

**Attitudes Towards Mathematics in Undergraduate Students of
Accounting and Administrative Sciences in Peru**

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The purpose of this study was to analyze the attitudes towards mathematics in university students of accounting and administrative sciences in Peru. The study was descriptive-comparative, quantitative, non-experimental, cross-sectional. A total of 700 university students from study programs related to accounting and administrative sciences, selected intentionally from a public university and two private universities in the city of Arequipa, participated in the study. A valid and reliable instrument was applied to collect the information. It is concluded that the university students present medium level attitudes with a high tendency towards mathematics, being positive in the general attitude and in the cognitive and behavioral attitudes. However, they present negative attitudes in the affective dimension, since most of the students do not like mathematics classes. When comparing attitudes towards mathematics, male students present better positive attitudes than female students; likewise, students in the banking and insurance program present better positive attitudes than students in other programs; and according to the academic cycle, students in the last cycles present better attitudes than students in the first academic cycles.

Keywords: higher education, attitudes towards mathematics, university students, accounting and administrative sciences

INTRODUCTION

The Peruvian education system has a National Education Project (PEN), which is the instrument for the formulation and execution of public policies, in addition, the organizing entity is the Ministry of Education, which must fulfill its functions of supervision, monitoring and evaluation of the curricular designs that are implemented in the institutions of basic and higher education, based on these processes, the serious deficiencies in the academic training of teachers in the specialty of mathematics are evident, as well as the use of textbooks provided by the Ministry of Education and some publishers that have not been developed based on a competency model, the use of school texts provided by the Ministry of Education and some publishing houses that have not been elaborated from a competency model, to this is added the cognitive capacity of the basic education student and the little interest in learning mathematics to solve problems, these situations bring as an effect a student with high probabilities of presenting negative attitudes towards mathematics that at the time of entering higher education become serious learning problems (Flores & Gaita, 2015; Flores & Neira, 2019).

However, university students of some specialties, such as accounting and administrative sciences, that demand mathematics in their academic training have acquired a convenient knowledge about these, which does not imply that they are passionate about mathematics, but that they are indispensable for their training and future professional practice evidencing some attitudes both positive and negative that influence their training and academic performance (López & Escribano, 2018).

Attitudes towards mathematics in university students are conceived from predisposition to valuation, appreciation, dedication, and above all interest in the discipline and learning (Flores & Auzmendi, 2018), prioritizing the affective dimension over the cognitive; likewise, attitudes are expressed through ideas, perceptions, feelings, preferences, opinions, beliefs, behaviors, and ways of acting, highlighting the tripartite or three-dimensional model attitudes as: affective (feelings), cognitive (knowledge), and behavioral (behaviors) establishing positive or negative valuations (Rosenberg & Hovland, 1960; Capote et al., 2022).

In that sense, in the process of teaching and learning mathematics in universities there is a majority group of students who think negatively, that mathematical knowledge is complex, and from this, it generates feelings of anxiety, fear, uneasiness, uncertainty and dissatisfaction, conceiving that it is a confusing, frustrating, stressful and complicated discipline (Meza-Cascante et al., 2019; Trigueros & Sánchez-Matamoros, 2022).

Within the field of study of attitudes towards mathematics, some coincidences were found to consider perspectives, and these are predispositions learned by the student to respond positively or negatively to the given situation, involve feelings, emotions, and behaviors, and allow to evaluate favorably or unfavorably the intensity of the attitudinal object (Capote et al., 2022; García-Gonzales et al., 2021).

In relation to attitudes towards mathematics specifically in university students of accounting and administrative sciences, there are few studies related to this population (Robbiani, 2020; Capote et al., 2022). However, there are some studies on the topic of interest in other academic groups such as educators (Cardoso, 2020; López-Mojica, 2022; Herrera, 2022), and engineers (Chacón, 2022; Villar-Sánchez et al., 2022). Most of the research on attitudes toward mathematics has been conducted on students in basic education, mainly high school students.

