Original Article

Infographics In The Literacy Of Statistical Skills In University Students

Ángel Salvatierra Melgar[1]*, Doris Fuster-Guillen[2], Raúl Alberto Rengifo Lozano[3], Eric Gálvez-Suárez[4]

*[1, 2, 3] Universidad Nacional Mayor de San Marcos, Lima, PERÚ
[4]Universidad Privada Del Norte, Lima, PERÚ

***Corresponding Author:** Ángel Salvatierra Melgar

*Universidad Nacional Mayor de San Marcos, Lima, PERÚ
DOI: 10.47750/pnr.2022.13.S02.69

Abstract

The results of the study made it possible to answer the question of what the use of infographics is like, as well as the literacy of statistical skills. For this purpose, experimental actions were carried out in 78 university students of the Faculty of Education; Two groups enrolled in the subject of Statistics Applied to Education were accessed. The experience consisted of the students constructing infographics with contents, concepts and description of statistical tables and figures to later detect their effect on statistical skills. For the reasons stated, the study is of an applied type and explanatory level. The experimental actions led to the conclusion. The use of infographics allowed the literacy of statistical competencies in terms of the acquisition of skills for reading and interpreting data, drawing conclusions from journalistic texts, detecting comparative statistics between both groups (8.21; +-2.47) compared to the group experimental (18.21; +-1.27) and (p_value <0.05). Statistical reasoning consisted of reasoning the text in relation to statistical reports; finally, in the statistical thinking competition, they were able to make inferences from the data presented in the infographic; however, the statistical thinking competence presents the lowest percentage of achievement compared to the other two, which we deduce that people lack in detecting sources of information and performing critical analysis, in addition to assuming with logical criteria in front of the data; however, it shows statistical significance comparatively.

Keywords: Infographics, Statistical Competence, Literacies, Reasoning, Statistical Thinking.

INTRODUCTION

The use of new technologies, internet access, facilities for different electronic media and the use of more intuitive and accessible specialized software have generated new ways of presenting and understanding information in the current moment we live in as part of the democratization of information. The media allow the disclosure and dissemination of knowledge that, in past times, was not possible since only a group with access to printing was covered [33]. Today, due to the mass media such as the Internet and with open pages, there is access to first-line research information, specialized with great impact, allowing a vertiginous number of scientific journals worldwide.

Infographics, due to their multiple uses, present various concepts, depending on the iconic form to provide the necessary communication and its interpretation; implies a different reading challenge for our portion of the audiovisual brain, reducing us to the simplest way of acquiring information such as the one that was in our early childhood that allows harmonic combination: points, lines, circles, slots, combinations between they make us simple and complex from the levels of abstraction to comprehension, allowing us to understand and comprehend the information in order to generate knowledge [16] . Visual components are combined with graphic support that displays clear, objective and coherent information of iconic origin, in addition the form of presentation leads to a panoramic detection of a set of data that allows interpretation, analysis and even the generation of inferences [17, 24].

The lexical composition of the word info (informatics) plus spelling; Therefore, infographics is the visual elaboration made by computer software in order to transmit information through the use of graphic resources of any kind, such as drawings, maps, organization charts, etc. [18, 5.32] . Infographics transmit specific information by combining texts and graphs on a previously selected set of specific data; infographics meet three general conditions: presence of graphic content; that is accompanied by a text, minimal conceptual information and a means of transmitting information [20].

She identifies various styles of infographics according to iconic information, highlighting a) infographic diagram, attributes to pictographic presentation in order to capture statistical information graphically combined diagram + pictogram or pictorial iconem. b) Enlightenment infographic, we generally find it within written or virtual press publications, they put rectangular frames in front of their information, c) infomap, the representation becomes visible within cartographic techniques, locations through guided maps, d) infographics of 1st Level, supposes the texts outside

the photos or icons, it is basically composed of; title anchor text and illustration, e) 2nd level infographics, the construction of an icon where it behaves dynamically, as occurs in comics associated with comic-type texts, f) space-time sequence, the time sequence of an event is shown through icons and associated texts, g) mixed infographics, is when the information is detailed in a combined manner between the aforementioned icons, g) megagraphics of the indicated infographics, more texts and icons are combined with abundant information, not respecting the quantity of text and graphics. Statistical infographics make up cartography, data representation in different forms such as pictograms [6].

They are very frequently used in short texts associated with representative icons, as in the case of the didactic sequences of a class session, presentation of visual organizers with the inversion of texts and luminous icons, in learning sessions, in the thematic development of the presentation of the timeline, summary systematization through the use of maps, cartographies, sequences, guides, among others [25, 30, 35-55]. Statistical infographics is an appropriate and balanced form of communication between statistical information texts and images [30]. Regarding the first, reference is made to summary data, statistics of relevant information with systematized texts alluding to the relevance and power of information. In reference to the second, statistical figures depending on the data are emphasized, the figures represent the systematization of data with easy interpretation, detection of instant information and the colors that characterize its aesthetics, and the form of access to fast scan information [23].

