# Practices of citizenship among university students with and without statistical literacy[1]

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**ABSTRACT**

The objective of the study was to know, characterize and identify if there are differences between the citizenship practices of statistically literate and non-literate university students. Two instruments were administered (a Statistical Literacy Test and a Citizenship Practices Survey) to a convenience sample of 849 students of different majors from two universities in the southeast of Yucatán (Mexico). Except for some items where low-magnitude differences were found, there is not enough evidence to confirm that there are differences between statistically literate university students and their non-literate counterparts in citizenship practices. Said practices are characterized, the attributions are analyzed and the implications are communicated depending on the context, the study programs, the curriculum, the teaching and the challenges to develop a statistical literacy in the university, closely linked to citizen education.

**KEYWORDS:** Citizen participation. Statistical Literacy. College student. Graphs. Citizenship education.

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*Prácticas de ciudadanía de estudiantes universitarios con y sin alfabetización estadística*

**RESUMEN**

El objetivo del estudio fue conocer, caracterizar e identificar si existen y diferencias entre las prácticas de ciudadanía de estudiantes universitarios estadísticamente alfabetizados y no alfabetizados. Dos instrumentos fueron administrados (una Prueba de alfabetización estadística y una Encuesta de Prácticas de Ciudadanía) a una muestra por conveniencia de 849 estudiantes de distintas carreras de dos universidades en el sureste de Yucatán (México). Salvo algunos ítems en donde se encontraron diferencias de baja magnitud, no hay suficiente evidencia que permita confirmar que existen diferencias entre los universitarios estadísticamente alfabetizados y sus contrapartes no alfabetizadas en las prácticas de ciudadanía. Se caracterizan dichas prácticas, analizan las atribuciones y comunican las implicaciones en función del contexto, los programas de estudio, el currículo, la enseñanza y los retos para desarrollar una alfabetización estadística en la universidad, estrechamente vinculada con la formación ciudadana.

**PALABRAS CLAVE:** Participación ciudadana. Alfabetización estadística. Estudiante universitario. Gráficas. Educación para la ciudadanía

*Práticas de cidadania de universitários com e sem alfabetização estatística*

**RESUMO**

O objetivo do estudo foi conhecer, caracterizar e identificar se existem diferenças entre as práticas de cidadania de universitários estatisticamente alfabetizados e não alfabetizados. Foram aplicados dois instrumentos (Teste de Alfabetização Estatística e Pesquisa de Práticas de Cidadania) a uma amostra de conveniência de 849 estudantes de diferentes cursos de duas universidades do sudeste de Yucatán (México). Com exceção de alguns itens onde foram encontradas diferenças de baixa magnitude, não há evidências suficientes para confirmar que existem diferenças entre estudantes universitários estatisticamente alfabetizados e seus homólogos não alfabetizados em práticas de cidadania. Caracterizam-se essas práticas, analisam-se as atribuições e comunicam-

se as implicações em função do contexto, dos programas de estudo, do currículo, do ensino e dos desafios para desenvolver uma literacia estatística na universidade, intimamente ligada à formação cidadã.

**PALAVRAS-CHAVE:** Participação cidadã. Alfabetização Estatística. Estudante de facuRDade. Gráficos. Educação para a cidadania.

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## Introduction

Despite the widespread consensus on the importance of statistical literacy for the exercise of citizenship (WEILAND, 2017; ENGEL et al., 2016), A first glance at the literature review allows us to affirm that, up to this point, there is a lack of empirical work on the relationship between both constructs. However, it is possible to notice that there are recent efforts by the academic community to move statistical literacy research beyond the school setting and from other perspectives.

For example, Engel (2017) argues that we are situated in an era characterized by the easy access to public statistical information through the internet along with the continuous democratic participation on social media. Paradoxically, there is a growing disregard for factual knowledge in public discourse, where the preference for emotions and personal beliefs seems to prevail. Given this scenario, Engel emphasizes the need for citizens to be able to use statistics as evidence to understand and make decisions about complex social phenomena. The before mentioned not only involves knowledge of statistics but also contextual understanding, computational skills, critical thinking, and a willingness to use data to reason, question, and solve problems.

Aizikovitsh-Udi, Kuntze, and Clarke (2019) focus their attention to the lack of empirical research related to the use of statistical literacy and critical thinking skills among the citizenry. In order to find intersections between both constructs, the authors present the results of an exploratory case study. They asked a mathematics teacher to solve four cases that required the use

of both statistical skills and critical thinking. The resolution of the cases, two of which were related to social issues, was carried out during the interview, and the participant was asked to explain how she arrived at the expressed conclusions . The results indicate that when an individual uses statistical thinking to achieve an answer, it is because they have been able to develop a structured framework of analytical principles that guide and support their reasoning. While efforts to expand studies on statistical literacy beyond the school context are found, further investigation in the field of statistical literacy evidences a lack of investigations focused on how it is used by citizens to make decisions and how statistical literacy plays a significant role. Since 2016, the International Association for Statistical Education (IASE) has emphasized the need to develop tools, materials, proposals, and theoretical frameworks that could contribute to the learning and understanding of statistics related to social phenomena (migration, employment, inequality, demographic changes, crime, and poverty), especially among high school and university students (ENGEL, GAL, and RIDGWAY, 2016).

