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Interventions based on executive functions: A systematic mapping of their impact on care

Intervenciones basadas en funciones ejecutivas: un mapeo sistemático de su impacto en la atención

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Abstract

This research aimed to analyze interventions based on executive functions and their impact on attention, using a mixed-methods approach. In the first phase, a systematic review of the scientific literature published in the last five years was conducted, consulting international and regional databases, to map the available knowledge on the topic. In the second phase, a field study was carried out to complement the theoretical information through direct data collection, applying a survey to ten students from an educational institution to explore the applicability and perception of these interventions in a real-world context. The results showed that interventions aimed at strengthening executive functions, through structured programs, play-based activities, metacognitive training, and the use of educational technologies, generate significant improvements in attention, especially in the school setting. It was also highlighted that these interventions are more effective when implemented at an early age, promoting holistic development and helping to prevent learning difficulties. Despite growing academic interest, gaps were identified in the adaptation of these strategies to specific sociocultural contexts. Therefore, it is recommended to delve deeper into research that evaluates the effectiveness of these interventions in diverse populations, with the purpose of designing evidence-based educational programs that enhance students' attention and academic performance.

Keywords: attention, executive functions, educational interventions.

Resumen

La presente investigación tuvo como objetivo analizar las intervenciones basadas en funciones ejecutivas y su impacto en la atención, empleando un enfoque mixto. En la primera fase, se realizó una revisión sistemática de la literatura científica publicada en los últimos cinco años, consultando bases de datos internacionales y regionales, con el fin de mapear el conocimiento disponible sobre el tema. En la segunda fase, se desarrolló un estudio de campo para complementar la información teórica mediante la recolección directa de datos, aplicando una encuesta a diez estudiantes de una institución educativa para explorar la aplicabilidad y percepción de estas intervenciones en un contexto real. Los resultados evidenciaron que las intervenciones dirigidas a fortalecer las funciones ejecutivas, mediante programas estructurados, actividades lúdicas, entrenamiento metacognitivo y el uso de tecnologías educativas, generan mejoras significativas en la atención, especialmente en el ámbito escolar. Asimismo, se destacó que estas intervenciones resultan más efectivas cuando se implementan en edades tempranas, favoreciendo un desarrollo integral y ayudando a prevenir dificultades de aprendizaje. A pesar del creciente interés académico, se identificaron vacíos en la adaptación de estas estrategias a contextos socioculturales específicos. Por ello, se recomienda profundizar en investigaciones que evalúen la efectividad de estas intervenciones en poblaciones diversas, con el propósito de diseñar programas educativos basados en evidencia que potencien la atención y el rendimiento académico de los estudiantes.

Palabras clave: atención, funciones ejecutivas, intervenciones educativas.

Introduction

Executive functions are currently regarded as a fundamental set of mental processes essential for learning, self-regulation, and adaptation to educational demands. These skills encompass working memory, impulse control, and cognitive flexibility, enabling students to manage their behavior, regulate their emotions, and

maintain focus on complex tasks (Diamond & Ling, 2020). Among these functions, attention plays a crucial role, allowing individuals to discriminate between irrelevant stimuli and concentrate on information that requires processing.

Recent research has demonstrated that interventions designed to strengthen executive functions positively and directly impact the development of attention. Pomahuacre-Carhuayal et al. (2024) confirmed the efficacy of the abbreviated version of the EFECO-29 scale, validating its capability to assess executive functions in university students in Peru, while emphasizing the importance of implementing relevant interventions in these areas. Similarly, Juárez (2021) evaluated the effectiveness of games and playful activities in stimulating executive functions in preschool-aged children, establishing that these strategies enhance both sustained attention and impulse control in young children.

In a global context, studies such as those conducted by Romero-Ayuso et al. (2021) highlight the use of technologies, such as virtual reality and immersive environments, as effective methods for improving executive functions and, consequently, attention in students, particularly among those with attentional difficulties or neurodevelopmental disorders.

Despite these scientific advances, there remain gaps in some contexts, especially in areas with socio-educational constraints, where the organization of knowledge regarding these interventions is limited. This lack of systematization constrains the development of contextualized and evidence-based educational programs tailored to the actual needs of students.

