# INPLASY

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# Cognitive training of executive functions based on computer systems and artificial intelligence: A scope review of studies in children

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## ADMINISTRATIVE INFORMATION

## INTRODUCTION

*R*eview question / Objective PICO framework: Population: Children aged 5 to 12. Intervention: Cognitive training programs based on computer systems and artificial intelligence to stimulate executive functions in children. Comparison: Not applicable Results: characteristics of the interventions, executive functions studied, characteristics of the samples, main effects of the interventions. Based on the PICO framework, the following questions were determined:

RQ1: What studies have been carried out in recent years on using computer systems and artificial intelligence in training programs for executive functions in children?
RQ2: What are the characteristics of these programs?
RQ3: What are the executive functions trained with these programs?
RQ4: What are the characteristics of the population samples of children studied?
RQ5: What are the main effects of these programs on children's executive functions?

**Background** Cognitive stimulation and rehabilitation programs are undergoing an important transformation from incorporating computational technological resources and artificial intelligence. The opportunities offered by using digital technologies, such as remote access to intervention sessions, gamification of activities, progress recording, and program adaptability, have promoted this type of intervention in clinical and educational settings. Consequently, it has been possible to observe a progressive increase in the supply of these programs, while research interested in evaluating the effects of cognitive training programs based on these technologies has increased. However, most of the studies have shown mixed results and, in some cases, have been inconclusive. This overview demonstrates the relevance of carrying out a scope review of intervention studies on cognitive training programs

for executive functions in children, based on computational tools and artificial cognitive systems, to collect evidence on the current state of the studies, the type of populations studied, the cognitive processes that are being addressed, the characteristics of the interventions and the main results found.

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## METHODS

**Strategy of data synthesis** Rehabilitation and cognitive stimulation programs have traditionally been based on pencil and paper activities. However, the digital transformation brought about by technological development in recent decades has had a notable impact on intervention programs and has given rise to new prospects for cognitive training with a promising outlook. These transformations have included initiatives ranging from the use of digital assistive technologies, the digitization of classic tasks and software design, the creation of innovative devices for neurofeedback training, the use of virtual reality, and the integration of artificial intelligence.

These technological transformations of the last decades have given rise, in an accelerated manner, to the emergence of new lines of action for the cognitive training of executive functions in childhood (Schubert et al., 2014), such as the use of video games. (Homer et.al., 2018; Gray et.al., 2019), The incorporation of neurofeedback training

(Minder et al., 2018), programs supported by computer systems (Rossignoli et al., 2020; Spawton et .al., 2020), virtual reality (De Luca et al., 2020), computational thinking (Arfé et al., 2020) and robotics (Di Lieto, 2017).

At the same time, interest in studying executive function training programs based on these new technologies has increased, evaluating their feasibility, adherence, and effects in different cognitive domains and their effectiveness in different population groups.

From this emerging panorama, the present review and scope have been proposed as an objective to identify the studies carried out in recent years, on programs of stimulation and cognitive rehabilitation of executive functions in childhood, based on computer systems and artificial intelligence.

**Eligibility criteria** Inclusion criteria
• Articles published in the selected databases
• Studies with the participation of a sample of children with an age range between 5 and 12 years with typical development or with some clinical condition.
• Studies that evaluate the effect of cognitive training based on computer systems or artificial intelligence.
• Studies evaluating the effect of interventions on the executive functions of children.
Exclusion criteria
• Articles that do not present results
• Abstracts or short articles, protocols
• Review articles and meta-analysis
• Studies with a mixed population that do not differentiate the results by age group.
• Studies that evaluate the effect of other cognitive processes and not of executive functions.
• Articles that in their complete text are in languages other than Spanish, English or French.

**Source of evidence screening and selection**
The electronic databases and editorial platforms selected were: Science Direct, Proquest, Springer, Taylor & Francis, Sage, Pubmed, EBSCO CINAHL, Medline.

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**Data management** The researchers constructed an extraction matrix to record the information retrieved from the articles. The data to be extracted will be: author, title, year of publication, study objectives, doi, country where the study was conducted, description of the sample (size, age, clinical condition), training characteristics, computer systems resources or artificial intelligence implemented, executive function trained, instruments used in the measurement of the variable's main results, secondary results, and the conclusions obtained.

**Language restriction** English, Spanish, French.

**Country(ies) involved** Colombia.

**Keywords** Executive functions, Cognitive training, Children, Computerized o computer based.

**Dissemination plans** An article with the research results is expected to be published in a high-impact journal.

**Contributions of each author**
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