In light of this scenario, it is worth asking what the purpose of developing statistical literacy among students is, if it, instead of becoming a tool for active citizenship participation and the pursuit of social change, simply adds to the accumulation of knowledge and skills for each individual's human capital. However, more empirical studies, especially in higher education, are needed to provide information on whether there is a relationship between statistical literacy and citizen participation and, if so, what it can be attributed to. This is a preliminary exploratory study that digs into this matter.

The research questions are the following: What is the assessment given by university students to citizenship practices? and Are there significant differences in the assessment of these practices between statistically literate and non-literate students?[4]

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[4] This text is part of a broader research project titled 'Citizenship Practices in University Students: An Analysis from Statistical Literacy' (2021). It comprehensively examines the public issue of poverty and inequality, analyzing

The reported study had the following objectives: a) to describe the level and characteristics of statistical literacy among university students, based on their understanding of the public issue of poverty and inequalities, b) to describe the assessment and opinions of university students regarding citizenship practices, and c) to identify whether there are differences in the citizenship practices of these students with or without statistical literacy.

## Conceptual framework

Two concepts were crucial on this study: citizenship practices and statistical literacy. Below, we briefly describe the conceptual framework that underpinned this research.

## Citizenship practices

Citizenship practices are assumed to be "a set of devices and interactions in which the individual recognizes and relates to others; a process whose ultimate purpose is the formation of the individual in all its features, as preparation for life and as a gateway to culture" (JARAMILLO and QUIROZ, 2013, p. 142). According to these authors, these practices reflect the condition and exercise of every citizen, giving them a sense of belonging and participation in society, in which the individual exercises their rights and fulfills their obligations. These obligations, defined for this research as citizenship practices, "constitute actions aimed at the exercise of citizenship... which are understood as the mode of action, as deliberate action that derives from a contextual situation, aimed at transforming a social reality" (p. 144).

Is in this regard, that a variety of practices that we, as citizens, often engage as part of a society, are identified. Thus, we observe formative citizen practices, as well as political, cultural, social, and consultative participation

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sociodemographic variables, education, and employment, as well as attitudes towards statistics, knowledge and perception of poverty and inequality, the type of citizen, democracy, and citizenship.

practices, among others. Jaramillo and Quiroz (2013) highlight some cross-cutting citizen practices, such as coexistence, participation, and autonomy. Meanwhile, Merino (2016) defines them as activities carried out by individuals in the public sphere and includes four categories: voting, participation in political campaigns, community or collective activities aimed at a specific purpose, and "activities [also collective] that arise from a particular conflict" (p. 39).

Jasso, Villagrán and Rodríguez (2022). In a previous study conducted to higher education students, they inquired into the relationship between teaching practices and citizenship. The latter was explored through a self-administered questionnaire (with 19 items) in which students assessed certain citizenship practices, namely: democratic responsibility, appreciation of human differences, and coexistence and peace. For the purposes of this research, citizenship practices were determined based on Córdova et al. (2016): (a) the assessment and interest in democracy, (b) membership in social organizations, (c) altruism, and (d) their role and impact or effectiveness in politics. The first two are associated with people's opinions, positions, and assessments regarding democracy, politics, and membership/participation in social organizations. The latter two are oriented towards the actions, acts, events, and activities that individuals engage in as citizens in the social and political sphere.

## Statistical literacy

Gal (2004) defines and characterizes the meaning of statistical literacy:

> The ability to interpret and critically evaluate statistical information, arguments related to a set of data or stochastic phenomena that can be found in various contexts, and the ability to discuss or communicate their reactions to such statistical information, as well as their understanding of the meaning of the information, their opinions on the implications of this information, or their concerns about the validity of the given conclusions. (GAL, 2004, p. 49).

The underlying idea is that statistical literacy is useful for individuals in multiple contexts - personal, educational, professional, familial, and civic - as it assists them in forming opinions and making decisions based on data (PINTO et al., 2017). Consequently, it contributes to the development of citizens capable of forming evidence-based opinions on public issues, rather than falling prey to cognitive biases, representativeness errors, and causal stereotypes (KAHNEMAN, 2012), which are more influenced by misconceptions, "common sense", the *status quo*, and a tendency to align with the majority's thinking or actions. Statistical literacy goes beyond knowing about a mathematical topic, a procedure, algorithm, or applying a statistical formula. It is *knowledge in use* to address real problems that we face as a society, that is, as citizens.

