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Enhancing executive functions in children: a comprehensive review of interventions via digital technologies and future directions

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Abstract. This review critically examines a broad spectrum of interventions aimed at bolstering executive functions (EFs) in children, a cornerstone for their academic, social, and cognitive development. We delve into a variety of EF enhancement strategies from June 2006 to March 2024, encompassing computer-based programs, physical exercises, classroom adjustments, and innovative technologies like virtual reality and educational robotics. Stressing the importance of parental involvement and positive teacher-student interactions, the review proposes an evidence-based approach tailored to individual needs, offering significant benefits particularly to children with or at risk for conditions such as ADHD and ASD. The synthesis underscores the imperative of collaborative initiatives among educators, policymakers, and families for fostering inclusive educational practices that nurture holistic EF development. The review sets forth the need for future research to embark on longitudinal studies and explore novel technologies, aiming to refine evidence-based educational strategies and enhance the cognitive and emotional well-being of children globally.
Keywords: Executive Functions, Cognitive Training, Educational Interventions, Technology in Education, Special Education, Neurodevelopmental Disorders, Teacher-Student Relationship, Parental Involvement.

Introduction

The development of executive functions (EFs) is crucial for navigating the complexities of learning, social interaction, and daily life. Executive functions, a set of cognitive processes including working memory, cognitive flexibility, and inhibitory control, are fundamental for academic achievement, behavioral regulation, and socio-emotional development (Diamond, 2013). These skills enable individuals to plan, focus attention, remember instructions, and juggle multiple tasks effectively, serving as the foundation for both academic learning and life skills (Zelazo, Blair, & Willoughby, 2016).

The objective of this review is to critically examine the effectiveness of various intervention strategies aimed at enhancing EFs in children, with a special emphasis on those with Attention Deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD). This investigation is both timely and essential, considering the increasing prevalence of neurodevelopmental disorders and the significant role EFs play in successful learning and social integration (Pasqualotto et al., 2021).

In the context of primary education, especially within special education settings, emphasizing the cultivation of EFs is essential. This review is specifically concerned with interventions targeted at the critical developmental period from early childhood through adolescence, a time frame crucial for the development of EFs. Children with neurodevelopmental disorders such as ADHD and ASD often face challenges in developing these crucial cognitive processes (Pasqualotto et al., 2021; Qiu, Liang, Wang, Zhang, & Shum, 2023). These challenges can significantly impact their educational trajectory, making it imperative to identify and

implement effective interventions designed to enhance EFs among this population.

The significance of EFs extends beyond the realm of individual achievement. Research has highlighted the role of EFs in supporting broader educational goals, including reading comprehension, mathematical problem-solving, and science reasoning (Best, Miller, & Naglieri, 2011). Moreover, EFs are predictive of important life outcomes, such as academic success, employment status, and general well-being, more reliably than IQ measures (Morrison, Ponitz, &Mcclelland, 2010; Benzing et al., 2019).

Given these considerations, there has been a growing interest in developing and evaluating cognitive training interventions aimed at enhancing EFs. These interventions range from computer-based programs and classroom curriculum modifications to physical exercises, mindfulness practices, and innovative approaches such as educational robotics and game-based learning (Benzing et al., 2019; Sánchez-Pérez et al., 2017; Lieto, 2020). The rationale behind this diversification stems from the recognition of EFs' multifaceted nature, necessitating varied approaches to effectively target these complex cognitive processes (Diamond & Lee, 2011).

Furthermore, the involvement of parents and caregivers in EF training represents another critical area of exploration. Suggesting that home-based practices and parental involvement can significantly amplify the benefits of EF interventions, this perspective offers a more integrated approach to cognitive development. This holistic view underscores the potential of extending EF enhancement efforts beyond the classroom, involving key stakeholders in the child's learning environment (Wilson & Gross, 2018).

