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Reading comprehension through ICTs and neurodidactics

La comprensión lectora a través de las TICs y la neuro didáctica

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Abstract

The purpose of this study was to implement a reading comprehension intervention project through the use of ICTs based on neurodidactics to strengthen communicative competence in secondary school students. It is a mixed-cut investigation, through the convergent design, using a reading comprehension test (pretest and posttest) designed by Samarén (2020) and with a Cronbach's Alpha of 0.846. The main findings were the development and intervention of a course to improve reading comprehension based on diagnostic inputs and the result of a t value of 5.046 with 23 degrees of freedom, indicating a bilateral significance of 0.001 between the pretest and posttest. As a conclusion, after the application of the pretest and posttest, a bilateral significance of 0.0001 was found for a significance level of (α= 0.05), which means that the intervention based on neurodidactics and ICTs managed to strengthen reading comprehension. in secondary school students, achieving the main objective of the research.

Reading comprehension, Neuro didactics, Tics, Secondary education.

Resumen

Este estudio tuvo como finalidad implementar un proyecto de intervención de comprensión lectora mediante el uso de las TICs fundamentado en la neuro didáctica para fortalecer la competencia comunicativa en alumnos de educación secundaria. Es una investigación de corte mixto, por medio del diseño de convergente, utilizando una prueba de comprensión lectora (pre test y post test) diseñado por Samarén (2020) y con un Alfa de Cronbach de 0.846. Los principales hallazgos fueron la elaboración e intervención de un curso para la mejora de la comprensión lectora a partir de los insumos del diagnóstico y el resultado de un valor de t de 5.046 con 23 grados de libertad señalando una significancia bilateral de 0.001 entre el pre test y post test. Como conclusión luego de la aplicación del pre test y post test se encontró una significación bilateral de 0.0001 para un nivel de significancia de (α= 0.05), lo que quiere decir que la intervención basada en la neuro didáctica y las TICs logró fortalecer la comprensión lectora en discentes de secundaria logrando cumplir con el objetivo principal de la investigación.

Comprensión lectora, Neuro didáctica, Tics, Educación secundaria

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Introduction

In recent years, education systems have taken on the challenge of researching innovations that benefit education, especially the way teachers teach, allowing for the personalisation of instructional processes (Sánchez, 2019). The structure of the curriculum, the selection of content and methodologies, the use of advanced resources, assessment models, the organisation of teaching centres, among others, have to be integrated into the innovation that society currently has, in order to better instruct students and for them to achieve better and more functional learning (Garza, 2016).

The Organisation for Economic Co-operation and Development [OECD] (2008), through the Centre for Educational Research and Innovation, states that during adolescence there are major changes in the emotional and cognitive development of the individual due to an invasion of hormones in the brain. Likewise, it has been proven that environmental factors such as the quality of the environment, sleep, physical exercise, interactions, among others, have a positive impact on the functioning of the brain, facilitating the learning process.

Pieres & Alcañiz (2018) reported that Mexico is at a low level in the area of reading compared to Singapore, which ranked higher with a difference of 112 points. It is worth mentioning that 55% of Mexican students reached at least level 2 of reading competence, characterised by identifying the main idea in a text, finding basic information and reflecting on the purpose and giving an opinion on what was read.

According to Padilla & Andino (2013), the deficiency in reading comprehension is still latent due to the development of inadequate planning, the lack or erroneous application of a diagnosis, resulting in deficiencies in student learning, demotivating them to learn due to the inappropriate and decontextualised selection of activities, strategies with a logical sequence that allows them to achieve the relevant competences with respect to their evolutionary stage.

Carrasco *et al* (2018), mention that this phenomenon is increasingly recurrent in Mexico, due to the scarcity or poor practice of an adequate pedagogical diagnosis when intervening with students, which has led teachers to prepare didactic plans that lack support for the learning of schoolchildren, as the needs are not previously identified for the selection of methods and means for a suitable teaching-learning process, an issue that has been addressed in the School Technical Councils.

Madroñero & Soler (2021), conducted a study whose objective was to investigate how emerging pedagogies impact on the strengthening of reading comprehension in students. Their results showed that the inclusion of technological tools such as design thinking, gamification and inverted learning increase academic achievement and assertive communication. (2023), and concluded that the design and implementation of comprehension workshops with a virtual focus strengthens linguistic competence (Pérez-Muñoz, *et al*., 2023).

Llanque (2022) proposed a programme of neurodidactic strategies for reading comprehension in students. The main findings of his study revealed that by using various operational, methodological and socioemotional strategies, students' interest and curiosity are awakened, and their emotions are taken into account in order to strengthen their reading competence. It was also concluded that it is of utmost importance to carry out a diagnosis of the pupils at both the cognitive and emotional level in order to design activities that have a positive impact on reading comprehension.