This research is grounded in the belief that social phenomena can be understood through statistics. That is, by using data and combining it with statistical tools, it is possible to describe and explain in a sufficiently useful way, though not the only way, to make decisions (SOSA-ESCUDERO, 2014). Consequently, public social problems, such as poverty and inequality in this case, can be addressed and studied through statistics. For this reason, "be statistically literate" is conceptualized as a tool that enables the development of individuals' capacities and the communities in which they participate. By promoting statistical literacy, education encourages individuals to use data to make fact-based decisions (ROSLING et al., 2018) in various aspects of their lives.

To approach the study of statistical literacy in poverty and inequality topics, we started by analyzing statistical graphs in the media. Since graphs are one of the most common ways to present information (GAL, 2002), they are the cornerstone of Exploratory Data Analysis, and interpreting various types of statistical representations is one of the first skills that every citizen should be able to perform (ARTEAGA et al., 2011).

The reference framework was the graphical understanding of Friel, Curcio, and Bright (2001) and Shaughnessy (2007), who argue that it develops through four cognitive levels: from the most elementary, called "reading the data" (RD), an intermediate level, "reading between the data" (RbtD), and finally two levels with a higher degree of complexity: "reading beyond the data" (RbyD) and "reading behind the data" (RbhD).

## Methodology

The nature of this research was exploratory, with a quantitative approach and a descriptive survey design.

## Population and sample

Students from the metropolitan area of Mérida, Mexico, were selected for this study from two universities: one public university with a student population of N=15,430, and one private university with an enrollment of N=2,565 students, according to ANUIES (2018) data, both at the undergraduate level. Ten academic programs (bachelor's degrees and engineering programs) were identified, offered by both institutions.

It was then determined whether the programs included at least one semester of statistics in their curriculum. Example course names included Statistics for Business, Statistics I, Statistics II, Probability and Statistics, Statistics Applied to Psychology, Quantitative Research Methods in Education, among others. The results of this review identified seven higher education programs present in both the public and private universities that were candidates for the study: two in the engineering field (civil and industrial engineering), three in the economic-administrative sciences (business administration, marketing, and public accounting), and the psychology and nutrition programs in the social and health sciences,

respectively. These seven programs were selected for data collection, which took place during the 2019-2020 academic year.

Through non-probabilistic convenience sampling, students who had previously completed and passed at least one statistics course and voluntarily decided to participate in the research were involved. The sample consisted of 99 industrial engineering students (12%), 110 business administration students (13%), 198 public accounting students (23%), 151 civil engineering students (18%), 103 marketing students (12%), 46 nutrition students (5%), and 142 psychology students (17%). This article presents the overall results obtained from the total of 849 respondents.

## Instruments

Two instruments were developed to conduct the research. Each one is briefly described below.

### *Citizenship Practices in University Students Survey (EPCU)*

The EPCU was constructed based on a review of the literature on political culture, democracy, and citizenship (e.g., CÓRDOVA et al., 2016, GÓMEZ, 2017, INE, 2015). As mentioned earlier, four citizenship practices were considered:

*Valuation of democracy*, with 7 items, where respondents were asked whether they agreed or disagreed with certain statements, as well as the frequency (none, a little, some, a lot) of their concern, trust, and interest in community issues.

*Membership in social organizations*, where students marked whether they belonged to specific groups or associations.

*Altruism*, with 5 items, in which students indicated whether they engaged in charitable actions such as providing financial support, donating food, among others.

*Political efficacy*, with 7 items, where students evaluated whether they took certain actions in the political sphere, such as participating in a protest or lodging a complaint, among others.

Each of these items was selected and adapted from Córdova et al. (2016). Before administration, it was reviewed and validated through expert judgment.

### Statistical Literacy Test Focused on Poverty and Inequality (PAEPCU)

As the name suggests, this test was designed to assess statistical literacy related to and applied to the knowledge and understanding of the public issue of poverty and inequality, through the reading and interpretation of statistical graphs. The design and validation process can be consulted in Pinto and Castillejos (2020).

The final version of the PAEPCU contains four cases related to the phenomenon of poverty and inequality in Mexico, with a total of 16 items, 4 for each case. Table 1 presents the content characteristics of the test:

**TABLE 1** – Characteristics of the PAEPDU

| No | Case | Type | Item number per classification | | | | Source (of the graph and context) |
|---|---|---|---|---|---|---|---|
| | | | RD | RbtD | RbyD | RbhD | |
| 1 | *Inequality.* Income distribution among Mexican househoRDs, by deciles (I to X), in 2016. | Circular | - | 3 | - | 1 | INEGI (2017) |
| 2 | *Social mobility.* Educational achievement of individuals bythe educational level of their father. | Bars | 1 | 1 | 1 | 1 | CEEY (2018) |
| 3 | *Poverty.* Evolution of the Minimum Wage and the Urban Welfare Line 1992-2018. | Lineal | 1 | 2 | 1 | - | CONEVAL (2019) |
| 4 | *Labor precarization.* Job characteristics of paid subordinate workers (2000 and 2017) | Bars | 1 | 1 | 1 | 1 | El COLMEX (2018) |

**Source**: elaborated by the authors and published in Pinto and Castillejos (2020, p.77).

## Procedure

The study involved a self-administered application in a single session, divided into two phases. When visiting the classrooms, the students were briefed on the study's purpose, provided with instructions, and invited to participate by completing the instrument. Initially, those who agreed to participate were given a printed copy of the EPCU. Once the first part was completed and returned, the students were given the PAEPDU, which they couRD solve using a calculator. The average response time for both sections was 30 minutes.