Statistical literacy is the ability to comprehend and critically understand statistical results displayed in daily life and the ability to appreciate statistical concepts within public, professional, and personal life at three progressive levels: basic understanding of terminology, incorporation of language and concepts in a context and a critical attitude [2]. In addition, it presents two competencies: a) the ability to interpret and critically evaluate statistical information, the related arguments in a given context and b) the ability to discuss or communicate such statistical information, as well as their understanding of the meaning of the information, which lead to to the investigative, reflective and critical dimension of the globalized world and for decision-making in environments of uncertainty [27, 28].

Statistical literacy is a responsibility assumed and shared by social organizations such as statistical offices, statistical societies, the media and, of course, within the educational system, implying the development of statistical thinking [2] ; It is the ability to read and interpret data critically and use statistics as evidence in everyday or professional contexts, allowing statistical reasoning and thinking [26].

Statistical competence allows the appropriate use of statistical symbols, understand the basic concepts and apply the tools in order to understand and explain the sequences for the interpretation of results showing awareness of possible interpretations [21]. It is committed to identifying reliable results, critical reasoning based on objectivity and predisposing synthesis and abstraction, which contributes to enhancing the interpretation, analysis, criticality of data and implicit and explicit information of the statistical report to promote the development of investigative skills. And the ability to adapt to the management of various statistical software, thus promoting the formation of statistical competence [9, 15].

On the other hand, statistical ignorance and fallacies are very widespread and are as dangerous as the logical fallacies that appear under the heading of illiteracy [7]. It is worrying, under this premise, since, in the knowledge society, the individual will discern the information that allows him to adapt and coexist in an informed manner thanks to his abilities to interpret and analyze the visible data in a given society. The statistical competencies are the following: a) statistical literacy, b) statistical reasoning and c) statistical thinking; they involve a more generalized conception and a panorama that is inserted into the solution to social situations [11]. Statistical literacy refers to the fundamental skills used to read and interpret data from tables and figures shown in news reports or some other sources [10]. This skill involves organizing data, building and presenting tables, and working with different data representations, it also includes a basic understanding of measurements and uncertainties. In other words, it could be said that statistical literacy would be the initial stage that the statistically educated citizen should reach [2].

Statistical reasoning refers to the way of reasoning against statistical data in relation to ideas, presentations of statistical reports, in addition to giving written or verbal information, involving making summary interpretations based on a set of statistical information in a conglomerate manner. [2]. Finally, the competence of statistical thinking commits to the understanding of why and how statistical concepts and data are inserted in the reporting or statistical reading processes, as well as the role played by implicit statistical announcements [2]. Statistical competence consists of the interpretive varieties of the results to later support and interpret statistically according to formal standards, select and apply the appropriate technique for collecting and processing them, verify the assumptions of the techniques used to detect the information, properly select the estimators for the prediction and precision levels during the induction, appropriately use statistical software that allows processing the data, as well as explain the logic of the statistical processes used , prior analysis and expose results achieved with sufficient ethics and honesty scientific.

MATERIAL AND METHOD

For the study, students from the Faculty of Education of the V academic cycle of the professional careers of Initial Education, Primary, Mathematics and Physics, Biology and Chemistry, English and Spanish, Language, Literature and Communication, History and Geography, Philosophy, Tutoring and CC SS, with a total of 78 students enrolled in the specific curricular experience of Statistics Applied to Education.

The units of analysis were made up of two intact comparative groups enrolled in two scheduled shifts of 8 weekly pedagogical hours for 9 weeks, time that the programming had an effect. The conformation of the intact group generated the experimental design of the quasi-experimental type, of applied level [22, 34]. The members of each group were from different professional careers.

The experimental learning sessions consisted of exposing the themes of the syllabus through the didactic medium of statistical infographics [20]; It allows to show visible texts to the theme, denotative icons. The students of the experimental group were induced for the elaboration and presentation of the statistical information after the processing of the information, who had to show in a representative way with the characteristics of the environment; Due to its structure, the students were able to systematize the information and show the graph or table adequately both in sufficiency. The components of the infographic were evaluated using a rubric: exposed information objective, identification of the topic to be reported, the title in congruence of the information, the support of the information based on academically validated sources (associations, surveys, interviews, articles, etc.), integration of the image, format of the text read without difficulty [16,20].

