



## Digital application strategies in the understanding of scientific texts

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## **Digital application strategies in the understanding of scientific texts**

**Abstract.** The low understanding of scientific texts in the university field requires an urgent alternative from the didactic. Therefore, digital application strategies are an interesting alternative solution. The purpose of this research was to determine the influence of a set of applications and programs used as a didactic strategy in the process of reading and understanding scientific texts. To achieve this, two tests (pre and post) were applied to assess reading comprehension. From a population of 1580 university students, a sample of 310 was taken: control (160) and experimental (150). For the data collection, adaptations of the Test CLUni, 2015 were applied in one paper of indexed journals. The results reflected significant differences in understanding, in the results of the evaluation of entry and exit according to study groups. Therefore, it was concluded that Digital Application Strategies significantly improve the understanding of scientific texts.

**Keywords:** Understanding scientific texts; E-learning; Reading strategies; Digital reading.

# 1 Introduction

In the present investigation, we sought to verify the influence of a digital strategy in the understanding of scientific texts by university students. Because of this, he focused on proposing activities that would have to be carried out in one or two classes at the most to test the relevance of virtual resources, programs and applications in achieving both literal, inferential and criterial understanding. The chosen reading was "The recognition and classification of concepts in understanding scientific texts" by Fernando Gomez & Carlos Segami. The research on the comprehension of texts is lush and yet the results remain tentative and preliminary with respect to an effective solution to the little or no reading comprehension. Unfortunately, there is a marked bias not to take scientific texts into account, referring them only to specialists. Those who address them, reduce the scientific text to the merely informative. Wasting the argumentative and rhetorical of them. Finally, when choosing a quasi-experimental design, the present research proposes a cross-section of the research, assuming that only in theses (and very little in articles) are the approaches of experiments that seek to significantly influence the understanding of texts. Likewise, there is a little approach to specific research with university students in relation to scientific texts (academic articles).

## 1.1 Reading and understanding in digital environments

Reading in physical or in a digital environment creates a great pedagogical dilemma in its use and use in both media. The physical texts are concrete and fixed to the environment that facilitates it; while digital is intangible and virtual (García, 2016). These differences disturbed the intellectuals who thought they could become precarious not only the reading itself, but their understanding. However, Piovano and Burin (2014) found no differences in understanding. In spite of this, users and specialists have marked the great qualitative difference between reading in physical and in a digital environment when it comes to bulky texts. In fact, in this type of reading the monotonous light of the screens causes a visual fatigue in the reader. It can even cause "dry eye" because of its excessive exposure. Also, if the reading is given on mobile devices, this reduces the holistic vision of an entire page as in a specific book reading. Even so, the studies were decanting these disadvantages to simple peculiarities, understanding that each of them had their own characteristics and therefore their intrinsic advantages and disadvantages.

For some pro-digital researchers, virtual reading on electronic devices meant more interaction and dynamism, than reading on simple pages. But that was not why they lacked disruptive elements. And that, to avoid cognitive overload, the digital reader had to have specific competencies to take advantage of all the advantages of virtual text and reduce its disadvantages (García, 2016). In this same sense, Romero (2014) states that it is necessary for readers to be effective readers who relate to the writing in a more fluid, effective and constant way. Skills such as design, search and

navigation (Fajardo et al; Wu, 2014 cited in Burin, Coccimiglio, González & Bulla, 2016). That is why this research has emphasized the design of activities that take into account the interactive, prior knowledge (McNamara, 2007; O'Reilly and Sabatini, 2013; Otero, León and Graesser, 2002; as cited in Martínez , Marrujo, Perillo, González & Burin, 2019) and the search for cognitive conflict to round understanding.

## **1.2 Impact level of digital programs and applications**

To work both reading and subsequent understanding, a didactic strategy was chosen that took into account the levels of impact of technology in education. According to Puentedura, 2006; López, 2015, as cited in Curiel, Sánchez, & de Tecamac, 2018, this impact can occur: (1) improving and transforming with a moderate replacement of the physical with the digital; (2) increasing the real in the virtual with a direct and functional substitution; (3) modifying the real in the virtual with a direct, functional substitution and the use of specific didactic strategies; and (4) modification of the real in the virtual with a substitution and the use of ICT tools in the creation of new learning.

In this investigation, the third level of impact was chosen. Since both the programs and applications used sought a direct replacement of physical reading by a virtual one in a functional way, as well as the use of specific didactic strategies to perform specific pedagogical processes such as collecting prior knowledge, cognitive conflict, recovery and organization of information , and evaluation of reading comprehension. The criteria for choosing the applications and programs were the ones that were most intuitive and did not imply cognitive overload, nor much difficulty for their access nor sophistication in their processing; since, in some occasions, the ICT tools instead of being a means, are involuntarily transformed into an end in themselves (Levis, 2016 cited in Pérez-Rodríguez & Ponce, 2012). In addition to having in most cases, economic conditions for their subscriptions.