With regard to studies researched in Mexico on this topic, Hernández (2021) conducted a study whose purpose was to promote reading comprehension in students at an inferential level, taking into account the contributions of neurodidactics. Among the results, it is highlighted that the activities implemented ensured that the students obtained significant learning in terms of reading competence. In another perspective, Jimenez & Cabezas (2020) evaluated the relationship between neurodidactics and teaching and learning (E-L) processes focused on reading comprehension, reviewing previous studies on the subject, as well as the relationship between neuroscience and E-L processes.

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Her finding was that cognitive neuroscience has had great contributions to the educational area, as it studies the mental representations that are manifested through cognitive, emotional, motivational and psychological processes.

It is important to mention that the variable of reading comprehension in the research context arises due to traditional practices that lead students to lack motivation for reading, as it was detected that 41.6% are at a poor level of reading comprehension, standing out for having difficulties in understanding a text (Ibarra, 2020).

Condori (2018) states that in order for planning to be successful, teachers must propose contextualised educational situations in their teaching, taking into account their experiences, previous knowledge and proposing new ones in which pupils can compare, establish relationships, transform, analyse, anticipate results, know the procedure to follow to solve problems, reason and justify results, making learning optimal.

In recent years, education systems have taken on the challenge of researching innovations that benefit education, especially the way teachers teach, allowing for the personalisation of instructional processes (Sánchez, 2019). The structure of the curriculum, the selection of content and methodologies, the use of advanced resources, assessment models, the organisation of teaching centres, among others, have to be integrated into the innovation that society currently has, in order to better instruct students and for them to achieve better and more functional learning (Garza, 2016).

In this sense, García (2018), Farmakopoulou *et al*. (2023) and Antonopoulou *et al.* (2023) state that neuroscience and neuroeducation is what the educational field needs to reinvent itself, as it will have knowledge of the brain activity of the learner and the teacher. Neurosciences are based on the plasticity of the brain, allowing changes at a neuronal level through behavioural exercises, emotional strategies, as well as the identification of the functioning of each pupil at a mental level. Therefore, a correct elaboration and execution of a lesson plan also needs to take into account the emotions, curiosity and attention of the pupil.

According to the pre-test applied to the participants of this research, a worrying index was identified regarding the deficiency in reading comprehension because 41.6% of the students require support in this area. Therefore, in order to find a solution to this educational problem, the following question was posed: What effect do neurodidactics and ICTs have on strengthening reading comprehension in secondary school students, followed by the general objective of the study to strengthen reading comprehension through an intervention project based on ICTs and neurodidactics in order to improve communicative competence in secondary school students?.

Methodology

The research has a quantitative approach and a quasi-experimental design, where the statistical analyses were applied to a single group, to which a pre-test and a post-test were applied.

The sample of this research consisted of 24 students in the second grade of secondary school (11 females and 13 males) with an age range of 13 to 14 years. It should be noted that the selection of this unit of analysis is of a non-probabilistic type under the convenience sample, formed by the available cases to which we have access, which were indicated by the teacher of the subject (Hernández *et al*., 2014).

The sample for this research consisted of 24 students in the second grade of secondary school (11 females and 13 males) with an age range of 13 to 14 years. It should be noted that the selection of this unit of analysis is non-probabilistic under the purposive sample, formed by the available cases to which we have access, which were indicated by the teacher of the subject (Hernández *et al*., 2014).

Instrument

Learning styles

This document was taken from Jarquín (2016) with a Cronbach's alpha of 0.780, it consists of 40 questions taking into account the interests of the students with respect to their education, where the tutor identifies the abilities, skills and attitudes of their students, in this way they can adapt their planning according to the needs presented by the students.

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Reading comprehension test (pre-test and post-test)

A pre-test and post-test questionnaire called the Reading Comprehension Test developed by the author Samarén in 2020 was used. This tool made it possible to check the level of reading comprehension of the schoolchildren in the experimental group that was analysed in both the pre-test and post-test (Rivadeneira, 2023). It is important to mention that it has a reliability of 0.846 according to Cronbach's alpha statistic.

Reliability statistics	
Cronbach's alpha	N of elements
,846	20

Table 1 Reliability statistics of the pre-test and post-test of reading comprehension

Multiple Intelligences

This instrument was taken from the one designed by Armstrong (2001), with a reliability of 0.976. It is organised into eight sections according to the type of intelligence (linguistic, logical-mathematical, spatial, bodily-kinaesthetic, musical, naturalistic, interpersonal and intrapersonal) with 10 questions each related to the previous items. It is a Likert scale with three scoring levels (yes, no and sometimes).

Emotional intelligence

Concerning the application of this questionnaire that was taken from the book of Ocaña (2011) it has a reliability of 0.892, which has 45 questions based on behaviours through a Likert scale of three levels: Always, Sometimes and Never to detect the ability of learners to feel, understand, control and modify the emotional states in an individual like that of other individuals.

Self-assessment of technological competence

In order to verify the prior knowledge that the students have regarding the use of computers, mobile devices, as well as their applications such as access to web pages, email, use of Microsoft office tools and information search. This tool was used under the adaptation of Blasco, Mengual and Roig in 2007, which has a reliability of 0.911. This tool was useful for the students to select the skills they have at their disposal when working with digital media.

