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Evaluating the Effectiveness and Opinions of School Children in North Chile on an Alternative Audiovisual or Text Report for Communicating Science

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Abstract

The dissemination of science at primary levels of education is one of the main public policies for the training of scientists and the sustainability of the planet in general. In this context, the main goal of this study is to compare two dissemination strategies (audiovisual vs. written reports) in the understanding of a coastal ecological scenario in elementary school students in northern Chile. To evaluate the effectiveness of a written and audiovisual report as a science communication strategy, both were presented to 6th-level primary school students. The result of this study revealed low levels of comprehension, with no significant differences between the communicational strategies. However, students recognized the value of writing over audiovisual media in the construction of their learning. The analysis of general comprehension of a common ecological environment, tested in both dissemination formats, shows that only one-third of the students fully understood the information. This study highlights the importance of this research on student perception and the incorporation of more advanced communication strategies in the dissemination of science and technology at the national level.

Keywords: *Audiovisual and report comprehension, Journalism, Scientific communication, Science journalism*

1. Introduction

A national survey on the importance of the dissemination of science and technology in Chile [9] shows high public interest in learning about its development, even more than other activities such as entertainment and politics; however, 76% of society claims that there is

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little information about different science disciplines at the national level. This survey shows that half of those who seek information on science and technology topics do so through video programs and a third reads texts in printed materials (e.g., newspapers, magazines, and books), which are the main communicational instruments for scientific dissemination in Chile.

Every communicative act includes the transmission of contents through a particular form [57]. Consequently, communication strategies are crucial for journalists or science communicators. For some, the relationship achieved in an interview is important, valuing the depth that a face-to-face or virtual report allows. In this context, the report is an informative instrument requiring research, the result of which is more profound than the news itself [47]. The report constitutes "an essentially informative journalistic account, free in its subject matter, objective and written in a direct style, evidencing a fact or event of current or human interest" [34]. Thus, this form of communication and its effectiveness depends heavily on the skill and craft of the person who carries it out.

Given that the report is a "journalistic genre where the author enjoys structural and expressive freedom, and is generally accompanied by photographs or infographics," the use of various strategies for the public communication of science and technology depends fundamentally on the journalist or communicator [46]. Nowadays, access to audiovisual or written platforms and media allows the use of graphic materials to capture the attention of the target audience and increase their understanding of science.

In this digital era, science communication is projected beyond text using videos on websites and social networks [12], constituting an important tool for science education and popularization [25]. In this context, YouTube has become one of the most widely used web platforms globally, with more than one billion users and billions of daily views in search of different content [40]. Considering that society more frequently uses sites with audiovisual materials [15], science communicators and communicators strive to attract public attention to disseminate the development, progress, and contribution of different scientific disciplines over other cultural, political, or entertainment proposals. Muñoz et al [41] estimated that by 2026, there will be more than 4,000 channels for the dissemination of science and approximately 100,000 scientific videos.

Young people and adolescents have a strong connection with digital media as it enables them to enhance their personal development, knowledge, and literacy in all forms [3]. In this context, science outreach using multimedia tools should have a greater impact and be more efficient than outreach through written media. However, the evidence that allows comparison of the levels of comprehension and learning between an audiovisual medium and a written medium is surprisingly scarce, as well as contradictory. Even though students may find audiovisual media more entertaining, more attention-grabbing, and more engaging than written media [18][55], it should not be forgotten that "seeing something is not learning and just showing is not teaching" [17].

It is important to highlight that worldwide science communication has taken a leading role, especially after the appearance of COVID-19 and the need to bring health information closer to society [14]. This has shown that, at present, audiovisual communication and the dissemination of written content continue to be one of the main informative actions developed by scientists, researchers or journalists [27][28][37], mediated by the use of social networks to transmit this type of information and taking advantage of advances in these applications, especially those that are most used by young people such as TikTok [8][33] and thus audiences can understand what is presented.

However, by providing a local look at these outreach strategies, it has become evident that science communication in Chile has not taken advantage of its full potential and still maintains aspects that limit it and denote a low priority by disseminators and institutions [32][50], which leads that, despite the interest in science that the population has, the levels of information received and understanding of these contents are low [57]. This is reinforced by the fact that a high percentage of the population feels poorly informed about science and technology [56] and the participation of researchers or scientists in dissemination actions, as well as their presence in Chilean media, is low and irregular, and they consider that dissemination in the country is "poor" [54], which affects access and scientific understanding of the information, or knowing what are the best techniques to disseminate this type of topics.