## Results

The relevant findings are presented below, organized as follows: a) characteristics of students' statistical literacy, and b) characteristics of students' citizenship practices, and differences between those who are statistically literate and those who are not..

## University Students Statistically Literate in Poverty and Inequality

Figure 1 shows the frequency distribution based on the number of correct answers from the 849 students who responded to the PAEPDU. Only five students, less than 1% of the sample, managed to obtain the maximum score, while the average score was 9.4 correct answers, with a standard deviation of 3.1 correct answers. The upper quartile started at 12 correct answers, and the median was 10 correct answers.

Based on the distribution, it was proposed that a statistically literate participant should have a score of 11 correct answers on the global scale, equivalent to 69% correct responses[5] for the test items and one point above

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[5] The cut-off point was 70%, which in Mexico is equivalent to "passing" in most universities. Less than that score would be failing. This would be equivalent, in countries like Spain "Notable" (7-8), Venezuela as "Good" (C) and Argentina as "Good" (7).

the median. This cutoff point is reflected in Figure 1, where the light shade transitions to a darker shade.

Under this premise, 331 out of the 849 participants (39%) were considered statistically literate, and 518 (61%) were grouped in the category of statistically non-literate.

**FIGURE 1**: Frequency distribution of PAEPDU results.
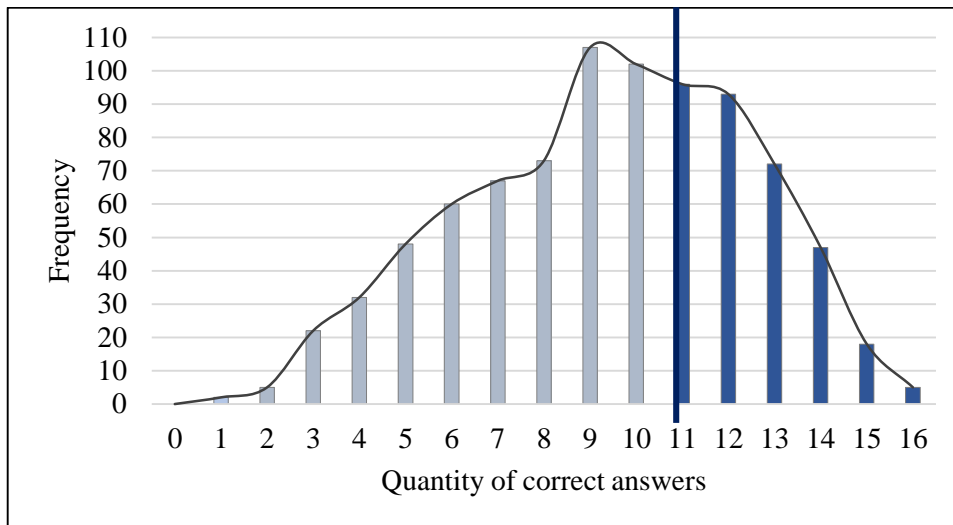


**Source**: elaborated by the authors

In relative terms, 39% of the participants indicated having taken one statistics course, while 29% reported taking two courses, and 32% of the participants stated they had taken or were currently taking three or more statistics courses.

Figure 2, using a box-and-whisker plot, illustrates the score distribution between the literate and non-literate groups.

Additionally, the number of correct answers for each graph or case was obtained (Figure 3). For the pie chart (Case 1 - inequality), only 8% of the students answered all items correctly, and the highest percentage (14%) had all items incorrect. In the bar graph (Case 2 - social mobility), 32% answered all items correctly, while 5% had no correct answers. Regarding Case 3 - poverty (line graph), 23% got all the correct answers,