Observation guide on learning rhythms

This technique collects general data such as the name of the school, the school year and the name of the person in charge of applying it. Its purpose is to observe the behaviour of the student's school work in class and classify it into the level: fast, moderate or slow.

Results and discussion

In the first instance, a diagnosis was made through the application of a series of instruments (learning styles, multiple intelligences, emotional intelligence, self-assessment of technological competence, observation guide on learning rhythms, interview with the psychologist on barriers to learning and participation and a reading comprehension pre-test) to find out the situation of the group. The most relevant information is broken down in the following table (see table 2).

Instrumento aplicado	Resultado significativo
Observation guide learning rhythms	54.2% of the students have a moderate learning pace.
Learning styles test	48% lean towards the kinesthetic style, 28% visual and 16% have auditory style.
Multiple intelligences	37.5% have kinesthetic intelligence, 20% spatial and 12% intrapersonal.
Technological competence	43.18% have excellent skills in managing ICTs and 47.72% have good skills.
emotional intelligence	72% have a medium-high socio-emotional ability to identify their emotions and those of others, 16% have a high degree of this ability.

Table 2 Resultados generales de la aplicación del diagnóstico

Planning the reading comprehension course

Once the results of the diagnosis were analysed, they were used as input for the development of a work plan that will help to raise the reading comprehension levels of the participants under the SAD approach, which is based on neuro-didactics, as it allows the instructional design to be adapted to the differences and learning styles of the students, thus facilitating inclusion in the classroom (UNICEF, 2022).

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A course of 12 sessions of an hour and a half each was structured, where neuro-didactic strategies were used through the active learning methodology, making the student the centre of learning and learning by doing, in addition to taking into account the tastes of the students by involving them in the selection of a book that would interest and motivate them.

It should be noted that, at the beginning of each session, a circle was created in which all the pupils participated, they were asked to analyse the cover of the book, the title of the chapters, the title of the book and, before reading, to make predictions about what they imagined they would find in the reading. Similarly, during the class, each person was asked how they felt about the book they had chosen, what they had liked most, what they had not liked and they were given a moment to express their opinion verbally about what they had read.

On the other hand, ICTs were a valuable input in the implementation of the course because they allowed the students to interact with different digital educational resources, which helped to develop their reading comprehension.

The Classroom application was the means by which students accessed the course information through their Gmail account with each of the selected activities that would help them strengthen their reading comprehension (froggy jumps in Educaplay, letter to the author, comparison chart, alternative ending in Canva, a forum in Padlet and the creation of an electronic presentation in Slidego, Canva or PowerPoint).

Comparison of the reading comprehension pre- and post-tests

From the analysis of the paired sample data, a t-value of 5.042 with 23 degrees of freedom was determined. It should be noted that the bilateral significance is 0.001. These results indicate that there is a statistically significant difference between the pre-test and the post-test assessment applied to the group of students in terms of reading comprehension.

It should be mentioned that, the bilateral significance of 0.001 indicates that this type of difference is not applicable to chance and is highly reliable.

Therefore, it can be concluded that the intervention has had a significant impact on strengthening reading comprehension in 13-14 year-old students in the group studied.

This result is congruent with the general objective of the study, which is to strengthen the reading comprehension of secondary school students. Moreover, these results are from the sample size of 24 participants. It should be clarified that, although it is a small sample size, the highly significant results obtained support the robustness of the findings (see table 3).

	Media	t	gl	Sig
Reading comprehension post-test score - Reading comprehension pre-test score	.875	5,042	24	.0001

Table 3 Paired samples pretest and posttest

Conclusions

A comparison between the findings of the pre-test and post-test presented showed that they coincide with the stated objective, since the structure of the reading comprehension diagnosis (pre-test and post-test) and the way the students learn were an input for designing an intervention project based on ICTs and neuro-didactics that helped to strengthen reading comprehension with a bilateral significance of 0. 0001 for a significance level of (α= 0.05), which means that there is a significant improvement in reading comprehension.

On the other hand, knowledge of the results made it possible to answer the research question posed: How to strengthen reading comprehension using neurodidactics and ICTs in secondary school students? In response to this question, it has been possible to establish that the inclusion of the strategy based on neuro-didactics, which consisted of selecting a book that was of interest to the student, motivated him/her to read and look for answers that would help him/her to understand the reading in a better way, ICT-based activities such as Froggy Jumps from Educaplay, the forum in Padlet, the creation of comparative tables and a glossary of words in Canva, diversified and facilitated the way in which the schoolchildren made known the content read, demonstrating an increase in reading skills.

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On the other hand, the active learning methodology had a real positive impact because it allowed for student participation. It should be noted that the activity in which the students were most enthusiastic was the presentation of the book, where, using the Power Point tool, they constructed their own version to explain the content of what they had read, making use of technology, decorating their slides with the theme of the chosen book and being motivated at the time of carrying out the explanation.

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