Taking into account the problems that attempt to improve the effectiveness of communicating scientific content, the scarce guidelines that exist to know which options are the most appropriate, especially for schoolchildren from public schools in central-northern Chile, is that this work has a general objective to know what is the effectiveness and understanding of scientific content in these students, through two communication strategies such as written texts and audiovisual reports and thus contributing to the development of strategies for public communication of scientific information.

2. Materials and methods

2.1. Research design

To evaluate the effectiveness of a written and audiovisual report as a science communication strategy for elementary school students, a written report of 1,050 words and an audiovisual report of 9 minutes and 30 seconds were developed. Both reports contained the same content, based on the description and functioning of the Las Salinas de Huentelauquén Wetland (Coquimbo Region), an ecosystem of high ecological importance and sensitivity to human intervention in central-northern Chile.

2.2. Research instrument

To evaluate both communication strategies, a questionnaire was developed considering (a) the level of comprehension of the stories, (b) appraisal of the material presented, and (c) perceptions and interests about communicational media.

Students' comprehension levels were evaluated through a series of literal, inferential, and critical reading questions [21], based on the reading comprehension questionnaire proposed by Medina et al. [36]. This approach responds to Barret's taxonomy, which explains how an individual establishes: (a) literal comprehension, i.e., the grasp and acceptance of textual meaning; (b) inferential comprehension, which involves the use of the information presented and intuition to conclude; and (c) critical comprehension, which requires a value judgment when comparing the information received with external or internal criteria related to values and previous learning [24].

To standardize the criteria and facilitate the comparison of results, a single questionnaire was used for both reporting formats. Although the questionnaire is based on reading comprehension instruments, it is assumed that comprehension is not only achieved through writing, since literacy should be understood not only as the ability to read written language but also as multi-literacy through audiovisual, technological, and media means [2].

To understand the students' perception of the reports, the questionnaire included two closed multiple-choice questions and one open-ended question that requested students evaluate the

report by writing what they would remove or add to the report they had seen or read. Additionally, students were asked about the media they found most attractive and via which they believed they learned the most, based on the VIII National Television Survey [10].

2.3. Respondents of the study

Utilizing a non-probabilistic approach [23], six elementary public schools were selected from the Coquimbo region with equivalent educational characteristics [Table 1]. The reports, in both video and text, were presented to 6th level primary school students who were 11 to 12 years of age. The assignment of the communication medium (written or audiovisual) to the different students was random [23]. The participating students were informed of the objective of the study and participated voluntarily with the consent of their teachers, who are responsible to their parents for the activities in which the students participate in Chilean schools.

Table 1. Sample data of surveyed students in Coquimbo

Audiovisual report	Written report
Database Role[2]: 620 (28 students)	Database Role: 13514 (36 students)
Database Role: 13593 (29 students)	Database Role: 13562 (30 students)
Database Role: 614 (24 students)	Database Role: 630 (40 students)
Total respondents audiovisual report: 81 students	Total respondents' written report: 106 students
Total sample: 187 students	

2.4. Data gathering procedures

The reports were presented to 187 students: 81 students for the audiovisual report and 106 for the written report. The students had 15 minutes to read the written reports. After the presentation of the video or the reading of the written report, the students were given 25 minutes to complete the questionnaire.

2.5. Data analysis

The comprehension questions were analyzed by contrasting the students' answers with the information delivered in the reports, assigning scores according to Medina et al. [36] for each category (literal, inferential, and critical). Percentage frequencies were estimated for the following categories: "No comprehension" (no correct answer); "Partial comprehension" (if at least one correct answer was recorded), and "total comprehension" (all answers were correct). Percentage frequencies were also estimated for the evaluation of news reports and interest in the media. In the case of open-ended questions, responses were coded according to the frequency of mention [23][39].

The significance levels of the frequencies of the students' responses were analyzed using the chi-square test for percentage frequency distributions[3].

[2] Database Role. It is the identification number of the educational establishments registered by the Ministry of Education in Chile.
[3] Using the website www.socscistatistics.com

3. Results

3.1. Comprehension of the reports

The analysis of general comprehension achieved by sixth-grade elementary school students of science reports in written and audiovisual formats suggests that, in both formats, the level of comprehension is low and only one-third of the students fully understood the information presented [Figure 1]. No differences in comprehension levels were found between the two formats ((X2 (2) = 0.02, p = 0.99)).