This review aims to fill a gap in the comprehensive comparison and integration of these varied approaches, particularly in how they cater to the diverse needs of children, including those with or at risk for EF deficits. Recent systematic reviews and meta-analyses have begun to shed light on the effectiveness of these interventions. For instance, interventions focusing on physical activity have been shown to positively impact EFs, attention, and academic performance in primary school children included preadolescent children (De Greeff et al., 2018; Egger et al., 2019). Similarly, computer-based and digital game interventions have demonstrated promising outcomes in improving specific components of EFs, such as working memory and cognitive flexibility (Benzing et al., 2019; Sánchez-Pérez et al., 2017).

Moreover, the role of the teacher-student interaction in the development of EFs has been explored, with evidence suggesting that positive interactions and supportive educational environments can strengthen EFs and self-regulation in children (Sankalaite et al., 2021). These insights underscore the multifaceted nature of EF enhancement and the potential synergies between different types of interventions.

Despite these advancements, variability in the effectiveness of cognitive training interventions remains, attributed to differences in intervention design, implementation fidelity, and participant characteristics. This variability underscores the importance of personalized and context-sensitive approaches, tailored to the individual needs and learning environments of children (Diamond & Ling, 2016).

This review advocates for an approach that emphasizes inclusivity, adaptability, and evidence-based practice as pillars for developing effective EF interventions. By synthesizing insights from diverse intervention strategies and emphasizing a holistic approach, the aim is to foster environments that champion inclusivity and adaptability to meet the complex needs of all learners (Zelazo, Blair, & Willoughby, 2016).

Methodology

Search Strategy

A comprehensive search was conducted across multiple databases including PubMed, PsycINFO, ERIC, and Google Scholar. The search strategy involved using keywords such as "executive functions," "cognitive training," "educational interventions," "technology in education "special education, "neurodevelopmental disorders", "teacher-student relationship", "parental involvement". The search, limited to articles published in English from 2006 to 2024, aimed to capture the most relevant and contemporary research. The initial search yielded over 200 studies, of which 67 met our inclusion criteria after screening for relevance and quality.

Selection Criteria

Studies were selected based on their relevance to the enhancement of EFs in children within the context of primary and special education. Both empirical research articles and systematic reviews/meta-analyses were included to ensure a comprehensive understanding of the field. Studies were excluded if they did not specifically address EF interventions or if they were not conducted within an educational setting.

Data Extraction

Relevant data were extracted from each selected study, including the study design, participant characteristics, intervention details, outcomes measured, and key findings. This information was used to synthesize the current state of research on EF interventions and to identify gaps and opportunities for future research.

Quality Assessment

The methodological quality of each study was assessed using established criteria, including the clarity of intervention descriptions, the appropriateness of the study design for the research question, the reliability and validity of outcome

measures, and the treatment of potential confounding variables.

This systematic and methodological approach provided a solid foundation for the comprehensive review, allowing for the synthesis of a wide range of interventions aimed at enhancing EFs in children and offering insights into effective strategies for future research and practice.

Theoretical Framework

Conceptualization of Executive Functions

Executive functions (EFs) are crucial higher-order cognitive processes responsible for orchestrating goal-directed behavior. This set of cognitive abilities, including working memory, cognitive flexibility, and inhibitory control, plays a pivotal role in regulating thoughts, emotions, and actions. Individuals rely on EFs to adapt to new situations, formulate complex plans, and engage in reflective decision-making, making EFs foundational elements of human cognitive architecture. They facilitate the integration of past experiences with present actions, vital for planning, problem-solving, and adapting behavior in dynamically changing environments (Diamond, 2013).

Developmental Trajectory of Executive Functions

The maturation of EFs primarily occurs in the prefrontal cortex, influenced by a dynamic interplay of genetic, environmental, and educational factors. Beginning in early childhood—a period marked by significant neural growth and plasticity—EF development extends into adolescence and adulthood. This trajectory underscores a critical window for cognitive and behavioral interventions to leverage the brain's adaptability and restructuration capabilities. The developmental progression of EFs highlights the composite nature of these functions and the importance of targeted interventions during formative years to optimize cognitive and behavioral outcomes (Zelazo, Blair, & Willoughby, 2016). Longitudinal research by Moffitt et al. (2011) emphasizes how childhood self-control, a key aspect of EFs, predicts later life health, wealth, and public safety, reinforcing the long-term impact of early EF development.

