contents, d) not being able to create a comprehensive image of the information to really understand it, and e) a negative attitude towards these contents.

The authors state that the students talk about these factors cause difficulties probably because their teachers use a language not easily accessible for them, their previous knowledge does not correspond to the level the teacher supposes students have, and/or there is an excess of content to study in one or two courses during their instruction. Other authors also consider the absence of previous knowledge in students as being another cause that makes it difficult for students. Garfield (1995) states that students cannot understand concepts such as probability and correlation if they do not possess a previous proportional reasoning. It has also been found that students' previous knowledge is correlated positively both with their attitude towards statistics and their attitude to learning it (Cerrito, 1999; Gil, 1999) that is, if the students lack previous knowledge about statistics, it is likely they will have a less favorable attitude towards this area, and they are expected to achieve a low level when learning statistics as well.

It also has to be discussed that the characteristics of the teachers who instruct the courses in statistics in higher education, often are those of mathematicians or actuaries with no specific

educational training for the teaching of statistics. Many of those professors have not been trained in applied statistics either, nor in the subjects their students are taking (Gould, 2004; Sorto, 2004). In short, Sorto (2004) states that in the teaching of statistics, the professors' background is important. Also important is suitable use of various resources such as computers and the web; the collaborative work, the dialogue and the debate, and the relation of the use of statistics to the reality that will furnish the students' careers.

In Mexico the importance of statistics has become a commitment in curricular plans among different higher education institutions. The National Pedagogical University, in its regular school system, teaches statistics in five of seven careers during the first two semesters. Two courses are taught specifically in Educational Psychology, Basic Statistics and Applied Statistics to Educational Psychology. Although courses in statistics are placed in the first semesters in the field of educational psychology, the objective is to equip students with the knowledge and the capacity to use statistical procedures in their academic and professional development. These courses are not wide enough, but rather of an introductory nature to enable students learn how to use statistics as a tool to improve their research.

For that reason the present study seeks the fulfillment of the following objective: to describe the use of statistics in educational psychology among graduate students from the National Pedagogical University (UPN), Ajusco Campus.

METHODOLOGY

First Stage

221 UPN Educational Psychology dissertations were reviewed, mainly the ones written between 1995 and 2004; in this first stage, theses were sorted out according to those which displayed some type of statistics analyses and those that did not.

Second Stage

It was found that 72.9% of reviewed theses presented statistical analyses. A more detailed analysis was made to determine how and what students did, who used some technique or process of statistics to describe, to analyze and to represent the results of their work. A format was designed in which information referring to the objective of the work appeared synthesized; it also showed the methodology used and the presentation of the results. An analysis of the observations made about each thesis was carried out. Afterwards, a series of categories was made, representing the most frequent difficulties among graduate students. Three different persons reviewed and analyzed the thesis; we have decided to include when they agreed.

RESULTS

In this section, each one of the found categories is described, an example is showed in some cases.

1. Incorrect Election of the Test or Statistical Tools

The student chooses a test or statistical tool that does not allow him/her to find the results raised in his or her objectives. The student uses correlation in order to compare the answers in a design pre-posttest.

2. No Data Interpretation

The candidate presents the statistical results in a chart or graph, or the values obtained in a statistical test; later on he/she simply makes a description of the data, with no data interpretation.

Table 1: Score obtained by a school

School	Score
School 1	8.3
School 2	8.9
School 3	7.3

"... as we can clearly see, school 1 had an 8.3 score, school 2 obtained 8.9, and school 3 obtained 7.3..."

3. *Erroneous Interpretation*

The writer of the thesis displays some interpretations of the data collected, but with some errors due to lack of knowledge of the meaning of some symbols, the use of the test, the meaning of values obtained in the process, to mention some of them. In the case that is being shown, the cause can be attributed to lack of knowledge of the characteristics of the test.

After the following data: “Relation between school-area 3 (verbal reasoning), $R = 359$, $p \leq .019$,” the authors conclude that “... there are significant differences between the school 1 and school 2 as far as verbal reasoning is concerned.”