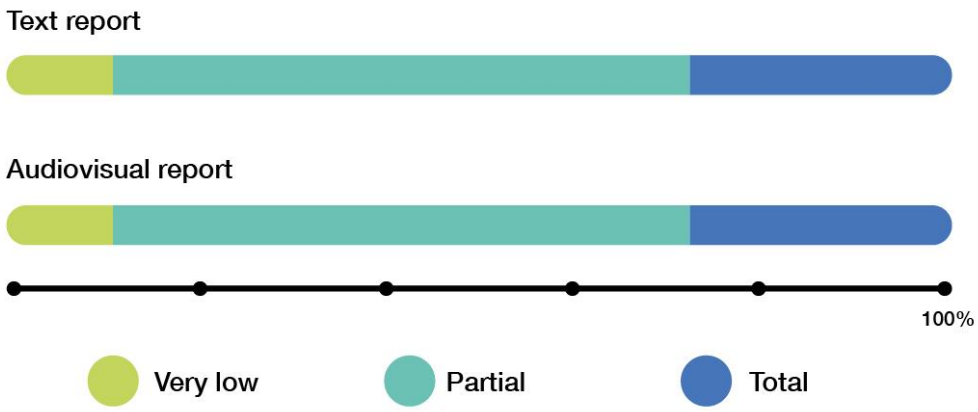

Figure 1. Percentage distribution of schoolchildren's general comprehension of written and audiovisual reports

A similar situation was observed when comparing the literal (X^2 (2) = 0.73, p = 0.69)), inferential (X^2 (2) = .64, p= 0.73)), and critical (X^2 (2) = 4.16, p = 0.13)) domains of comprehension [Figure 2], finding no significant differences in the level of comprehension achieved by students in both communication formats. There was a slight tendency to achieve higher levels of comprehension among those students who read the written report in the areas of literal and critical comprehension, but not in the case of inferential comprehension, where a slight improvement was observed in those students who were exposed to the audiovisual report.