Neurobiological Foundations

EFs are supported by an extensive network of neural circuits extending beyond the prefrontal cortex to include areas responsible for sensory integration, memory, and emotion regulation. This distributed network's sensitivity to external stimuli underscores the potential of targeted interventions to significantly influence EF development via neural plasticity mechanisms. Dosenbach et al. (2006) elucidate the development of the brain's functional connectivity networks related to EF, providing empirical support for the neurobiological infrastructure underpinning these cognitive processes.

Educational and Behavioral Implications

EFs play a pivotal role in educational achievement, problem-solving, social-emotional learning, and behavioral regulation. They are essential for navigating academic environments, underscoring their importance in facilitating learning, reasoning, and the execution of complex tasks. Enhancing EFs through structured educational programs and interventions can lead to marked improvements in academic performance, behavioral self-regulation, and socio-emotional well-being (Diamond, 2013; Zelazo, Blair, & Willoughby, 2016; Pasqualotto et al., 2021; Qiu et al., 2023; Diamond & Ling, 2016; Gkora & Christou, 2023; Gkora, 2024). Jacob and Parkinson (2015) review the efficacy of EF interventions in educational settings, highlighting their significant impact on academic outcomes and EF skills.

Imperative for Targeted EF Interventions

Given the critical role of EFs in educational outcomes and personal development, designing interventions to enhance these cognitive functions is paramount. Tailored interventions that cater to the unique needs of children, especially those at risk for EF deficits like ADHD and ASD, hold significant potential for improving EFs. Cortese et al. (2015) provide a systematic review and meta-analysis on the effectiveness of interventions for ADHD, supporting the necessity for evidence-based, specific strategies to address EF weaknesses and contribute to improved academic success, behavioral regulation, and socio-emotional development.

The theoretical framework for EF development and the importance of interventions provide a foundation for understanding how targeted strategies can support cognitive growth and development. This background sets the stage for a detailed review of specific interventions aimed at enhancing EFs in children, including the evaluation of their effectiveness, challenges in implementation, and recommendations for practice and policy.

The subsequent sections will delve into various EF interventions, examining their theoretical basis, empirical support, and practical considerations. Through this exploration, the paper will contribute to a nuanced understanding of how to effectively support EF development, ultimately informing educational practices and policies to foster the cognitive and emotional well-being of children.

Review of EF Interventions

In our comprehensive review of interventions designed to enhance executive functions (EFs) in children, we have meticulously assessed a wide range of strategies, including computer-based programs, physical exercises, classroom adjustments, and innovative technologies. For each intervention type reviewed, we have endeavored to highlight the methodological quality and evidence level, providing the reader with a clear understanding of the strength and applicability of the findings. This critical evaluation aims to present a nuanced view of

the current landscape of EF intervention research, focusing on the effectiveness of these strategies for children, particularly those with neurodevelopmental disorders such as ADHD and ASD.

Computer-Based and Digital Game Interventions

The domain of computer-based and digital game interventions illuminates the cutting-edge application of technology in bolstering EFs among children. Through the pioneering efforts of researchers like Sánchez-Pérez et al. (2017) and Johann & Karbach (2020), the potential of digital games to enrich the spectrum of EF enhancement has been considerably expanded. These strategies not only target essential EF components, such as working memory and cognitive flexibility, but also engage children in an environment that is both interactive and immersive. The adaptability and allure of these digital interventions mark a new chapter in cognitive training—one that seamlessly marries educational goals with the engaging nature of digital platforms.