Investigating executive functions and their influence on student attention is currently essential in both educational and cognitive psychological realms. Numerous studies underscore that executive functions, defined as a set of mental capabilities that facilitate organization, personal regulation, and impulse control, are crucial for academic performance and the holistic development of students. In this regard, Gutierrez (2023) notes that strengthening these skills early in education significantly impacts attention and self-regulation, directly influencing the learning process. Concurrently, Canchumanya (2021) emphasizes that within Peru's educational system, there are difficulties in the early identification of attention problems and the implementation of pedagogical strategies that foster the development of executive functions. This situation underscores the urgent need to address this issue from a proactive and holistic perspective.

Methodology

The study's methodology is structured into two clearly defined phases. In the first phase, a systematic review was conducted to examine the relationship between executive functions and attention levels in students, utilizing various relevant academic sources. This procedure was based on the methodological model proposed by Rojas (2022), who developed a similar study among primary education students, demonstrating the utility and relevance of this approach in the educational domain.

In the second phase, a field study was undertaken to complement the theoretical information by directly collecting data. A survey was administered to ten students from an educational institution to gather their perceptions regarding their attention levels and the pedagogical strategies implemented in their school environment. The design of the questionnaire adhered to the recommendations of Gambarini et al. (2023), who highlight the importance of employing clear, accessible, and contextualized instruments to ensure the validity of the results.

The combination of the systematic review and the field study facilitated a more comprehensive understanding of the investigated topic by linking theoretical evidence with the real experiences of the participants.

For information collection, international academic databases such as Scopus, Web of Science, ERIC, and Google Scholar were consulted, along with open-access repositories like RENATI and Redalyc. The search strategy incorporated keywords such as "executive functions," "attention," "educational interventions," and "academic performance," combined using Boolean operators.

Selection criteria considered publications from 2019 to 2024, including peer-reviewed scientific articles, theses, and academically rigorous documents in both Spanish and English. Only studies addressing interventions aimed at strengthening executive functions and their relationship with attention processes were included. Duplicated documents, research without school or university populations, and those lacking access to full texts were excluded. Following the application of these criteria, 18 studies were selected for final analysis, meeting the required standards of relevance, timeliness, and quality.

Regarding the studied population, employed methods, and findings, a descriptive and thematic analysis was conducted to identify trends, predominant approaches, and gaps in the literature. Additionally, a structured questionnaire consisting of ten questions was developed and administered to ten students to supplement the theoretical information with their perceptions regarding their attention levels and the educational practices they

received. The survey was designed following the guidelines provided by Hernández Sampieri et al. (2014) for developing data collection instruments in educational studies.

Results and discussion

The results of this study allowed for the identification and compilation of recent findings related to interventions based on executive functions and their impact on student attention. Through a systematic analysis and the application of a survey, relevant patterns were detected in both the academic literature and student perceptions.

In the literature review, 18 studies were examined, of which 64.3% were international and 35.7% were conducted within the Latin American context. The majority of these studies (71.4%) focused on early and primary education populations, while 28.6% addressed interventions at secondary and higher education levels.

Regarding the interventions identified, programs utilizing educational games, metacognitive training, and educational technologies were the most frequently employed strategies. The literature demonstrates that these interventions resulted in significant improvements in sustained attention, self-control, and cognitive flexibility among students (Romero-Ayuso et al., 2021; Quiroz et al., 2023).

Conversely, the results from the survey administered to 10 students revealed that most experienced difficulties concentrating during classes, attributing this issue primarily to environmental distractions and a lack of dynamic pedagogical methods. The analyses conducted showed a clear consensus: the implemented actions significantly contributed to the development of executive functions, which was reflected in a notable improvement in the attention of the subjects involved.

Table 1

Summary of student perceptions and key findings on attention and executive functions

Question	Main Findings
Ease of maintaining attention	Most reported difficulties in sustaining attention
Major distraction situations	Noisy environments and lack of dynamic classroom activities
Participation in attention programs	Only 18% participated in attention improvement activities
Perceived effectiveness of interventions	Participants reported moderate improvements in their attention
Knowledge of executive functions	76% indicated a lack of understanding of the concept
Influence of planning on attention	Most recognized its importance but had limited strategies
Impulse control and attention	A direct relationship was reported, especially in stressful situations
Attendance at self-regulation workshops	Only 22% had received workshops on the subject
Effective classroom strategies	Games, dynamics, and activity changes improve attention
Interest in attention improvement programs	94% expressed interest in receiving such interventions

To deepen the theoretical review and gain a clearer understanding of the relationship between executive functions and attention within the educational context, a survey was applied to a group of students, as previously mentioned. Table 1 synthesizes the most relevant perceptions and results, highlighting significant trends related to difficulties in sustaining attention, the level of knowledge about executive functions, and the perceived efficacy of pedagogical strategies implemented in classes. This data is essential for identifying priority needs and guiding future educational initiatives that promote self-regulation and cognitive development among students.