Therefore, this research used the following programs and applications: Seva, Kahott, miMind, Educaplay, Goconqr, and Thatquiz digital library. The Seva Digital Library was used to access the two stories used in this work. The Kahott was used for the collection of previous knowledge and cognitive conflict. The miMind was ideal for retrieving and organizing information in Harmonic Mind Maps. The Educaplay platform was very important for the design and application of post-reading recreational activities such as word search, crossword puzzles and interactive maps. Finally, Tango Goconqr and Thatquiz served to evaluate the readings.

It is necessary to note that the use of technology in education is still low. Salazar et al (2015) revealed that only 6% used electronic devices for educational purposes in Colombia. It should be added that, due to poverty, the technological gap in Latin America is greater (Rodríguez, 2005; Bravo, 2012) and precisely because of this, the requirement for teachers to make the most of the available resources. It is in this context that strategies in digital environments become the ideal means to positively influence learning.

After ensuring learning, the immediate thing is the evaluation. For this, this work opted for online tests. Modality according to Thorne et al, 2013; and Ponce et al, 2007

is an alternative that, if well used, can improve results. In this investigation, a pre test and two post test (one previous and one definitive) were applied. Understanding that the fact of carrying out an additional evaluation as an essay means the security of improving the total understanding of the text read (Benítez, Barajas, Uresti & Nallehly, 2014).

Online assessments, in turn, have the advantage of being immediate, fast and with the option of self-regulation according to each learning pace. The researchers recommend that reading evaluations appeal to a contextualized design (Mon, & Cervera, 2013) and that the items investigate an understanding of deep and relevant reading (McNamara, 2007 as cited in Martínez, Marrujo, Perillo, González & Burin , 2019).

## 2 Method

Type of study: We worked with an experimental research design of the quasi-experimental cross-sectional type.

**Participants:** The research focused on a population of 1580 students of the Faculty of Education of the UNMSM, of which a sample of 310 participants was taken (Control group: 160 and Experimental group: 150) of oscillating ages between 18 to 27 years, through a simple probabilistic sampling (Malhotra, 2008). Those selected signed an informed consent document and were given their respective return of results.

### 2.1 Materials

An indexed magazine article was used: "The recognition and classification of concepts in understanding scientific texts" by Fernando Gomez & Carlos Segami as a reading for both the pre test and the post test. A 17-page paper of high textual complexity, which requires prior knowledge and good reading technique. Therefore, a reading time of 1 hour was assigned for its corresponding reading. Ten questions were applied based on the CLUni Test (2015) where, through multiple alternative questions, information of literal, inferential and critical comprehension is collected. Also, the pre test is applied in the That quiz platform, a first post test in the Goconqr environment and a last post test in That quiz.

In the experimental group, a brief five-minute questionnaire was used in Kahoot, before reading; and after reading a Digital Mind Map through the miMind platform, for 15 minutes; Three recreational activities were carried out through the Educaplay platform: a crossword puzzle (10 minutes), a word search (10 minutes) and an interactive map (5 minutes).

## 2.2 Procedure

In the first class the signature of the informed consent is made, the papery is read and after it is completed, the pretest is applied to both the Control group and the Experimental group.

In the second class, a recovery of the previous knowledge is developed with the Experimental group and the cognitive conflict is sought through a brief Kahoot questionnaire, where the first two questions are for the collection of previous knowledge, important to anchor and relate to new information; and the last two to provoke a cognitive conflict from the reflection on the theme of the paper. Crucial theme of the story to be read. The conflict arises from the statement that man is or is not mired in time. The assertion is true, but it is used to cause an imbalance in the acquisition of new learning (Campione, Brown & Ferrara, 1987; Piaget, 1985; Siegler & Richards, 1989 as cited in Gerraikaetxebarria, 1996).

## 3 Results

The comprehension notes of scientific texts were analyzed and the normality test was applied.

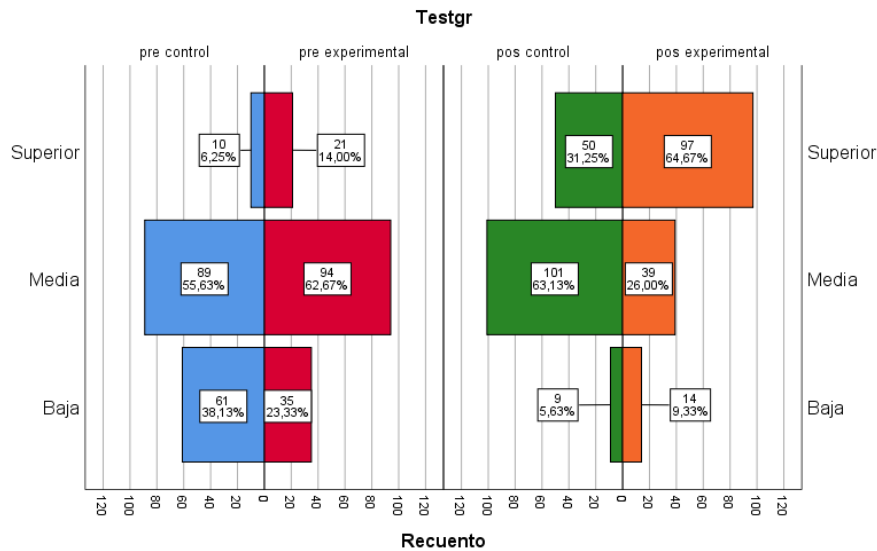
**Table 1.** Normality test of Understanding scientific texts