In this sense, given the situations previously described, the need arises to investigate the subject of attitudes towards mathematics in university students in order to understand the difficulties or benefits that may arise in universities in the process of academic training, specifically in the study programs that demand this specialty.

Therefore, the general objective was to analyze attitudes towards mathematics in university students of accounting and administrative sciences in Peru, comparing them according to their socio-academic variables.

METHODOLOGY

The study was descriptive-comparative, quantitative, non-experimental, cross-sectional (Calizaya et al., 2022), and the information was collected during the months of August to October 2022 (Calizaya et al., 2022).

Participants

A total of 700 university students from programs related to accounting and administrative sciences, such as accounting, administration, finance, banking and insurance, were intentionally selected from one public university and two private universities in the city of Arequipa, Peru.

Instrument

The scale of attitudes towards mathematics (EAHM-U) of Bazán and Sotero (1998) adapted for Peru by Mamani (2012) was used, the scale is of Likert type with 5 types of response (from 1= totally disagree to 5= totally agree), the final version is of 31 items. The instrument presents 3 dimensions: affective dimension, consisting of the student's affections and emotions towards mathematics (+1,9,17,25,8,16,24; -5,13,21,29,4,12,20,28); cognitive dimension, reflecting the level of knowledge presented by the student towards mathematics (+3,11,19,27; -31,7,15,23); and behavioral dimension, manifesting the applicability and predisposition towards mathematics (+2,6,10,18,22,26; -14,30). The application of the test is individual, a quick response is expected without the possibility of elaborating judgments, emphasizing the valuative aspect before the cognitive one; high scores, when higher, denote a greater positive attitude and low scores, when lower, indicate a greater negative attitude. The cut-off points were: low= 61 - 95, medium= 96 - 106, high= 107 - 121, very high= 122 - 147. In addition, the instrument included socio-academic variables of the students such as: age, gender, type of university, study program and university cycle.

For the local sample, the reliability levels of the scale were obtained using the internal consistency method with McDonald's ω test, therefore, the instrument has good reliability when the ω values ≥ 0.700 (Revelle, 2019) for the case a $\omega = 0.761$ was obtained according to the reliability assessment of the instrument is assessed as reliable.

Procedure

For the application of the instrument, we had the authorization of the Directors of the Universities. Then, the instrument was adapted to the Google Forms format and applied individually to the student through social networks and institutional email, after being informed of the objective of the research, and the instructions of the inventory and the confidentiality of the data provided, accepting to participate voluntarily (admitting the respective informed consent).

Data Analysis

The data were analyzed considering the normality distribution through the Shapiro-Wilk test, showing that there is no normal distribution ($p < 0.001$). The mean, skewness, kurtosis and standard deviation were determined. In addition, homogeneity of variance tests was performed, deciding to use nonparametric tests. Descriptive analysis of attitudes towards mathematics was also performed to determine the positive or negative attitude, and student attitude was compared according to the type of university, study program, university cycle, sex and age.

The following statisticians were used: To compare two independent samples, the Mann-Whitney U was used with its respective effect size (TE), the calculation of the probability of superiority (PSest) was performed, obtaining that the interpretation standards are: no effect ($PSest \leq 0.0$), small ($PSest \geq 0.56$), medium ($PSest \geq 0.64$) and large ($PSest \geq 0.71$) (Ventura, 2016). To compare k independent samples the Kruskal Wallis H and Pos Hoc tests were used, their effect size used was epsilon squared (ϵ^2) (Tomczak & Tomczak, 2014), being their interpretation standards: small for $\epsilon^2 \geq 0.01$, medium for a $\epsilon^2 \geq 0.06$ medium and large for a $\epsilon^2 \geq 0.14$ (Cohen, 1992). And for the statistical analysis, the statistical program Jamovi Project in its version 2.3 (2022) was used