4. *Confusion About Statistical Concepts*

The thesis writer uses in an indiscriminate way a concept for another, for example, association for correlation or validity for reliability.

5. *Error as a Product of an Objective Badly Raised*

The thesis writer raises hardly clear objectives, which change during the task; from this difficulty one derives an inadequate methodology and, as a consequence, analysis of inconsistent results.

6. *Excessive Use of Graphs and Charts*

By judging a future presentation to have clearer results, the thesis writer displays data in graphs and charts; in addition, he/she sticks to a formal description. See the example of category 2. Many theses also showed that charts and/or graphs are used to display irrelevant or unnecessary information for the purpose of the study.

7. *Inadequate Design*

The thesis writer raises an inconsistent methodology with the objective of the work; that is, the selection and allocation of samples, techniques, instruments or procedures are not adequate for the task.

The objective of a thesis was: “To train a group of children of 6th grade primary school in the use of strategies improving reading comprehension of expositive texts through two models of instruction: Direct Instruction and Reciprocal Education.” Hypothesis: a) “Both intervention procedures will produce significant changes in reading comprehension.” b) “the group that gets reciprocal education will have higher marks than the other group.”

Design

Group	Previous evaluation	Treatment	Final valuation
Group 1	X	Teaching the strategy of the main idea through direct instruction.	X
Group 2	X	Teaching the use of the three <i>macrorreglas</i> (main ideas) through direct instruction	X

It aimed at finding out whether the treatment (educational program) produced significant differences between both groups; therefore, the only thing that had to be changed in the treatment was the type of teaching structure, and not the type of strategies. With that kind of design it cannot be known if the differences are due to the type of education or to the type of strategies.

8. *Use of Non Valid Instruments*

The thesis writer uses instruments to gather data, which by means of the construct that is measured and the reach intended in the research had to be within a reliability set and validated.

DISCUSSION

The use of statistics in a practical, professional situation (writing a thesis) turns out to be complicated for graduate students in the field of Educational Psychology at the National

Pedagogical University, Ajusco Campus. It was found that, in a number of the theses, the use of statistics was itself a problem that prevented the thesis writer from reasoning according to statistical standards. Although the analysis of the internal coherence of the tasks (consistency with objective, methodology, results and conclusions) does not allow us to know accurately the type of statistical reasoning that graduate students use when they made their theses, it is possible to deduce that, in some cases, their reasoning was elementary or almost nonexistent.

We assume that the inadequate use of statistics can be due to various aspects, as isolating education from a real context. In this case the teachers who give lessons in statistics in Educational Psychology are the same ones who teach it in other university careers, thus, it turns out hardly viable for them to prepare specialized class material, basing their objectives on the students' subject, since the goals of the various courses they teach are very similar.

Another factor that we believe important is that the students of Psychology take courses in statistics in the first two semesters, when they do not possess yet a sufficient knowledge of Educational Psychology to relate it to statistics and discover its advantage by using it in this area. We suppose that the students' knowledge cannot go ahead, for the courses that come after demand the knowledge of statistics, but students are not supported to continue developing that knowledge. We think it would be better to teach statistics from 3rd semester on, once the students have already learnt how to relate psychological facts to statistics. It is also desirable to practice statistics during the degree courses in procedural knowledge, which begin in 3rd semester and finish in the 8th one. Perhaps in this way, the learning of statistics would extend all through the studies, and maybe in the last two semesters it could be included as an elective course.

One more suggestion would point toward using statistical data, found in specialized journals, to teach statistics that allowed the student to discover the real and daily use of this resource. It is also necessary to consider Murtonen and Lehtinen's findings (2003), about the causes attributed by college students to their difficulties in learning statistics: among other things, lack of links between theory and practice, unfamiliarity with statistical concepts, inability to create a comprehensive account of statistical or mathematical problems (Sorto, 2004), and having a negative attitude towards courses in statistics (Gil, 1999). It would be interesting to make a study in this University in order to know if the students attribute their difficulties to causes mentioned above or to other ones, so that the University can count on pertinent information to improve education in this subject.

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