Furthermore, the study by Moron et al. (2022) provides a systematic overview, illustrating the integrated benefits of executive functions, motor development, and digital games within intervention programs. This integration not only bolsters cognitive skills but also has the potential to elevate academic performance and problem-solving abilities, showcasing the comprehensive impact of digital interventions in educational settings. Additionally, the focused inquiry by Edwards, Chu, & Carroll (2024) into inhibitory control training for addressing anxiety and math achievement adds a critical dimension to our understanding of digital interventions. Their proof-of-concept study is poised to explore specific cognitive and emotional challenges, offering a nuanced perspective on the efficacy and depth of digital interventions. This study serves as a testament to the targeted application of digital technologies in meeting unique developmental needs, presenting a more personalized and potentially more effective approach to EF enhancement.

Collectively, these studies underscore a shift towards leveraging interactive, engaging, and efficacious methods of enhancing EFs through digital games and targeted interventions. This body of research not only illuminates the transformative potential of technology in educational practices but also highlights the importance of adopting a nuanced and multifaceted approach to cognitive training. Such an approach is adaptable to the diverse needs of children, maximizing the unique benefits that digital platforms provide in the realm of cognitive development and educational outcomes.

Physical Exercise and Movement-Based Programs

Physical exercise and movement-based programs have been universally acknowledged for their significant contributions to cognitive health and general well-being. Research spearheaded by De Greeff et al. (2018), along with comprehensive meta-analyses (Contreras-Osorio et al., 2021; Li et al., 2020), elucidate the profound impact of physical activity in fortifying executive functions (EFs)—key cognitive domains such as attention, working memory, and cognitive flexibility are notably improved through regular physical engagement. These findings collectively stress the necessity of embedding physical activities into daily regimens not merely for cognitive growth but also for bolstering physical health and emotional wellness.

Further exploration by Martin et al. (2018) into the synergistic effects of physical activity and dietary interventions reveals a positive correlation with enhanced school performance and cognitive abilities in children and adolescents facing challenges due to obesity or being overweight. Their research underlines the potential of lifestyle modifications, particularly those that incorporate physical activity, in improving cognitive executive function scores, although the outcomes on specific academic abilities like mathematics and reading, and on inhibition control, display variability in impact levels and evidence robustness.

The imperative for integrating movement-based programs within educational curricula emerges as a pivotal strategy for nurturing well-rounded development. Such initiatives not only foster mental and physical prowess but also equip individuals for a balanced lifestyle. Pioneering work by Chang et al. (2022) further demonstrates this symbiosis, presenting significant enhancements in EFs and handwriting abilities in children diagnosed with ADHD through targeted coordination activities, exemplified by table tennis. These findings validate the versatility and effectiveness of physical exercises in addressing a spectrum of developmental requirements, underscoring the transformative potential of carefully selected, activity-specific interventions in boosting cognitive and motor skills simultaneously.

Cumulatively, these investigations advocate for the fundamental role of physical exercise and movement-based programs in catalyzing cognitive enhancement and holistic developmental health. Championing their incorporation into educational systems, they call for the establishment of environments that are conducive to all-encompassing growth—cognitive, physical, and emotional. By elevating physical activity from a supplementary to a cornerstone element of education and personal development, these studies pave the way for enriched developmental paths for children and adults alike, affirming the integral place of physical activity in fostering a well-balanced and prosperous life.

Classroom Curriculum and Behavioral Interventions

Integrating EF-focused activities into classroom curricula is identified as a strategic move to enhance cognitive skills, mindful of the diverse learning requirements of students. The foundational research by Diamond (2013) and Zelazo, Blair, and Willoughby (2016) supports the implementation of interventions targeting crucial EF components such as working memory, cognitive flexibility, and inhibitory control.

Additionally, Benzing et al. (2019) demonstrate the effectiveness of these interventions even in later primary education years, shifting prior assumptions about the most effective period for such interventions. The "Train Your Mind" program, detailed by Bervoets et al. (2018), exemplifies the remarkable improvements in attention, working memory, and cognitive flexibility that are achievable with thoughtfully designed interventions, providing significant benefits to children with ADHD and ASD.