RESULTS

FIGURE 1
DESCRIPTIVE OF STUDENTS' SOCIO-ACADEMIC CHARACTERISTICS

| Socio-Academic Characteristics | | N | % |
|--------------------------------|-----------------------|------|------|
| Gender | Male | 290 | 41.4 |
| | Female | 410 | 58.6 |
| | Total | 700 | 100% |
| Syllabus | Administration | 279 | 39.9 |
| | Accounting | 132 | 18.9 |
| | Finance | 140 | 20.0 |
| | Banking and Insurance | 149 | 21.3 |
| | Total | 700 | 100% |
| University cycle | First cycle | 166 | 23.7 |
| | Second cycle | 129 | 18.4 |
| | Third cycle | 113 | 16.1 |
| | Fourth cycle | 170 | 24.3 |
| | Fifth cycle | 122 | 17.4 |
| Total | 700 | 100% | |
| Type of university | Private | 326 | 46.6 |
| | Public | 374 | 53.4 |
| | Total | 700 | 100% |

Note: N= sample. %= percentage

The table describes the socio-academic characteristics of the university students of accounting and administrative sciences, finding the following information: according to sex 41.4% are men and 58.6% are women; according to the program of studies 39.9% were in administration, 18.9% in accounting, 20% in finance and 21.3% of banking and insurance; in relation to the university cycle 23.7% are first cycle, 18.4% second cycle, 16.1% third cycle, 24.3% fourth cycle and 17.4% fifth cycle; and according to type of

university 46.6% study in public universities and 53.4% in private universities; in addition, the average age of the student was estimated to be 19.7 with a standard deviation of 2.22 in a range of 17 to 25 years.

FIGURE 2
LEVEL AND ASSESSMENT OF ATTITUDES TOWARDS MATHEMATICS

| Attitudes | Levels | | | | Valuation |
|------------------|---------|------------|----------|---------------|-----------|
| | Low (%) | Medium (%) | High (%) | Very High (%) | |
| General attitude | 17.1 | 64.0 | 17.4 | 1.4 | Positive |
| Affective | 34.6 | 56.6 | 7.4 | 1.4 | Negative |
| Cognitive | 6.9 | 48.6 | 39.4 | 5.1 | Positive |
| Behavioral | 18.6 | 56.6 | 22.6 | 2.3 | Positive |

Note: %= percentage

In the above figure we describe the level of attitudes towards mathematics in university students of accounting and administrative sciences, finding in the general attitude medium level (64%) with a slight tendency to be high, being the valuation of the positive attitude; in the affective attitude dimension (feelings that mathematics generates in them) the level is medium (56.6%) with a tendency to be low, being the valuation of the negative attitude, in the cognitive attitude (knowledge acquired about mathematics) the level is medium (48.6%) with a tendency to be high, presenting a positive attitude, as well as, in the behavioral attitude (knows the application and procedure of mathematics) it is the same tendency (56.6%) positive.

FIGURE 3
COMPARISON OF ATTITUDES TOWARDS MATHEMATICS BY GENDER

| Attitudes | Gender | N | Average Range | <i>U</i> | <i>Z</i> | <i>p</i> | <i>PSest</i> |
|------------------|--------|-----|---------------|----------|----------|----------|--------------|
| General attitude | Male | 290 | 375.61 | 52168 | -2.767 | .006 | 0.12 |
| | Female | 410 | 332.74 | | | | |
| Affective | Male | 290 | 361.60 | 56230 | -1.226 | .220 | 0.05 |
| | Female | 410 | 342.65 | | | | |
| Cognitive | Male | 290 | 383.85 | 49778 | -3.699 | .001 | 0.16 |
| | Female | 410 | 326.91 | | | | |
| Behavioral | Male | 290 | 356.62 | 57676 | -0.678 | .498 | 0.03 |
| | Female | 410 | 346.17 | | | | |

Note. N= sample; U= Mann Whitney U statistic; Z= value of the statistic; p= significance (0.05); PSest= probability of superiority.

When comparing attitudes towards mathematics according to the gender of the university student, there is sufficient statistically significant evidence in the general attitude and cognitive attitude, with male students presenting better positive attitudes compared to female students, small effect size, however, in the affective and behavioral attitude there are no statistically significant differences between male and female students.