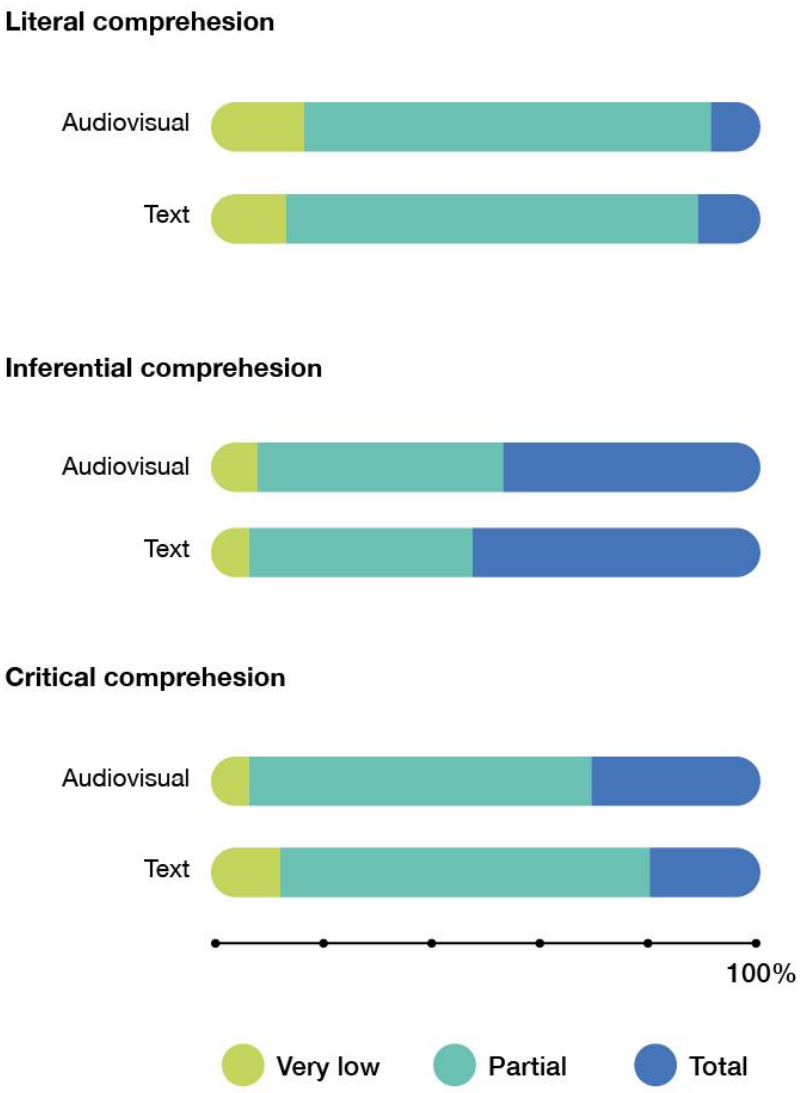

Figure 2. Percentage distribution of students' literal, inferential, and critical comprehension of written and audiovisual reports

3.2. Perception of the level of comprehension

Most of the students stated that they had achieved a high level of comprehension of the reports [Figure 3], with no significant differences in this perception between the written and audiovisual formats (X^2 (2) = 0.34, p = 0.84). Thus, less than 10% of the interviewees considered their level of comprehension or learning in relation to the report to be low, regardless of the format.

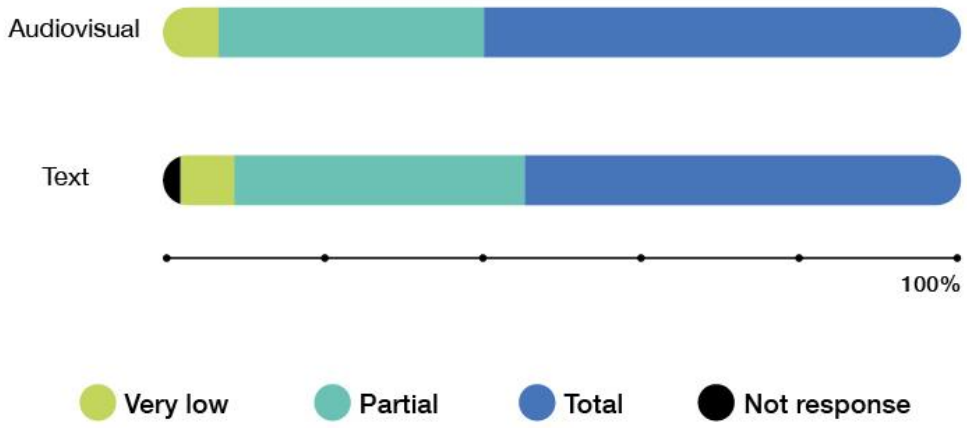

Figure 3. Percentage distribution of schoolchildren's perception of their level of comprehension of written and audiovisual news reports

However, while a high proportion of students perceived that they had achieved high levels of understanding, the application of an objective test showed the opposite, these differences being statistically significant (X^2 (2) = 15.47, p < 0.05)).

3.3. Assessment of the reports

Faced with the open-ended question on how to improve reporting, 65% of the students answered "Nothing," "Don't know," or simply did not answer. However, among the opinions obtained about the audiovisual report, the students point out that "it would be interesting to have a greater plurality of opinions," highlighting "the greater participation of women, boys, and girls," while another group proposed "including more environmental information, either about what happens in the wetland," or about "the problems that are manifested in relation to this ecosystem." The same opinion of "adding more environmental information and information about what happens in the ecosystem-wetland" appeared in the written report. In addition, a couple of students recommended that the report "could be funnier" and stated that "the text is too long."

3.4. Uses and perceptions of the media

When asked about the media of greatest interest or taste for the students surveyed, 44% stated that they watched videos via the Internet. However, interestingly, this perception was inverted when asked about the most appropriate medium for learning, with 47% of the students considering that the written medium was the most suitable [Figure 4]. Although in a smaller proportion, lectures or expositions were also considered effective means for learning. These differences were statistically significant (X^2 (5) = 23.3, p < 0.05).