and 5% got none. Finally, in the bar graph (Case 4 - social precarity), 17% managed to answer all items correctly, while 8% did not.
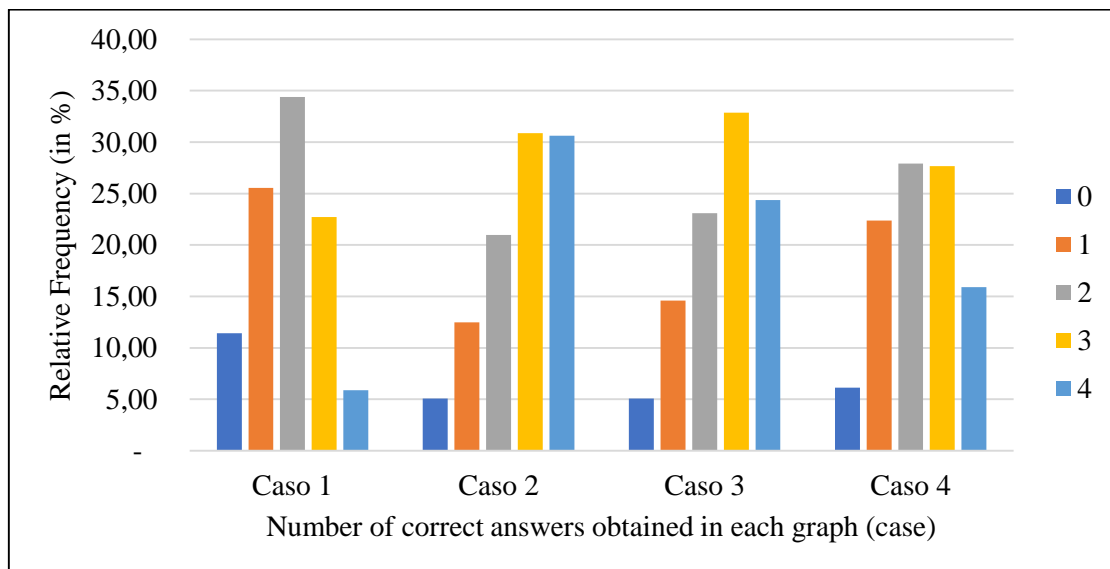
Most of the students obtained 2 to 3 correct answers for each case (55%, 54%, 56%, and 59%, respectively).

**FIGURE 2:** Box-and-Whisker Plot on the Differences in PAEPCU between the Literate and Non-Literate
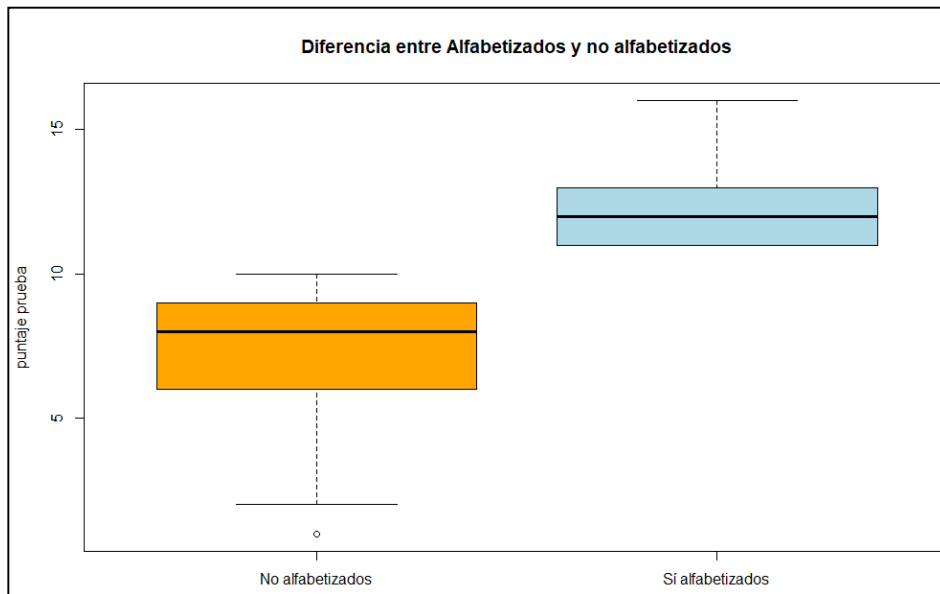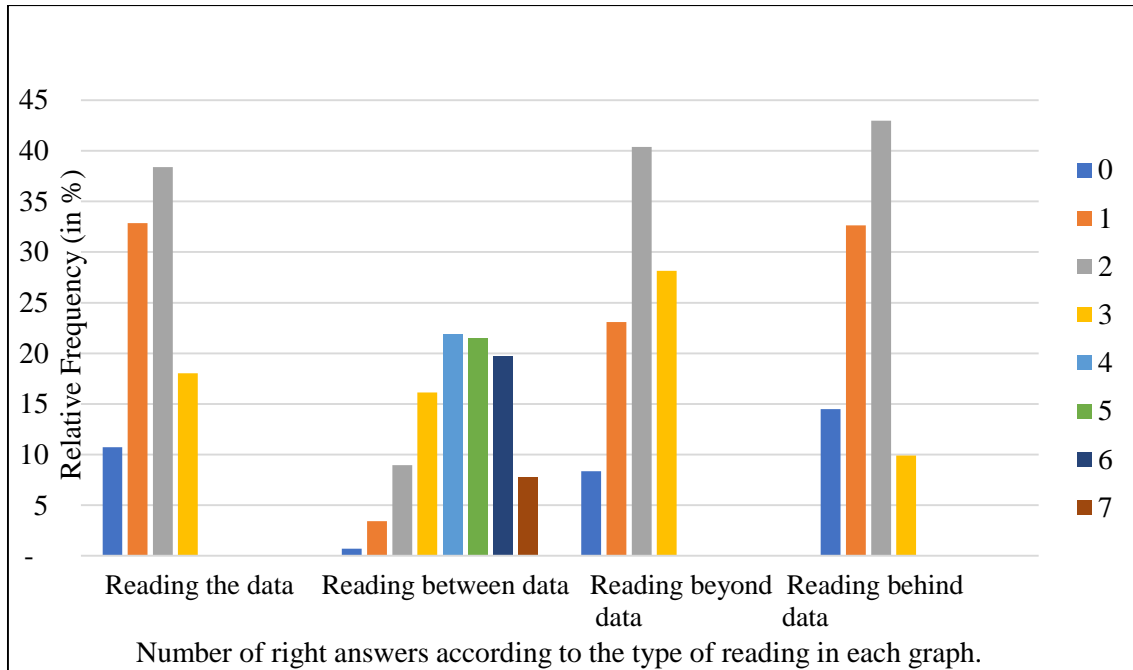