FIGURE 4
COMPARISON OF ATTITUDES TOWARDS MATHEMATICS BY TYPE OF UNIVERSITY

| Attitudes | University | N | Average Range | <i>U</i> | <i>Z</i> | <i>p</i> | <i>PSest</i> |
|------------------|------------|-----|---------------|----------|----------|----------|--------------|
| General attitude | Public | 374 | 344.75 | 58811 | -0.807 | .420 | 0.03 |
| | Private | 326 | 357.10 | | | | |
| Affective | Public | 374 | 339.24 | 56751 | -1.583 | .113 | 0.06 |
| | Private | 326 | 363.42 | | | | |
| Cognitive | Public | 374 | 352.15 | 60344 | -0.233 | .816 | 0.01 |
| | Private | 326 | 348.60 | | | | |
| Behavioral | Public | 374 | 346.08 | 59308 | -0.624 | .533 | 0.02 |
| | Private | 326 | 355.57 | | | | |

Note. N= sample; U= Mann Whitney U statistic; Z= value of the statistic; p= significance (0.05); PSest= probability of superiority.

When comparing attitudes towards mathematics in university students, it was found that there is not enough statistically significant evidence, i.e., attitudes towards mathematics in general and its study dimensions do not differ according to public or private university, presenting similar positive and negative attitudes.

FIGURE 5
COMPARISON OF ATTITUDES TOWARDS MATHEMATICS ACCORDING TO STUDY PROGRAM

| Attitudes | Program of Studies | N | Average Range | <i>H</i> | <i>gl</i> | <i>p</i> | ϵ^2 |
|------------------|-----------------------|-----|---------------|----------|-----------|----------|--------------|
| General attitude | Administration | 279 | 360.53 | 2.358 | 3 | .501 | 0.003 |
| | Accounting | 132 | 328.00 | | | | |
| | Finance | 140 | 349.03 | | | | |
| | Banking and Insurance | 149 | 353.04 | | | | |
| Affective | Administration | 279 | 362.57 | 2.873 | 3 | .412 | 0.004 |
| | Accounting | 132 | 345.45 | | | | |
| | Finance | 140 | 354.38 | | | | |
| | Banking and Insurance | 149 | 328.73 | | | | |
| Cognitive | Administration | 279 | 349.72 | 14.343 | 3 | .002 | 0.020 |
| | Accounting | 132 | 322.14 | | | | |
| | Finance | 140 | 325.04 | | | | |
| | Banking and Insurance | 149 | 401.02 | | | | |
| Behavioral | Administration | 279 | 343.05 | 1.685 | 3 | .640 | 0.002 |
| | Accounting | 132 | 341.83 | | | | |
| | Finance | 140 | 366.59 | | | | |
| | Banking and Insurance | 149 | 357.02 | | | | |

Note. N= sample; H= Kruskal Wallis statistic; gl= Degrees of Freedom; p= significance (0.05); ϵ^2 = Epsilon squared.

The only statistically significant differences were found in the cognitive attitude, the comparisons between groups indicate that it is the students of the banking and insurance studies program who present

better positive attitudes towards mathematics than the students of the other programs, small effect size, however, in the general, affective and behavioral attitude, they present similar attitudes, observing the importance of mathematics for these students according to the nature of the academic training.

