Perception of Importance and Anxiety about Learning Statistics Among University Students in Lima

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Abstract

This research was carried out with 270 students of a private university in the city of Lima (Peru) who were taking general education courses with the intention of finding out their perceptions regarding the importance of statistics and their anxiety about learning it. For this purpose, a brief questionnaire was elaborated with response selection items. Likewise, we were interested in knowing the (declared) anxiety generated by learning statistics. The results show that the variable type of degree area is significantly associated with the perception of the importance of statistics for professional practice, and that students of Engineering and Management valued this discipline more highly. On the other hand, statistical anxiety in women is much higher than in men.

Key words

statistical perceptions, statistical anxiety, statistics
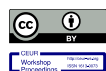
1. Introduction

Nowadays, statistics is a fundamental course within the curricula of almost all university education alternatives (undergraduate). Thus, at least one compulsory course must be taken during the first two years of general education [1]. Thus, the importance of statistics becomes evident only when one enters university, but not in basic education, where it seems that the teaching of these contents is diluted within the curricular area (subject) of mathematics. [2], [3].

Thus, although there are still problems associated with the teaching of statistics in higher education (non-university and university), the need to incorporate these courses or subjects within a framework of understanding identified with statistical literacy, statistical reasoning, statistical awareness or statistical thinking, among other similar considerations (which would not necessarily mean the same thing), would have been understood. In any case, the strong idea that statistics is vital not only to guarantee a better professional practice -and deployments in the field of science and technology-, but also to ensure a much more relevant exercise of citizenship, has been assimilated. Also, the authors mention that statistics today should lead us to consider it as a discipline that makes it possible to move from data to information, and from there to be projected to decision making. The latter coincides with the connotations of this discipline, which is not limited to the cognitive dimension, but also to the applied or technological dimension. In this framework, empirical evidence reports favorable attitudes in future teachers of basic education as well as in the university environment [4]–[6]. Already in university students in general have reported considerations about the usefulness of statistics, but difficult as a discipline [7].

However, historical problems persist in its teaching, such as, for example, the emphasis on algorithms rather than on statistical reasoning. In addition, students often have to face a teaching that is little contextualized or incarnated in the usual uses given to statistics for professional or scientific purposes and/or for the exercise of citizenship. Similarly, background studies also report that statistics is often not taught hand in hand with statistical programs (statistical software) or a spreadsheet such as Excel. This would have repercussions in the formation of negative attitudes (from basic education as previous negative experiences) towards statistics [8], [9]; which in turn would impact students' dispositions towards learning [10]–[12].

But it is also reported that anxiety and fear in learning statistics at university may be due to the irrelevant experiences they went through during their primary and secondary school years [13]–[16]. Similarly, failure to exploit the full potential of statistics in basic education (e.g., teaching it in research contexts or within projects involving one or more school subjects) would condition university students in their first semesters with fear, resistance, anxiety, and reduced self-efficacy in terms of their learning. The latter has given rise to a series of important efforts in universities around the world concerned with guaranteeing meaningful learning, and therefore also intrinsically motivated, from the first courses, which has led to the emergence of research groups and the design of new ways of teaching it through experimentation.

The research tradition in these topics, such as attitudes, dispositions and statistical anxiety, has been supported by psychometric instruments that are the backbone of the studies. For example, the Scale of Attitude towards Statistics (EAE-25) of Auzmendi is one of the most widely used in Latin American environments [17].

Under this scenario and considering that there are not only problems in the teaching of statistics in basic education, but this study also aims to analyze the perceptions regarding the importance of statistics and the anxiety that would arouse their learning in a sample of students (different degree area) belonging to a private university in the city of Lima (Peru).

2. Methodology

A quantitative observational (non-experimental), descriptive, comparative and correlational study was developed. Specifically, this is survey research with the questionnaire as an instrument. The sample consisted of students from a traditional associative university with more than 50 years of existence and located in the city of Lima (Perú).

2.1. Sample

Regarding the description of the sample (n = 270), it should be noted that these university students were studying general studies or general training; and it is for this reason that the vast majority had not yet taken the statistics course. The latter allowed us to study a series of aspects from the perspective of the pretensions of the present investigation. Specifically, regarding the age of the respondents, we found a mean of 18.3 and a standard deviation of 1.6; this in a range that goes from 16 to 24 years of age. The other characteristics are detailed in Table 1.