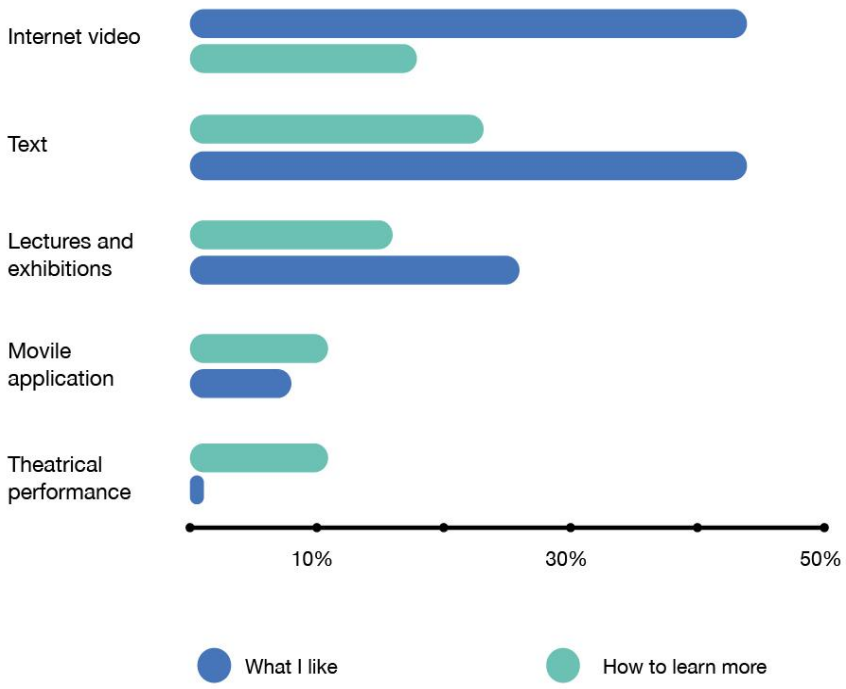

Figure 4. Percentage distribution of schoolchildren's opinion on tastes and perception of learning on different communicational media of science and technology

4. Discussion

This study shows that elementary students from public schools in northern Chile present significant deficiencies in the comprehension of scientific reports in both written and audiovisual formats. This information is consistent with other studies that show that Chilean students present a delay in reading comprehension and fail to understand what they read [19][43]. Moreover, evidence suggests that primary education students lack critical thinking skills, this being one of the most complex facets to be achieved by boys and girls [21][51]. As Núñez-Valdes & Medina-Pérez [44] point out, this deficiency affects performance in different subjects and influences how individuals fit into society, which is a recurrent reality in Latin America [53]. In Chile, the literature published on comprehension of audiovisual media is scarce, and low comprehension levels among teachers [13] may be a determining factor in the reading comprehension of their students.

Given the massive scale of and students' affinity for audiovisual media, greater comprehension of the audiovisual report was expected compared to comprehension achieved using written text. However, the results show that there are no significant differences in the comprehension of the contents of a scientific report between the two formats. This result contrasts with what has been reported by other authors, who suggest that the audiovisual mode as a communicational and pedagogical tool is more effective than written forms in the teaching-learning process and the comprehension of scientific-technological content [5][16][55]. In turn, the surveyed students preferred audiovisual media; however, they recognized the printed text as the best medium to achieve greater learning. In this context, this study suggests paying attention to the construction of strategies for science communication

that involves a balance between content and entertainment, thus capturing the attention of students while simultaneously promoting learning.

It is important to consider that the written instrument facilitates a certain level of understanding, in contrast to the audiovisual one, since reading requires concentration and structuring of ideas, favoring conceptualization and scientific thinking [16]. Having a written document allows re-reading, an advantage that is not usually available with a video. In this sense, "in many occasions, we understand only what we can hold in our hands, that which is tangible and that at some point we can take it and concretize some discursive figure" [26].

On the other hand, it seems that the use of audiovisual media is more effective than printed text in communicating content from different disciplines since it includes sounds, texts, graphics, and didactic elements [1]. Students consider that these elements, e.g., images, increase motivation to learn since they illustrate concepts that are easy to remember whereas the same information presented in a text can be more difficult to understand [6]. Although visualization can facilitate comprehension, transferring study strategies from written texts to videos is not an easy task [7]. The perception that the audiovisual medium is more effective because it activates two memory channels (visual and auditory) is not entirely accurate since students are exposed to cognitive overload (listening and watching while simultaneously recording notes on the content received). In this context, both instructors and students agree that while audiovisual media allows more comprehensive communication, a written format achieves more efficient and organized feedback of the contents [4].