The instrument that allowed detecting the achievements of statistical competence has three sections. With respect to the first, it presents literal questions of recognition of statistical concepts, immediate calculations of statistics, while the second section consists of questions for the elaboration of tables and figures, in addition to the interpretation of the values and statistics detected in the table, Finally, in the third section, it consists of 3 situations that allow the elaboration of a representative statistical report of a table, specifying explicit and implicit data, then generalizing and assuming a dation taking from the detected data; For the three sections, the three components of the competition have been taken into account. The pedagogical evaluation was validated by 6 judges related to the subject, obtaining an Aiken coefficient of 0.954, in terms of coherence, relevance and sufficiency [12,19] ; In addition, the instrument was put to consideration of reliability with the Kuder Richardson 20 technique, detecting a coefficient of 0.984, it also has an adequate difficulty index of 0.65 with a measurement error margin of 0.345, of which it was detected that item 5 and 7 show a low difficulty index of 0.795, while item 3 and 9 have a complexity index of 0.345 compared to the other 10 items that the evaluation instrument consists of [12, 29].

RESULTS AND DISCUSSION

Prior to the detection of the comparative results between the research groups, the achievements in the presentation of the statistical infographic were evaluated in the experimental group through a rubric: exposed information objective, identification of the topic to be reported, the title in congruence of the information, the support of the information based on academically validated sources (associations, surveys, interviews, articles, etc.), integration of the image, format of the text read without difficulty that is shown below:

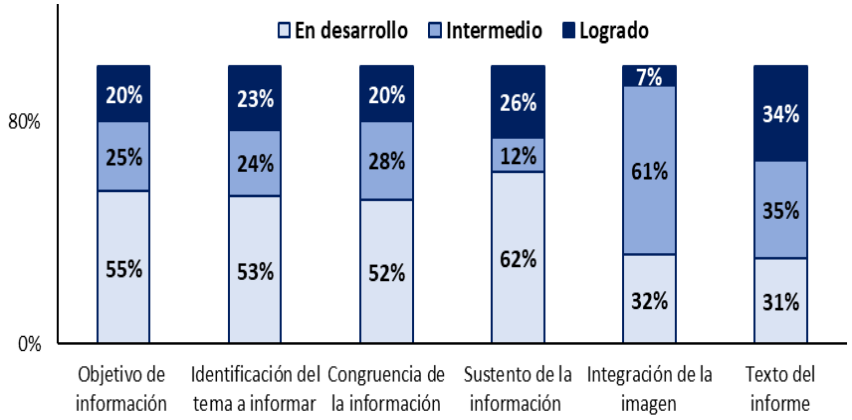

Figure 1: Performance levels of the rubric criteria

Globally, the data in the figure show that a large percentage of students are developing in the way of presenting an infographic with statistical content, even more so 62% of students fail to insert the appropriate information from the figure

or table. statistics and, where they have greater difficulty, is in the criterion of the integration of the appropriate figure and the insertion of the text in a systematic way consistent with the objective and the title of the icons.

Table 1: Comparative levels by group regarding statistical skills and statistical parameters.

Statistical skills	levels	Control group (46)		Experimental group (32)		Statistics/ Parameters
		pre-test	post test	pre-test	post test	
Statistical literacy	Developing	60.87%	21.74%	68.75%	6.25%	T (1-α/2) = 16.24 p_value = 0.000 nse. ***
	Intermediate	36.96%	52.17%	28.13%	12.50%	
	Accomplished	2.17%	26.09%	3.13%	81.25%	
	(ȳ ; S)	(8.21; 2.52)	(15.31; 2.41)	(8.21; 2.47)	(18.21; 1.27)	
statistical reasoning	Developing	63.04%	30.43%	59.38%	3.13%	T (1-α/2) = 12.02 p_value = 0.000 nse. **
	Intermediate	32.61%	47.83%	37.50%	12.50%	
	Accomplished	4.35%	21.74%	3.13%	84.38%	
	(ȳ ; S)	(7.08; 3.46)	(15.31; 2.41)	(8.29; 3.46)	(18.23; 1.81)	
statistical thinking	Developing	69.57%	45.65%	56.25%	6.25%	T (1-α/2) = 11.65 p_value = 0.000 nse. **
	Intermediate	28.26%	43.48%	34.38%	21.88%	
	Accomplished	2.17%	10.87%	9.38%	71.88%	
	(ȳ ; S)	(7.06; 2.87)	(15.31; 2.41)	(8.49; 2.97)	(17.79; 1.03)	

The results of the control group are the product of the actions taken by the teacher in the way the learning sessions are being developed, focusing on the chair with theoretical information, reinforcement actions in case of resolutions of practical sheets, teachers manage to develop exercises, problems and cases; but many of them fail to represent the adequate table that systematizes or summarizes the data, lacking its informative purpose. This is reflected in the results obtained in the post -test of the control group, where the bulk of the percentage is at the intermediate level in terms of data management, of which only 10.87% of students achieve statistical thinking competence and a group of students have difficulty inserting statistical concepts and data into reports, do not require the proper use of techniques for the systematization of the report, have difficulty interpreting data and do not show the levels of precision of a summary report of statistical tables or figures.