Table 1
Distribution of the sample according to its characteristics

Characteristics		N	%
Sex			
	Men	105	38.9
	Women	165	61.1
School			
	Public	40	14.9
	Private	208	77.3
	Parochial	21	7.8
Degree area			
	Social Sciences	213	78,3
	Engineering and Management	58	21,3
Approved statistics			
	Yes	59	21.7
	No	25	9.2
	I'm taking it	29	10.7
	I have not yet taken it	159	58.5

2.2. Instrument

For the purposes of this study, the first three authors considered in this paper developed a brief questionnaire, which underwent a review process by experts in the field. This instrument consists of two parts. The first part collects sociodemographic data such as: sex, age, school of origin, degree area being studied and situation with respect to the statistics course. It is worth mentioning that, to carry out a much more concise analysis, the degrees have been grouped (a posteriori) into fields of knowledge or areas of professional training. The second part of the instrument explores the perceived security with respect to the study of statistics. The third part explores (with two items) considerations regarding the importance of statistics for one's professional life and as a citizen. The fourth part, composed of two items, asks about the use of Excel and about whether they know any statistical software. The last part, with only one item, asks about the anxiety that the statistics course generated, generated or would generate in the future. See Annex 1 for the instrument. This application was carried out in person and the instrument was self-administered.

Statistical analyses were performed in the JAMOVI statistical program in its version 2.4.8 for Windows (www.jamovi.org). In this regard, we used descriptive statistics, Pearson's χ^2 and Student's t-test for independent groups or samples.

Finally, regarding ethical aspects, this study complied with the ethical criteria of the National Council of Science and Technology (CONCYTEC) and the American Psychological Association (APA). In this context, it is important to note that the questionnaire was answered under informed consent, anonymously, and the name of the university institution where the sample was taken is not mentioned in this report.

3. Results

For the purposes of this communication, we will report the results referring to the perception of the importance of statistics for professional practice and to anxiety about learning this discipline (which is a compulsory subject at the university where we conducted this study). In this framework, we have privileged in the analyses the independent variables sex (male and female) and degree area (social sciences and engineering and management).

Table 2 shows the distribution of perceptions of the importance of statistics for professional practice according to sex. Thus, no significant association (χ^2= 3.762; Sig. ,439) or differences in these perceptions according to sex were found (t = 1.435; Sig. 1.144). In any case, men showed a higher mean (M = 4.076; SD 1.107) than women (M = 3.872; SD 1.116). It should be noted that to proceed with the T-test we went from an ordinal to a quantitative scale where scores were assigned from 1 (not at all important) to 5 (very important).

Table 2
Perception of Importance of statistics for professional practice according to sex

	Sex	
Importance	**Men**	**Women**
Nothing important	5 (4,8%)	7 (4,2%)
Not very important	4 (3,8%)	11 (6,7%)
Something important	18 (17,1%)	39 (23,6%)
Important	29 (27,6%)	47 (28,5%)
Very important	49 (46,7%)	61 (37,0%)
Total	105 (100%)	165 (100%)

Table 3 shows the frequencies and percentages of the perception of the importance of statistics for professional practice according to the degree area. In this context, we found significant associations (χ^2= 22.688; Sig. ,000) that tell us about that students in Engineering and Management degrees consider statistics to be more important for professional practice. Similarly, we found statistically significant differences (t = -4.481; Sig. ,000) according to the degree area and where those in Engineering and Management (M = 4.500; SD ,755) show higher scores than those in Social Sciences (M = 3.778; SD 1.159). It should also be noted that both men and women report a fairly high valuation of statistics for professional practice, with a slightly higher tendency in favor of men.