Globally, the use of digital resources outside the educational context is high; however, students prefer printed text as a learning resource [52]. In this context, it has been documented that students who use printed texts over texts in a digital format achieve significantly higher scores on a reading comprehension test [30], suggesting that the contents coming from a screen are perceived as a source of superficial information, reducing the mobilization of cognitive resources.

Although elementary school students currently consume a lot of audiovisual content through media via television and social networks, this does not contribute to achieving higher levels of comprehension. According to a report on programming offerings and consumption of children's television, prepared by the National Television Council of Chile [11], only 8% of television offerings are aimed at children. Moreover, this scarce content is evaluated by 60% of parents as of "low quality." However, the entry of educational signals such as television education and new digital television offers could increase the number of programs to provide more educational content.

Regardless of the comparison between communicational strategies for science communication, the results of this study indicate the low levels of comprehension of students in the sixth year of primary education, which, although corresponding to a sample of a region in the north of Chile, seem to be common to primary education in public schools nationwide. In this context, although there is no information available on the levels of comprehension of audiovisual content in Chile, these results coincide with the studies of Fundación La Fuente and Adimark GFK [20], where half of the students who graduated from primary education in Chile do not understand what they read and suggest that they do not understand what they see. The Ministry of Education has recognized that most students experience difficulties accessing information, understanding a text, and reflecting and evaluating the contents of what they have read [38]. The latter is increased by the effects of the COVID-19 pandemic, which has increased educational gaps due to low connectivity and face-to-face access to educational centers [42]. According to the Ministry of Education's national survey of school monitors in May 2021, one-third of schools report having one or more grades showing

underperformance compared with a normal year. For these reasons, it is necessary to promote and evaluate the effectiveness of policies and strategies to improve the comprehension skills of public primary education students, especially for science communication.

The low levels of primary school students' comprehension of a science report can be explained by the lack of previous experience in science and technology [48]; thus, initiatives of national coverage such as the Explora Program and Public Science Programs of the Ministry of Science, Technology, Knowledge and Innovation, which promote the linkage with specialists in research centers and universities, can result in a greater understanding of the processes and results of science. A recent study showed a sustained increase in science communication in public and private education in 14 Latin American countries, including Chile, where universities and research centers are the largest contributors to its dissemination, along with museums, zoos, aquariums, and planetariums, among others [35].

The perspective of students, who believe their understanding of scientific reports to be ineffective, suggests that the complete decoding of information is a complex process [29][49]. This misperception is highly detrimental as it does not encourage greater efforts in the compression and integration of knowledge, which negatively impacts students' personal development and integration into society [45]. This study highlights the importance of developing studies on students' perceptions in relation to the way they receive scientific information, which is very useful in the design of strategies and public policies aimed at achieving higher levels of reading and visual comprehension, as well as for the communication of science and technology.

The communication of science to educational communities and society in general in Chile requires greater articulation between different actors such as universities and research centers, journalism schools, the media, the educational system, and especially the government [22]. Although local governments, encouraged by the Ministry of Education, have developed instances of scientific dissemination, these are only temporary; consequently, they do not manage to develop a critical mass concerning the development of scientific culture. In this sense, the recent creation of the Ministerio de Ciencia, Tecnología, Conocimiento e Innovación (Ministry of Science) in Chile could be a catalyst for the generation of linkages that benefit and impact the entire system: both students and teachers. In a global context, it is urgent to incorporate social sciences more strongly in science and technology communication processes, as well as to generate alliances with initial teacher training schools at all levels to train future scientists and technologists, especially in countries that need to incorporate added value to their natural resources, with a view of distancing themselves from extractivist' policies [31].

5. Conclusion

The scientific education of society and particularly of schoolchildren is the key to promoting sustainable development in Latin American countries. Considering the lack of information on the effectiveness of different methods for the communication of contents associated with research carried out in local centers, the main objective of this study was to evaluate the effectiveness of reading documents and watching audio-visuals for the comprehension of research results. The evidence obtained does not show differences between both methodologies in the levels of comprehension; however, more depth is required since the students' comprehension levels were low and, in their opinion, the written report allows them to achieve greater learning. The results of this study reveal the importance of evaluating scientific dissemination techniques, because, despite the general belief and the boom of

audiovisuals as a means of communication, they do not ensure higher levels of understanding. Having this type of information is necessary to plan science communication processes and to optimize the use of the scarce economic resources available for science education in Chile and Latin America.

Disclosure statement

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