The inclusion of mindfulness practices into the curriculum, as recommended by Zelazo and Lyons (2012) and empirically evidenced by Semple et al. (2010), has been shown to enhance reflection, reduce stress, and improve cognitive outcomes. This highlights the importance of a varied approach in fostering an environment conducive to EF development, advocating for the adoption of comprehensive, evidence-based strategies within educational frameworks.

This body of work underscores the importance of a dynamic and multifaceted curriculum development approach that incorporates evidence-based strategies for EF enhancement. By creating an educational environment that nurtures the development of EFs through a spectrum of interventions, educators can establish a supportive and enriching space that addresses the complex cognitive and emotional needs of all learners, thereby laying the groundwork for improved academic performance and overall well-being.

Innovative Technologies and Approaches

The exploration of innovative technologies, such as Virtual Reality (VR) and educational robotics, marks a significant advancement in intervention strategies aimed at enhancing Executive Functions (EFs). The work by Di Lieto et al. (2020) highlights the unique, interactive potential of educational robotics in fostering cognitive development in children with special needs, emphasizing the role of hands-on, engaging activities in learning. Additionally, Drakatos & Drigas (2024) discuss the impact of STEAM (Science, Technology, Engineering, Arts, and Mathematics) education through robotics on both typical students and those with ADHD, showcasing how such integrative approaches can support EFs and overall cognitive growth.

In parallel, Gkora & Driga (2023) and Gkora (2024) delve into the realm of VR and digital technologies, examining their efficacy in re-wiring cognitive processes and providing immersive, tailored learning experiences that cater to individual needs, including those of students with ADHD. These investigations highlight the pivotal role of modern technologies in reshaping educational practices. They argue for a transition to more vibrant, inclusive, and engaging learning environments that utilize the full spectrum of digital advancements to accommodate the broad array of learner needs.

However, while the potential of innovative technologies in educational settings is vast, challenges related to accessibility, cost, and teacher training remain. Ensuring equitable access to these technologies requires strategic investments in infrastructure and professional development for educators, as well as ongoing research to optimize their use in diverse educational contexts (Angwaomaodoko, 2024; Tohara, 2021).

Parental Involvement: A Catalyst for Cognitive Growth

The essential role of parental involvement in nurturing children's executive functions (EFs) is increasingly acknowledged for its critical contribution to both cognitive and emotional development. Wilson and Gross (2018) delve into the complex interplay between parents' executive functioning skills and their engagement in their children's education, demonstrating how parental capabilities in planning, flexibility, and inhibitory control can profoundly affect the creation of supportive home learning environments. This suggests that enhancing parents' EFs could, in turn, positively influence their children's educational outcomes.

During the COVID-19 pandemic, Zhang (2021) highlighted the indispensable role of caregiver involvement. This challenging time underscored the adaptability and resilience of families in ensuring educational continuity, showcasing the vital impact of active parental participation in maintaining cognitive growth amidst significant disruptions.

Additionally, Gredebäck et al. (2023) investigate context-dependent cognitive development, pointing out how environmental factors and parental input are crucial for fostering EFs in children. Their research provides concrete evidence that tailored parental engagement, responsive to children's specific contextual needs, is instrumental in their cognitive and emotional development.

These studies advocate for a comprehensive approach to EF interventions, extending beyond conventional educational frameworks to include the home environment. By recognizing parents and caregivers as central figures in the cognitive development journey, a holistic support system is envisioned—one that not only highlights the importance of parental involvement in educational engagement but also emphasizes the need for empowering caregivers. This approach aims to facilitate a well-rounded development process, promoting cognitive, emotional, and social growth in children, thereby ensuring a supportive and enriching environment for all aspects of child development.

Teacher-Student Interaction: The Keystone of EF Enhancement

The intricate relationship between teacher-student interactions and the cultivation of executive functions (EFs) is a cornerstone of educational psychology. Research by Sankalaite et al. (2021) delves into how positive engagement in the classroom is vital for developing EFs, underscoring the need for supportive and enriching teacher-student dynamics to foster

essential cognitive skills, including self-regulation and problem-solving.

