INPLASY

Serious game-based interventions to assess and train Executive Functions in children with ADHD and SLD: A systematic review and Meta-analysis

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INTRODUCTION

Review question / Objective This study aims to compare the impact of serious game-based interventions to assess and train Executive Functions (EFs) in terms of efficacy and acceptability of children with Attention Deficit Hyperactivity Disorder (ADHD) and Specific Learning Difficulties (SLDs) to better inform clinical practice.

To this end, the proposed systematic review and meta-analysis will address the following main research question: What is the role of serious game-based interventions in assessing and training EFs of children with ADHD and SLDs?

Rationale Executive Functions (EFs) are core aspects of human behaviour and cognition, which have been linked with broad and significant implications for everyday life and success (Mischel et al., 2011; Moffitt et al., 2011; Blair & Razza, 2007). Additionally, difficulties displayed by individuals with Neurodevelopmental Disorders (NDDs) have been shown to be partly explained by executive dysfunction (e.g., Lonergan et al., 2019; Willcutt et al., 2019).

As an upcoming research and practice field, the use of computer-based interventions has addressed many barriers in treatment, and the potential to increase motivation and adherence (e.g., Khan et al., 2019; Ahn & Hwang, 2017). The use of gamified computer-based tasks to train and improve executive skills has become a hot field for research and development. Most of the published interventions show promising evidence of the effectiveness of computer-based interventions (e.g., Tan-MacNeil et al., 2021; Khan et al., 2019; Ahn & Hwang, 2017).

Various systematic review papers have been documenting the use of digital-based

interventions, highlighting the need for interventions to be structured and standardized (e.g., Khan et al, 2019). Hence, we hope to provide an overview regarding the role of gamified tasks and serious games used to assess and train EFS in children with ADHD and SLDs.

For the purpose of this research, we are going to focus on serious games, which are specifically designed to promote behavioural change and capitalize on computer technology to instruct, train, and prompt change among players (Blumberg et al., 2013).

We anticipate that the outcomes of this study will provide a significant contribution to the literature concerning executive dysfunction in children with ADHD and SLDs, shedding light on the current state of assessment and training digital resources. This insight will help to identify areas of advancement and inform future research and interventions aimed at supporting children with neurodevelopmental disorders.

Condition being studied The aim of study is to compare the impact of digital interventions based on serious games to assess and train the executive functions of children with ADHD and SLDs, in order to better inform clinical practice. EFs are core aspects of human behaviour and cognition that have been shown to be, at the least, part of the genesis of the difficulties displayed by children with both ADHD and/or SLDs (dyslexia being the one with the most published studies).

METHODS

Search strategy A search in the major databases: EBSCOhost web, ERIC, Web of Science, IEEE, SciELO, Scopus, ProQuest and ScienceDirect is going to be conducted using a combination of search terms.

Participant or population Children and adolescents with ADHD and/or SLD, aged 4 to 18 years.

Intervention Technology-based interventions that are specifically designed to improve Executive Function skills in children and adolescents.

Comparator Control group (placebo training condition); pre and post-test assessment measures.

Study designs to be included RTS, quasy-experimental studies, longitudinal studies, pilot studies; studies with enough information to calculate effect size.

Eligibility criteria Inclusion Criteria: (1) children meeting the diagnostic criteria for ADHD, and SLD as outlined in DSM V (APA, 2013), (2) full-length, peer-reviewed articles within the domains of psychology education, or computer science, (3) Randomized Controlled Trials (RCTs), (4) quasi-experimental studis, (5) longitudinal studies, (6) pilot studies, (7) exploratory analyses, (8) studies incorporating technology-based interventions, such as gamified tasks or serious games, and (9) executive function performance measures utilized as outcomes.

Information sources A search in the major databases [EBSCOhost web, ERIC, Web of Science, IEEE, SciELO, Scopus, ProQuest, and ScienceDirect] is going to be conducted using a combination of search terms.

Main outcome(s) We aim to obtain insights into the performance of children with ADHD and/or SLDs across various executive functions (EFs) when using serious games as a training method. The results will be segmented into distinct analyses, with subsections for each disorder. Each subsection will also encompass descriptions of the EFs targeted by the serious games-based interventions, their effectiveness, and how those skills are assessed within each game.

Additional outcome(s) We will also conduct a meta-analysis to further our understanding of the results obtained from the systematic literature review.

Data management The authors will construct a documentary analysis matrix to record the information retrieved from the articles. The recorded data will be as follows: author, title, year of publication, the country where the study was conducted, description of the sample (size, age, sex, clinical diagnosis, medication taken), study design, content presented in the tasks (psychological construct that is being assessed and trained), the statistical power of the studies, content delivery and intervention designs (modality, duration of intervention, participants' eligibility criteria, theoretical framework to justify the selection of tasks, customization, data collection, instruments used to assess psychological constructs, and monitorization of the impact of the interventions on participants).

Quality assessment / Risk of bias analysis To evaluate the quality of study design, execution, and reporting of results, and to minimize errors and risks of bias, we will employ the ROBINS-I tool (Sterne et al., 2016), specifically tailored for use

with non-randomized studies. Following the recommendation by Boland et al. (2017) to enhance the quality of our study and increase confidence levels in our results, we will also implement blind screening conducted by two researchers to assess the inclusion/exclusion of articles in the systematic literature review. Any conflicts will be resolved by a third researcher. Additionally, we will calculate Cohen's Kappa to assess the level of agreement among researchers.

Strategy of data synthesis Once the data has been extracted, it will be presented in the results section in a summarized format. Descriptive analysis will be employed for dichotomous, continuous, and ordinal data, while quantitative analysis, utilizing a fixed effects model, will be conducted for data such as sample proportions, the magnitude and direction of variable relationships, estimated intervention effect sizes, and precision. Schemes and tables will be used for both types of data presentation.

Subgroup analysis To answer our research questions, we will also carry out subgroup analyses, dividing the participants' data into subgroups, dependent on their diagnoses, to make comparisons between them.

Sensitivity analysis To show that the outcome of the current review does not depend on arbitrary or unclear decisions, we will carry out a sensitivity analysis. This analysis aims to repeat the primary analysis, replacing alternative decisions or ranges of values with other decisions and checking how this influences the results obtained.

Country(ies) involved Portugal.

Keywords Executive Functions, Serious games, Digital interventions, Neurodevelopmental Disorders, ADHD, SLD, Dislexia.

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

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