Kolmogorov-Smirnov <sup>a</sup>	test	Estadístic o	gl	Sig.
Understanding scientific texts	pre control	,153	160	,000
	pre experimental	,175	150	,000
	pos control	,140	160	,000
	pos experimental	,174	150	,000

a. Lilliefors significance correction

And since the p value of significance was less than, 005, it was determined that the data presented a non-normal distribution. Because of this, the U the Mann Whitney was established as a non-parametric test for subsequent hypothesis testing.

### 3.1 Descriptive results



**Fig. 3.** Result of the Tests of Understanding of scientific texts

It is observed in Fig. 3 that in the pre-test of Understanding scientific texts both the control group and the experimental group were in similar conditions, although with small differences. In contrast, in the post test, these differences were highlighted in favor of the experimental group; since a significant percentage of the low level rose to the medium level; as well as another large percentage rose from the middle to the upper level.

### 3.2 Inferential Results

General Hypothesis Test

H0: Digital application strategies do not improve understanding of scientific texts

Hi: Digital application strategies improve understanding of scientific texts

**Table 2.** Mann-Whitney U test to test the general hypothesis  
Statistical Contrast Ranges

Test y Grupo	Rangos			Estadísticos de contraste		
	N	Rango prom.	Suma rangos			
Understanding scientific texts	Pre Control	16	162,69	26030,00	U de Mann-Whitney	10850,000
		0			W de Wilcoxon	22175,000
	Pre Experimental	1	147,83	22175,00	Z	-1,479
		50			Sig; p. Asintót. (bilateral)	,139
Pos Control	16	134,88	21580,00	U de Mann-	8700,000	

	0			Whitney W de Wilcoxon	21580,000
Pos Experimental	0	15	177,50	26625,00	Z -4,216
				Sig; p. Asintót. (bilateral)	,000

It is observed in table 2 that in the pre-test of Comprehension of scientific texts the ranges of the Control Group and the Experimental Group are not so differentiated. And that both the p value. of significance (greater than  $\alpha = ,05$ ) and the Z value (greater than the critical limit -1.96) confirm that there are no significant differences between the two groups. However, in the Posttest, there is a marked difference in the ranges. In addition, it is appreciated that p. of significance (greater than  $\alpha = ,05$ ) and the Z value (less than the critical limit -1.96) confirm that there are significant differences between both groups. Therefore, the null hypothesis is rejected and it is concluded that Digital application strategies significantly improve the understanding of scientific texts.

#### 4 Discussion

In the present investigation, some activities were tested in digital environments with the objective that students read and understand short scientific texts. The application of this type of strategy has been of great impact in the understanding of texts by university students. These results enter into a dialogic controversy with what was found by Pulgar (2016), who also used a quasi-experimental design, to corroborate the significance of the incorporation of ICT tools as a strategy to improve the understanding of texts in university students. And he concluded that the effect was 76.9% in general reading comprehension at the end of his quasi-experimental investigation. The incidence in literal comprehension was from 12.8 to 56%; 7.7 to 66% in inferential understanding; and 23.1 to 41% in the criterial understanding. Results significantly higher than those found in the present work, but that would be marked by the fact of the use of narrative texts and in this paper a scientific text was used.

Another immediate reference is the research carried out by Novoa, Cancino, Flores & Nieto (2018), who find a significant influence using the physical version of the digital variant used in this work: the harmonic mental map. In this research a significance is achieved ( $p = ,000$ ), checking the working hypothesis, that the Harmonic Mind Maps significantly influence the understanding of texts by university students.



The importance of adding digital elements to the pedagogical strategies such as the case of Millalén (2015) who carried out a quasi-experimental investigation to verify the effects of multimodality in the understanding of scientific texts in university students comes into convergence with what was found in this research. The author showed that the experimental group scored 55.6 and the control group 38.8 in general understanding. This advantage was verified by the Student's T test ( $t = 6.381$ ) and a significance  $p = 0.000$ . Accepting with this your working hypothesis as in this investigation. Although it should be noted that the text was in English and oriented to a second language.

## 5 Conclusions

It was found that the use of a digital strategy based on the use of virtual programs and applications in a transversal way (one or two days) has a significant effect on the understanding of narrative texts.

It was evidenced that there was improvement in the dimensions of textual comprehension and criterial comprehension, but that the significance in the inferential understanding was not achieved, most likely due to the fact that there is a rush in the deductions of the participants, a very common situation in youth of these times.

It was demonstrated that the use of digital programs and applications of intuitive use and of little complexity and interference in educational activities, have good results both in their applicability and in the results that show improvement.

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