**Source**: elaborated by the authors.

**FIGURE 3:** Relative frequency on the PAEPDU results, according to type of graph reading.



**Source**: elaborated by the authors.

**FIGURE 4:** Relative frequency of the PAEPDU results, according with the type of graph reading.



**Source**: elaborated by the authors

Figure 4 shows the results by cognitive level of graphic comprehension, that is, reading the data (RD, 3 items), reading between data (RbtD, 7 items), reading beyond the data (RbyD, 3 items), and reading behind the data (RbhD, 3 items).

Regarding RD, 18% of the students got all the answers correct, and 11% none, with 38% being those who got 2 of 3 items correct. In RbtD, only 8% got all the correct answers, and 1% could not have any correct answers, with 41% of the answers being between 5 and 6 correct items. In RbyD, 28% managed to answer the items correctly, a 8% none, with 40% getting 2 of 3 items correct. Finally, regarding RbhD, 10% got the answers correct, and 14% got them wrong, while 43% correctly answered 2 out of 3 items at this level.

**Differences between statistically literate and non-literate university students.**

The analysis proceeded to determine if there were differences between both groups of students regarding their citizenship practices. The following descriptive results in each dimension are presented: appreciation of democracy, belonging to social organizations, altruism, and political efficacy. Subsequently, in each section, information is provided on the comparative results between students with and without statistical literacy.

*Valuation of democracy.* Table 2 presents the participants' responses regarding four statements related to the appreciation of democracy

**TABLE 2** - Frequency percentages of effective responses regarding the assessment of democracy.

| Statement | Yes | No | | |
|---|---|---|---|---|
| Democracy is preferable to any other form of government. | **83.97** | 16.03 | | |
| I would be willing to give up some of my rights (civil, social, political) in exchange for living without economic pressures. | 16.39 | **83.85** | | |
| The vote of the mayority must decide the government's actions. | **71.50** | 28.62 | | |
| Political parties are essential for democracy to work. | 29.93 | **70.55** | | |
| Statement | Mucho | Algo | Poco | Nada |
| How much do those who govern you care about meeting your demands? | 2.83 | 36.28 | **49.35** | 11.54 |
| How much can you trust most people? | 3.07 | 43.63 | **47.41** | 5.90 |
| How interested are you in the problems of your community? | 42.27 | **49.70** | 7.44 | 0.59 |

**Source**: elaborated by the authors

The results of the responses made by the participants to the seven questions relating to the assessment of democracy were classified depending on whether or not the participant was statistically literate. From these data, the Chi square statistical test was carried out. In all cases, the *p*-value exceeded .05, so the hypothesis that there is no difference between the variables was accepted.

*Membership in social organizations.* The students were asked if they belonged to any group or organization and, additionally, how easy or difficult they considered it to be to organize with other citizens to work on a common cause. 63% affirm that it is between difficult and very difficult to organize with other citizens to work for a common cause. In fact, less than 1% think it is very easy and 6% think it is easy. 13% (111 students) responded that they did not know or have not tried.