Table 3
Perception of the importance of statistics for professional practice according to degree area

	Degree area	
Importance	**Social Sciences**	**Engineering and Management**
Nothing important	11 (5,2%)	1 (1,7%)
Not very important	17 (8,0%)	0 (0,0%)
Something important	54 (25,4%)	3 (5,2%)
Important	57 (26,8%)	19 (32,8%)
Very important	74 (34,7%)	35 (60,3%)
Total	213 (100%)	58 (100%)

Table 4 refers us to the declared anxiety regarding the learning of statistics according to sex. Thus, we found the existence of significant associations (χ^2= 15.301; Sig. ,004) where women would be denoting more anxiety than men. Also, we found statistically significant differences (t = -3.917; Sig. ,000) according to the sex variable and where women (M = 3.26; SD 1.199) would exhibit greater anxiety than men (M = 2.68; SD 1.189).
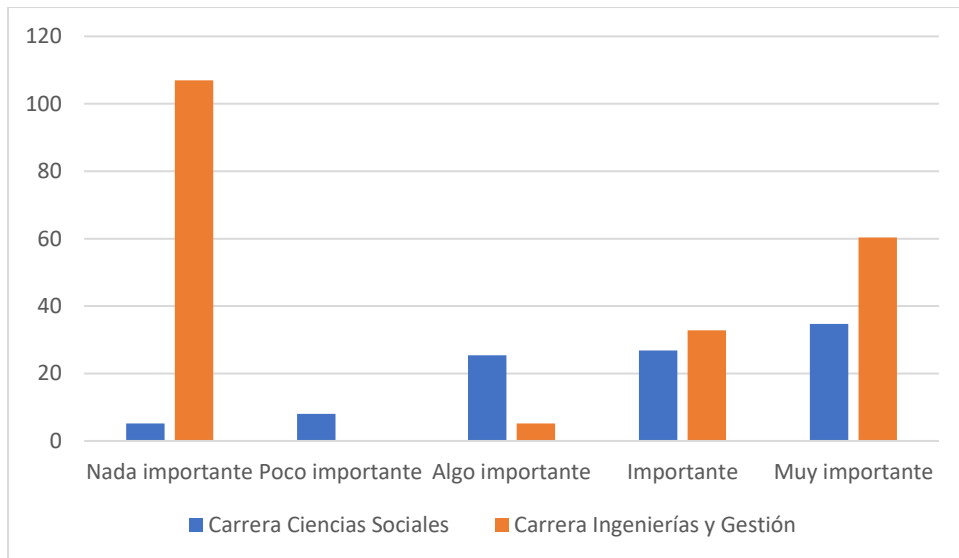
Figure 1: Perception of the importance of statistics for professional practice according to degree area

Table 4
Anxiety about learning statistics according to gender

	Sex	
Anxiety	**Men**	**Women**
Nothing	16 (15,2%)	11 (6,7%)
Little	38 (36,2%)	38 (23,0%)
Some	25 (23,8%)	44 (26,7%)
Much	16 (15,2%)	41 (24,8%)
Too much	10 (9.5%)	31 (18,8%)
Total	105 (100%)	165 (100%)

Table 5 shows that there were no significant associations (χ^2= 7.607; Sig. ,107) between anxiety towards learning statistics and the degree area. Similarly, no statistically significant differences (t = 1.743; Sig. ,082) were found in anxiety according to degree area (Social Sciences M = 3.11; SD 1.233 and Engineering and Management M = 2.79; SD 1.166).
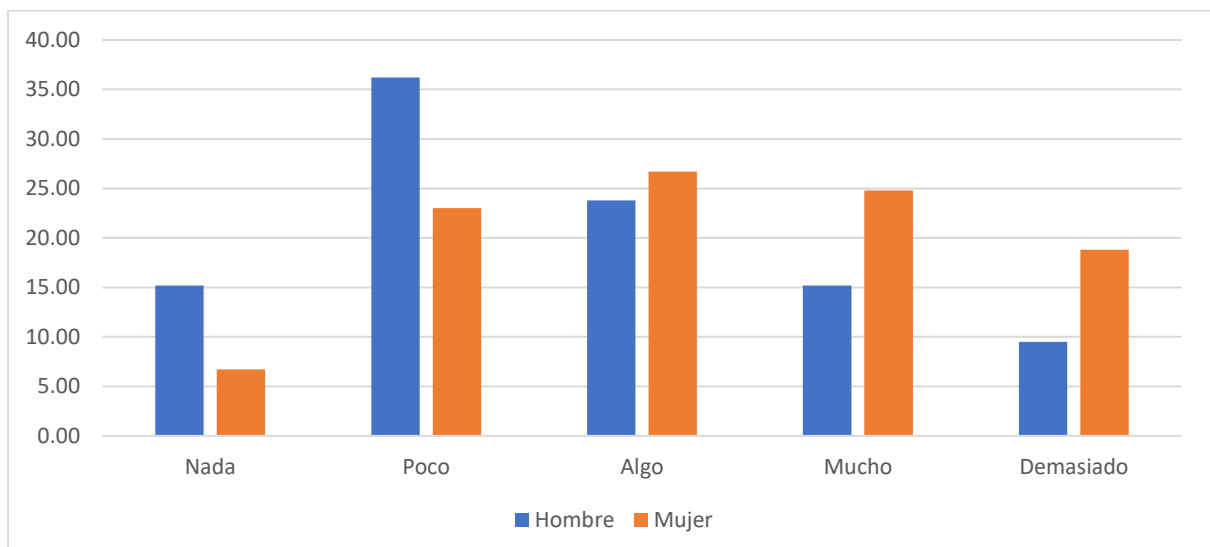
Table 5
Anxiety about learning statistics according to degree area