FIGURE 6
COMPARISON OF ATTITUDES TOWARDS MATHEMATICS ACCORDING TO UNIVERSITY CYCLE

| Attitudes | University Cycle | N | Average Range | H | gl | p | ϵ^2 |
|------------------|-----------------------------|-----|---------------|--------|----|------|--------------|
| General attitude | Cycle 1 (Semester 1 and 2) | 166 | 340.58 | 3.166 | 4 | .530 | 0.004 |
| | Cycle 2 (Semester 3 and 4) | 129 | 378.50 | | | | |
| | Cycle 3 (Semester 5 and 6) | 113 | 348.90 | | | | |
| | Cycle 4 (Semester 7 and 8) | 170 | 343.38 | | | | |
| | Cycle 5 (Semester 9 and 10) | 122 | 345.80 | | | | |
| Affective | Cycle 1 (Semester 1 and 2) | 166 | 365.85 | 2.054 | 4 | .726 | 0.002 |
| | Cycle 2 (Semester 3 and 4) | 129 | 345.36 | | | | |
| | Cycle 3 (Semester 5 and 6) | 113 | 358.62 | | | | |
| | Cycle 4 (Semester 7 and 8) | 170 | 336.88 | | | | |
| | Cycle 5 (Semester 9 and 10) | 122 | 346.50 | | | | |
| Cognitive | Cycle 1 (Semester 1 and 2) | 166 | 322.15 | 10.881 | 4 | .028 | 0.015 |
| | Cycle 2 (Semester 3 and 4) | 129 | 350.21 | | | | |
| | Cycle 3 (Semester 5 and 6) | 113 | 325.23 | | | | |
| | Cycle 4 (Semester 7 and 8) | 170 | 383.30 | | | | |
| | Cycle 5 (Semester 9 and 10) | 122 | 378.20 | | | | |
| Behavioral | Cycle 1 (Semester 1 and 2) | 166 | 344.91 | 9.573 | 4 | .048 | 0.014 |
| | Cycle 2 (Semester 3 and 4) | 129 | 325.22 | | | | |
| | Cycle 3 (Semester 5 and 6) | 113 | 333.42 | | | | |
| | Cycle 4 (Semester 7 and 8) | 170 | 362.87 | | | | |
| | Cycle 5 (Semester 9 and 10) | 122 | 393.28 | | | | |

Note. N= sample; H= Kruskal Wallis statistic; gl= Degrees of Freedom; p= significance (0.05); ϵ^2 = Epsilon squared.

When comparing the attitudes towards mathematics according to the university cycle of accounting and administrative sciences students, statistically significant differences were found in the cognitive and behavioral attitudes; when comparing the groups, it is the students in the last cycles who present better attitudes than the students in the first cycles, small effect size; however, in the general and affective attitudes, no significant differences were found between the analysis groups.

CONCLUSIONS

It is concluded that university students of accounting and administrative sciences present medium level attitudes with a high tendency towards mathematics, being positive in the general attitude and in the cognitive and behavioral attitudes. However, they present negative attitudes in the affective dimension, reason enough to understand the level found since most of the students do not find pleasure in mathematics classes.

When comparing attitudes towards mathematics according to the gender of the university student, in the general and cognitive attitude, male students have better positive attitudes than female students; according to the study program, statistically significant differences were only found in the cognitive

attitude; comparisons between groups indicate that students in the banking and insurance studies program have better positive attitudes towards mathematics than students in the other programs; and when comparing the groups by academic cycle, students in the last cycles have better attitudes than students in the first cycles.

The results of the present research are valuable above all for the design, planning, and execution of the teaching-learning processes, both for teachers and educational authorities in order to improve the curricular plans in the formative process of students who will continue to interact with the discipline of mathematics not only in the academic classroom but also in the professional environment.

The teaching of mathematics in universities requires teachers with pedagogical skills to form positive values towards mathematics, it is essential to carry out an affective mathematical literacy so that teachers can prepare students and motivate them first affectively (taste, passion, emotion for mathematics classes) and then cognitively and behaviorally (knowledge and application).

The direct responsibility for developing and forming positive attitudes towards mathematics lies with the teachers who teach courses in the specialties of accounting and administrative sciences, i.e., strategies must be established to generate a favorable predisposition towards mathematics by improving learning and its respective processes such as: thinking and reasoning, arguing and justifying, using mathematical language properly, posing and solving problems, in order to affirm positive attitudes in students.

Finally, it is necessary to continue conducting studies with the proposed topic of interest, expanding the sample in a larger number of Peruvian universities, considering taking into account all areas and programs of study, to compare the results found, in order to modify the directives of the universities in relation to the curricular plans, strengthening the teaching of mathematics since the subject is taught as a general course in all programs of study, and should dose the level of teaching according to the program and area of study.

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