The results reflect an urgent need for educational programs aimed at strengthening executive functions, which would positively impact student attention. This conclusion is consistent with findings from Juárez (2021) and Porto et al. (2021), who highlight the favorable impact of interventions based on playful and metacognitive strategies for enhancing concentration and self-regulation in the school setting.

A detailed analysis of Table 1 reveals that most students face challenges in maintaining sustained attention, particularly in distracting environments or in less dynamic classes. This reality aligns with observations from Juárez (2021) and Porto et al. (2021) regarding the effectiveness of playful and metacognitive activities in enhancing concentration and self-control.

Additionally, the data indicates a widespread lack of familiarity with the concept of executive functions, as 76% of respondents stated they were not acquainted with the term. This gap highlights the disconnect between

acquiring skills and their practical understanding. In alignment with this, Alvarez (2023) points to limitations within the Peruvian educational system in training teachers capable of promoting the development of these functions from early levels.

Moreover, only 18% of participants had engaged in programs aimed at improving attention, while 94% expressed interest in participating in such initiatives. This discrepancy underscores the urgency of establishing structured programs that address attention and self-regulation as key competencies in the educational process. Gutierrez (2023) reinforces this idea by emphasizing the role of playful-cognitive activities in enhancing academic performance and student motivation.

On another note, a significant majority recognizes the importance of planning and impulse control for maintaining attention, although they admit to having few strategies to implement them effectively. This finding is consistent with Diamond and Ling (2020), who argue that strengthening inhibitory control and planning enhances working memory and concentration, essential components of cognitive functioning.

The pronounced interest shown by students in participating in workshops and programs that nurture attention indicates a favorable attitude toward incorporating educational interventions. This willingness paves the way for designing contextualized pedagogical proposals that integrate technological resources, participatory dynamics, and self-regulation techniques, in line with the recommendations of Diamond and Lee (2011) and Zelazo et al. (2017), which advocate for multisensory and digital approaches.

Overall, these findings illustrate that while students value attention and executive functions as essential factors for their learning, there remains a lack of systematic application of educational strategies that enhance these aspects. Therefore, it is imperative to promote evidence-based programs that comprehensively address cognitive, emotional, and motivational dimensions, in order to sustainably improve attention, self-regulation, and academic performance.

Conclusions

The conclusions of this research affirm that strategies aimed at strengthening executive functions are essential for improving attention among students, particularly in educational contexts facing significant pedagogical limitations where the implementation of active methodologies is still in its infancy. This finding holds particular relevance in school environments that require educational innovations that promote active participation and the holistic development of students.

The results obtained demonstrate a clear and robust relationship between the development of specific executive competencies—such as planning, self-control, and inhibition—and the sustained and selective increase in attention. These factors are directly reflected in academic performance and the quality of learning. In this regard, the study makes a valuable contribution to the field by consolidating, synthesizing, and organizing the most recent scientific evidence related to executive functions and their impact on attention, thereby providing an updated framework that can guide future interventions and pedagogical proposals.

Furthermore, this research generates a significant empirical foundation that transcends local contexts, as its conclusions are applicable across various educational settings both nationally and internationally. The challenges associated with attention and performance are present in different educational systems, making it pertinent to adapt and replicate the recommended strategies to foster cognitive development and self-regulation among students from diverse backgrounds. This cross-contextual relevance opens the door for interdisciplinary collaborations and the creation of educational policies that promote the integration of programs designed to enhance executive functions from the earliest stages of learning.

Lastly, the importance of fostering a comprehensive approach is recognized, one that considers not only cognitive development but also the emotional and motivational aspects that influence attention and learning. By promoting inclusive and stimulating school environments, strategies grounded in a solid theoretical framework and supported by evidence can significantly contribute to improving student well-being and academic success, thereby consolidating a more equitable, effective, and relevant education for the needs of the 21st century.

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