	Degree area	
Anxiety	**Social Sciences**	**Engineering and Management**
Nothing	20 (9,4%)	7 (12,1%)
Little	54 (25,4%)	21(36,2%)
Some	59 (27,7%)	11 (19,0%)
Much	43 (20,2%)	14 (25,5%)
Too much	37 (17,4%)	4 (6,9%)
Total	213 (100%)	58 (100%)

4. Discussion

The results of this study refer us to situations previously reported by empirical research carried out in recent years. In particular, it stands out that both men and women have the same opinion regarding the importance of statistics for future professional practice (and it is quite high in both cases). However, the differences arise in terms of the type of studies or disciplinary field of the students, where those who study Engineering and Management have higher scores. The latter is largely related to the daily tasks expected of an engineer or business administrator, which are closely related to probabilities, statistics, predictions and the use of programs such as Excel. In contrast, in Social Science degrees, the use of statistics is more limited to research tasks (and when management is performed) and not so much to the usual professional tasks [3]. In any case, empirical evidence shows that attitudes and dispositions towards statistics are more auspicious in non-humanities majors [11]. This could explain these results, while recognizing that the students of the Social Sciences degrees showed a high valuation. However, there is still a need to emphasize among social science majors the importance of statistics for professional practice, the management of our data (not necessarily research data) and its possibilities to critically understand scientific literature. In any case, it offers valuable clues to consider those studies that report positive correlations between attitudes toward statistics and attitudes toward research [17].

In terms of declared anxiety (which to a certain extent refers to fear), the relevance of the sex variable in terms of anxiety or fear before formal studies in this discipline is thus highlighted. Specifically, it was evidenced that women present more anxiety than men regarding their learning. Therefore, this study shows the international trend in terms of the insecurity that is often transmitted (and internalized) to women regarding the learning of numerical subjects such as mathematics and statistics. Similarly, it is likely that this finding is identified with sexist teaching that is prone to transmit the false idea that men are better than women in numbers and science. However, other studies report no differences in anxiety in relation to statistical learning according to gender [13].

Acknowledgments

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Appendix

Statistics in the life of university students

Hello! We are educational researchers, and we are conducting a study on the appreciation of statistics in university students. In this context, we would like you to answer this anonymous questionnaire that will not take more than two minutes.

If you do not agree, please return it to the person who gave it to you.

Thank you for your valuable time!

I. Sex:
Male ( ) Female ( )

II. Age:
_____ years

III. School of origin:

Public ( )   Private ( )   Parochial ( )

IV. What degree program are you studying?

_____

1. Have you passed the statistics course as part of your general studies?

Yes ( )   No ( )   I am taking it ( )   I am not taking it yet ( )

2. How confident do you feel, or would you feel learning statistics content?

Very insecure 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) Very confident

3.   How important is statistics for your life as a citizen?

Not at all important 1 ( ) 2 ( ) 3 ( ) 3 ( ) 4 ( ) 5 ( ) Very important

4.   How important is statistics for your future professional practice?

Not important at all 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) Very important

5.   If you had to give yourself a grade (from 0 to 20) for your level of Excel, what would it be?

_____ grade

6.   Do you know or use any statistical software learned at school or university?

Yes ( ) No ( )

7.   If you checked "Yes", please indicate which one(s)? _____

8.   How much anxiety did, do, or would you feel about taking the statistics course?
None 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) Too much