On the other hand, with respect to the results shown in the experimental group, where it has been possible to apply the strategies for the elaboration of the infographic in order to strengthen the presentation of the statistical results in a coherent and timely manner. Regarding the competence of statistical literacy, 81.25% of the students achieve fundamental skills for reading and interpreting data from tables and figures, they manage to draw conclusions from journalistic reports or other sources, as well as assign interpretations, summarize Statistical representative texts within infographics. However, the results of the statistical reasoning competition, 84.38% of the students manage to internalize and reason the statistical data in relation to the ideas of the statistical reports, they also managed to abstract the data that generalize the statistical presentations and contextualize in varied scenarios. comparatively.

Finally, regarding the competence of statistical thinking, 71.88% of the students exposed to the experiment present a level of achievement, they are able to discover, identify the causes of the statistical reports, and make inferences from the data exposed in the infographic. , managed to systematize the reports, determining the title. The presentation of reports, elaborate systematized texts, generate logical sequences for their visualization to the public and access the information visually; With the fact of making the statistical presentations visible, the information of the explicit and implicit data was detected, allowing the generation of a generalized summary product of a data set.

These actions taken in the experimental group evidenced the construction of the infographic of statistical content of topics exposed in the syllabus of the subject; allowed the comparison against the members of the control group described above, evidencing that there are significant differences in terms of the comparison of the T Student for means in independent samples at a level of statistical significance of 0.05, appreciating that both in the competition of the literacy and statistical reasoning, the comparison of means between the post -test is highly significant, while in the statistical thinking competence it is also significant but at a lower level compared to the other two.

The study is referred to how to strengthen statistical skills from the use of infographics; In it, icons such as figures and statistical tables associated with systematized texts with relevant information are captured, of which the students who evidenced the experimentation reported their infographics, detecting that, during the elaboration of the informative medium, it aroused interest, motivation in the student, allowing achievements in statistical skills. The vertiginous scientific-technological development in the information society allows information to be displayed through visual organizers through icons [15], while infographics gain importance in the knowledge society that allows the empowerment of information in a systematized and visual way associated with denotative figures. To relevant information [1]; in the case of the study, it was to denote relevance to the statistical results. The study allowed to awaken the fundamental skills for

reading texts associated with infographics where icons and texts are shown in a systematic way that aroused interest in reading by the research units, the study shows relevance compared to the interest on the part of the student in how much they managed to systematize the data and poured the synthesis as a summary, showing significant data from the figure and statistical tables [23].

The importance of infographics in the presentation of predominant summaries is shown, since the intention of these media is precisely to show important and relevant data associated with representative icons of the information [5] ; Under this line, studies were developed in order for students to reflect on the contents of the texts, allowing them to discover the implicit and explicit information of a literary infographic, since it is important to discover the data and explicit and implicit information of the informative tables. Here are the most representative data. The infographic shows the message through different iconic types presented in the infographics for a later semiotic analysis of each iconic typology [25, 8].

's expertise and extracting information during the interaction with summarized data and figures associated with ergonomic criteria [4, 31]. The complementarity between the language -verbal and visual- results and allows the detection of a report from the interactions of the icons and short texts present in the infographic [6].

Finally, the study was developed in two groups of university students made up of different professional careers, one of them was presented with the theme for the implementation of infographics associated with the concepts of statistics and, to the second, the same theme was presented. of the syllable with the absence of the tool under study. This made it possible to determine that informative graphics and icons are tools that impact the forms of access and appropriation of knowledge, allowing the strengthening of statistical skills in such a way that it is an educational resource in the face of the prevailing visual culture.

CONCLUSIONS

The results detected, after the experimental phase, indicated that the group of students managed to promote statistical skills compared to the group that did not use infographics as a didactic medium. The results show that 81.25% of the students presented a level achieved in statistical literacy, which implies having acquired skills for reading and interpreting data, drawing conclusions from journalistic texts; while 84.38% of the students achieved statistical reasoning, since they internalized and reasoned the data in relation to the ideas of the statistical reports, they also managed to abstract data from the statistical presentations; Finally, 71.88% of the members of the experimental group were at the level of achievement in terms of statistical thinking, implying that the student was able to identify the sources and origin of the statistical reports, and also make inferences from the data presented in the infographic. , identify implicit and explicit data. Of the results described, the statistical thinking competence presents the lowest percentage of achievement compared to the other two; therefore, it follows that, just like students, people also have a lack of detecting sources of information and performing critical analysis and judiciously accepting the data exposed in television or newspaper reports, where they are often shown in statistical infographics. However, the use of infographics allowed the literacy of statistical skills in university students.

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