Smith et al. (2016) extend this exploration through their assessment of the "Tools for Getting Along" program, which evidences the program's success in promoting healthy teacher-student relationships. This initiative illuminates the significant impact of curricula in cultivating an educational milieu that encourages self-regulation, critical thinking, and emotional resilience. Such programs exemplify effective curricular interventions aimed at enhancing EFs, showcasing the paramount importance of fostering positive interactions within educational frameworks.

Moreover, a meta-analysis by Vandenbroucke et al. (2018) highlights the classroom as a crucial setting for cognitive and particularly EF development. Their analysis confirms the substantial influence of teacher-student dynamics on the development of children's executive functions. This contribution aligns with and reinforces previous studies, advocating for the essential role of nurturing teacher-student relationships as a fundamental component of effective educational environments.

This body of work collectively emphasizes the transformative power of teacher-student interactions in supporting and enhancing EF development. By prioritizing positive, constructive engagement between educators and learners, the educational community can significantly influence cognitive growth and development, laying a strong foundation for lifelong learning and problem-solving capabilities.

In summary, the comprehensive review of interventions aimed at enhancing executive functions (EFs) across various domains—ranging from computer-based and digital game interventions to physical exercise, classroom curriculum adjustments, innovative technologies, and the pivotal roles of parental involvement and teacher-student interactions—underscores a multifaceted approach towards cognitive development in children. These interventions highlight the importance of leveraging a combination of traditional and modern strategies to foster a conducive environment for EF enhancement.

The diversity of EF interventions showcases the need for an adaptable and integrative approach to support cognitive growth. This review sets the stage for applying these insights into practice and policy, aiming to enrich educational strategies and outcomes.

Implications for Practice and Policy

The cultivation of executive functions (EF) in children is a cornerstone for their academic achievement, social development, and overall well-being. Given the extensive research underscoring the significance of EF, it is imperative that educational settings, curriculum designs, teacher training programs, and family engagement initiatives be structured in ways that foster these critical cognitive skills. Below, we outline strategic recommendations for practice and policy designed to enhance EF development.

Educational Settings and Curriculum Design

The integration of EF-enhancing activities into school curricula should be a priority for educational policy makers. Such integration acknowledges the pivotal role that EF plays in students' academic performance and social adaptability. Activities should be varied, encompassing both cognitive challenges and physical activities, to engage different aspects of EF (Diamond, 2013; Zelazo, Blair, & Willoughby, 2016; Pasqualotto et al., 2021; Qiu et al., 2023; Best, Miller, & Naglieri, 2011). This multi-faceted approach ensures a holistic development of EF, catering to the diverse needs of students.

Teacher Training and Professional Development

Professional development programs for educators should emphasize the importance of EF and provide comprehensive training on implementing EF interventions. This includes the use of digital tools, physical exercises, and behavioral strategies aimed at enhancing EF (Jacob & Parkinson, 2015). Training should also focus on how teachers can integrate EF activities into everyday classroom settings, fostering an environment that nurtures cognitive development seamlessly (Juhásová, Gatial, &Mesíková, 2022; Serpell& Esposito, 2016).

Assessment and Evaluation Frameworks

To measure the effectiveness of EF interventions within educational settings, the development and adoption of comprehensive assessment tools are necessary (McClelland et al., 2007). These tools should not only evaluate the outcomes of specific interventions but also guide curriculum adjustments and identify students who may benefit from further EF support (Otero, Barker, & Naglieri, 2014).

Family and Community Engagement

Engaging families and communities in the process of developing EF in children is crucial. Schools should offer workshops and resources that empower parents to support their children's EF development at home. Such collaboration can enhance the effectiveness of school-based interventions and ensure a consistent approach to cognitive development across different environments (Rothschild et al., 2022; Haine-Schlagel & Walsh, 2015).