**TABLE 3** – Percentage of membership in social organizations

| Type | % | |
|---|---|---|
| | Those that sponke[a] | From the total of students.[b] |
| | n = 212 | n = 849 |
| Religious | 29.29 | 8.24 |
| Volunteering | 23.43 | 6.60 |
| Student | 20.50 | 5.77 |
| Sporty | 5.44 | 1.53 |
| Policy | 5.02 | 1.41 |
| College of professionals | 3.35 | 0.94 |
| Cultural/Artistic | 1.3 | 0.35 |
| Business/Employer | 0.8 | 0.24 |
| Union/Workers | 0.8 | 0.24 |
| Others not listed | 10.04 | 2.83 |
| Total | 100.0 | 28.15 |

**Source**: elaborated by the authors
Note: [a] in relation to the total number of participants who did indicate belonging to an organization; [b] in relation to the total number of participants in the instrument.

Regarding participation in social organizations, 72% (611 out of 849 respondents) stated that they did not belong to any social organization. 28% answered that they do belong to a social organization, such as student society, football team, student council, political party, religious group, professional association, civil association, sports team, scouts, employers' association, and volunteering (see Table 3). Of these, 26% declared membership in one organization, while 21 (2%) indicated belonging to between 2 and 5.

Among the students who claimed to be part of an organization, the top three were, in order of the highest percentage: 1) religious, 2) volunteering, and 3) student organizations.

At the global level, it's noteworthy that only 12 students declared any political affiliation (1.41%).

To determine if there were differences between statistically literate and non-literate students regarding the question, "How easy or difficult is it to organize with other citizens to work for a common cause?" it was verified that the frequencies followed a normal distribution. When applying the Kolmogorov-Smirnov normality test, $p$-values below .05 were obtained, indicating a non-normal distribution. Subsequently, the non-parametric Mann-Whitney test was used to compare the medians of two independent samples. The result was a $p$-value of .191, indicating that there are no significant differences between the groups.

Students were classified based on 1) whether they belonged to at least one social organization (regardless of type) and 2) whether they were statistically literate or not. The Chi-squared statistical test was performed, resulting in a $p$-value of .521, indicating that there is no statistically significant difference between the variables.

*Altruism*. Similarly, participants were asked to indicate if they had performed any generous, compassionate, or humanitarian actions in the last 12 months intentionally and/or unselfishly seeking the welfare of others (see Table 4). The actions in which young people participated the least were

volunteering for a community-related activity (57%) and performing some work for their community or neighborhood (69%).

Students were classified based on: 1) whether they had performed these actions or not, and 2) their status as statistically literate. Hypothesis testing was then conducted.

TABLE 4 - Percentage of effective participation in altruistic activities in the last 12 months.

| Actions | No (%) | Yes (%) | | |
|---|---|---|---|---|
| | | Individual | Colective | Both |
| 1. Give money to a relief organization (e.g. Red Cross) | 35.38 | **60.47** | 3.79 | 0.36 |
| 2. Donate food, medicine, clothing. | 30.88 | **57.96** | 10.69 | 0.48 |
| 3. Participate as a volunteer in some activity to benefit your community. | **57.14** | 22.14 | 19.88 | 0.83 |
| 4. Help someone you didn't know. | 26.55 | **72.02** | 0.83 | 0.60 |
| 5. Do some work for your community or neighborhood (clean a park or green areas, fill a pothole, organize a neighborhood gathering) | **69.08** | 18.79 | 11.65 | 0.48 |

**Source**: eaborated by the authors

A Chi-squared statistical test was performed to determine if there was any statistically significant association between literacy and the listed altruistic actions. With the exception of the statement "Donated food, medicine, clothing," the $p$-values exceeded the threshold of .05, indicating that there is no statistically significant relationship between both categorical variables.

For the action where there was a statistically significant difference ($p$= .040), it was found that 72% of students without statistical literacy stated that they do donate in-kind items (food, medicine, clothing), while 28% do not. In contrast, students with statistical literacy reported that 65% do donate, and 35% do not.

*Political Efficacy*. Finally, participants were asked to indicate if, in the last 12 months, they had carried out certain types of actions representative of political efficacy, in which the beneficiary was either an individual or the community. Additionally, participants were asked to indicate if the action they had taken had achieved the proposed objective (see Table 5).

**TABLA 5** - Effective percentage on political effectiveness. Activities carried out by participants in the last 12 months

| Action | No | Yes | In whose interest? | | Was the objective achieved? | |
|---|---|---|---|---|---|---|
| | | | Pers[a] | Com[b] | Yes | No |
| Put in contact with a politician or official. | **87** | 13 | 7 | 6 | 8 | 5 |
| Signed a petition or letter of support. | **68** | 32 | 7 | 24 | 13 | 19 |
| Put in contact with a politician or official. | **90** | 10 | 1 | 8 | 4 | 5 |
| Signed a petition or letter of support. | **83** | 16 | 11 | 6 | 10 | 6 |
| Participated in a protest demonstration or march. | **93** | 7 | 3 | 4 | 3 | 4 |
| Sought support from an organization. | **86** | 14 | 6 | 9 | 4 | 11 |
| Complained or requested help in the media. | **98** | 2 | 0 | 2 | 1 | 1 |

**Source**: elaborated by the authors
Note: [a] the action was in personal interest or benefit,[b] the action was in the interest or benefit of the community.