Technology Integration and Innovation

The role of technology in enhancing EF cannot be overstated. Investment in educational technologies, such as serious games and virtual reality (VR) applications tailored for EF development, is essential. These technologies offer engaging and innovative ways to strengthen EF, particularly in children with attentional challenges (Bul et al., 2018; Ciotola et al., 2022). Furthermore, exploring STEAM education and robotics as part of an innovative curriculum can motivate and enhance creativity and motivation, supporting EF development in novel ways (Chen, Lin, & Chung, 2023). Investment in educational technologies is essential. Therefore,

policymakers should consider incentives for the development and integration of EF-enhancing technologies in classrooms, ensuring that all students have access to innovative learning tools (Angwaomaodoko, 2024; Tohara, 2021).

Future Research Directions

For a comprehensive understanding of EF interventions' long-term benefits, longitudinal studies are critical. These studies should examine the effects of EF interventions on various life outcomes, providing valuable insights for refining and tailoring future interventions (Moffitt et al., 2011; Jaschke, Honing, & Scherder, 2018). Additionally, cross-cultural studies can offer perspectives on the universality and cultural specificity of EF development strategies, enriching our understanding of effective practices across diverse contexts (Gaskins & Alcalá, 2023; Thorell et al., 2013). Finally, the potential of emerging technologies like AI and machine learning in personalizing EF interventions warrants further exploration, promising a new frontier in cognitive training (Robledo-Castro, Castillo-Ossa, & Corchado, 2023; Dhinakaran, 2023).

By adopting these comprehensive strategies, educators, policymakers, and communities can significantly enhance the development of executive functions in children, laying a solid foundation for their future success.

Conclusions

This review highlights the complex and nuanced task of enhancing executive functions (EFs) in children, underscoring the critical importance of adopting a holistic approach. Embracing a comprehensive methodology that seamlessly integrates traditional methodologies with innovative strategies is paramount. Such an approach ensures interventions are not only adaptable and inclusive but also deeply anchored in the latest empirical evidence. To foster optimal EF development, particularly in children facing or at risk of EF deficits, a collaborative synergy among educators, policymakers, families, and communities is indispensable. This collective endeavor is pivotal in equipping every child with the tools needed to realize their fullest potential. As we advance, the relentless exploration of effective EF enhancement strategies becomes essential in effectively bridging the gap between theoretical research and practical implementation. The capability of our educational systems to support the cognitive and emotional development of each child will depend on a sustained commitment to innovation and collaboration across all facets of society. Enhancing EFs goes beyond merely improving academic outcomes; it is fundamentally about nurturing the overall well-being and success of future generations. By championing a holistic and inclusive approach to EF development, we lay down a solid foundation for a brighter, more equitable future for all children.

Finally, we stress the significance of all digital technologies in the field of education and in executive functions training, which is highly effective and productive and facilitates and improves assessment, intervention, and educational procedures via mobile devices that bring educational activities everywhere (Stathopoulou et al., 2019; Drigas, Dede, & Dedes, 2020; Politi-Georgousi & Drigas, 2020), various ICT applications are pivotal in supporting education (Drigas & Petrova, 2014; Bravou & Drigas, 2019; Drigas & Theodorou, 2016; Galitskaya & Drigas, 2021; Bamicha& Drigas, 2022) and enhancing educational procedures through AI, STEM, and robotics (Demertzi, Voukelatos, Papagerasimou, & Drigas, 2018; Chaidi, Kefalis, Papagerasimou, & Drigas, 2021). Furthermore, the integration of ICTs with theories and models of metacognition, mindfulness, meditation, and emotional intelligence supports executive functions training and improves educational practices and outcomes (Drigas, Mitsea, & Skianis, 2022; Drigas &Sideraki, 2021; Karyotaki et al., 2022; Mitsea et al., 2022). These advancements underscore the transformative role of digital technologies in both general and special education contexts, fostering innovative approaches to teaching and learning.

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