It could be observed that the most commonly reported activity, at 32%, is having signed some form of support letter. The other actions have been undertaken very little by the students. For example, it's revealing that out of the 849 respondents, only 8 students have participated in a protest, and 25

have lodged a complaint or requested assistance. It's noteworthy that 93 out of 119 students claimed to have achieved their goal of pressuring authorities through social media.

A Chi-squared statistical test was conducted to determine if there was any statistically significant association between having or not having statistical literacy and the listed actions. For all seven cases analyzed, the $p$-values exceeded the threshold of .05, leading to the conclusion that there is no statistically significant relationship between the two categorical variables.

**Final considerations**

Regarding citizenship practices, it is noted that the majority of the students (84%) value democracy and are willing to defend their rights, and 40% are very concerned about community issues. However, according to their perception, about 64% claim that it is difficult or very difficult to belong to any social organization. Only 28% belong to at least one group, which is mostly related to religion, volunteering, and being part of a student group at the university. Furthermore, less than 5% (40 students) engage in actions like participating in sports, politics, culture, arts, business, employer, or labor organizations.

Out of the total number of students, about 7% declared that they volunteer. This is also reflected in altruistic actions, where volunteering (57%) or doing work for their community or neighborhood (69%) is less common among students, and these activities tend to be more personal rather than collective. Regarding political efficacy, it was found that 86% on average do not take any action in this regard.

The instrument used to assess statistical literacy was designed to recognize the students' ability and reasoning in reading and interpreting statistics-related graphs taken from the media about poverty and inequality issues. About 39% were determined to be statistically literate.

Different comparisons with the dimensions of citizenship practices suggest that there is no significant difference between them, whether the students are statistically literate or not. There may be several reasons for the results obtained.

The first reason may be attributed to the fact that most students do not clearly and strongly manifest citizenship practices. As found, participation rates are low and only in specific actions.

Furthermore, based on Weiland (2017), one must consider *the model of citizenship* one aspires to and its relationship with the formative processes in university. Furthermore, if such a model exists, what characteristics does it have and what citizenship practices are promoted and developed. Therefore, it will be important to investigate first, how citizenship is formed in higher education institutions, and second, what dimensions it has and how it is achieved. In this sense, this research explored certain citizenship practices, but based on the literature, there are others that need to be further investigated. The question arises: Which citizenship practices may be more closely associated with statistical literacy?

Another reason is that currently, statistics programs do not incorporate the development of statistical literacy, either in the design or in the teaching and learning approach, or in the analysis of social issues or citizen education, as recommended by Aizikovitsh-Udi, Kuntze and Clarke (2019). As Pinto (2020) states, it seems that in higher education, "there prevails a curriculum approach from the discipline, with a technical perspective, a closed and linear model that is not closely related to societal issues" (p.56). Exploring teaching practices and activities carried out in the classroom will provide information on the real curriculum (operational) with regard to citizenship education related to the development of statistical literacy.

The training of critical citizensis is a priority, and Zapata-Cardona (2018) asserts that through statistics (its teaching and learning), it can be

developed, as long as it is recognized and addressed "as a quality of thought that supports conscious citizens in environmental, social, political, and economic contexts and develops critical attitudes towards the world in which they live... and that is formed based on a deep study of societal crises such as repression, conflict, contradiction, misery, inequality, ecological devastation, and exploitation, and through attempts to overcome them" (p. 65). In the same vein, Vázquez (2020), based on UNESCO (2015), emphasizes the need for citizens who are literate in sustainability. Furthermore, when analyzing the progress in addressing the issues stated in the Sustainable Development Goals, it is affirmed that "insufficient teacher training continues to be an obstacle" (UNESCO, 2018, p. 9).

One way to intertwine citizenship education with statistical literacy, according to Ángel Alsina (in CAMPUS VILLARRICA UC, 2022), is to incorporate the integration of sustainability into statistics learning through three specific competencies: a) of *anticipation* (What would happen if...?, How would the environment change...?, What implications would it have on...?), b) of *self-awareness* (How would I feel if...?, How does it relate to me...?, How sustainable is it...?), and c) *strategic* (What actions could you promote to...?). This would be crucial in statistics courses at universities.

Finally, the results presented lead to the need to further investigate this matter, mainly on three levels of analysis: 1) based on a different classification criterion to differentiate the statistically literate from the non-literate. For example, establishing levels of statistical literacy per person based on the grouping of correct responses at each level of graphic understanding, 2) conducting an analysis of the fragility index (based on statistical test results and significance levels ($p$-value) that allow evaluating their robustness, scope, and limitations, and 3) incorporating an analysis of the number of statistics subjects taken and their content, as well as the type of university program, to expand the attribution or explanation of the findings.

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