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Systematic Review

Multiple Ways in Which Video Games Make Education Inclusive: A Systematic Review of Cognitive Enhancement for Neurodivergent Learners

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Abstract: Children with neurodevelopmental disorders, such as ADHD, ASD and SLDs, often face challenges in executive functioning that can impact their inclusion and participation in educational and social experiences. Digital technologies, in particular video games, are becoming increasingly more integrated into children's lives and are receiving attention as tools to support cognitive development in these populations. This systematic review analyses the effects of video games on Working Memory (WM) and Executive Functions (EFs) in neurodivergent individuals, to evaluate their effectiveness as training tools and their impact in terms of inclusion. Following the PRISMA guidelines, 25 peer-reviewed studies published between 2013 and 2025 were analysed. The interventions included action-video games, exergames, serious games and ad hoc video game training with a pre- and post-assessment in neurodiverse participants. The results indicate that action-video games and exergames show promise in enhancing EFs, while serious games and ad hoc video game training seem to support WM. Despite a few contrasting results, overall, video games are emerging as promising tools of inclusive education thanks to their interactive, customisable and socially empowering nature, especially significant for neurodiverse children. The discussion will depict multiple ways in which video games can make education more inclusive for these populations.

Keywords: video games; executive functions; working memory; neurodevelopmental disorders; inclusion; children; ADHD; ASD; SLDs; systematic review

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1. Introduction

Digital technologies have become an integral part of young people's daily lives, supporting both educational activities [1,2] and leisure pursuits [3]. Among these technologies, video games occupy a particularly prominent role. The recent Health Behaviour in School-aged Children (HBSC) study, conducted across Europe, Central Asia, and Canada, provides insights into the patterns of digital game use among youth. According to the survey, 34% of adolescents reported playing video games daily, with 22% engaging in gameplay for at least four hours per day [4]. The data further indicate that the peak in gaming activity occurs at age 13 for males and at age 11 for females. While gameplay frequency declines with age among females, it remains consistently high among males [4]. Importantly, youngsters employ various types of video games, such as action video games (AVGs), exergames (ExGs) and serious games (SGs), which have been associated with different cognitive benefits in neurodiverse populations. AVGs often entail fighting enemies in single or multiplayer modality, and they are characterised by fast-paced and visually complex environments. They have been shown to improve attentional control and shifting, in particular in children with dyslexia [5]. ExGs, which combine physical activity with digital interaction, typically requiring the use of a gaming console, such as the Kinect device, have been linked with enhancements in inhibition and shifting in children with ADHD [6] and ASD [7,8]. Lastly, SGs are classified as "educational games", designed with explicit educational purposes, and appear particularly effective in children with ADHD as support for Working Memory (WM) [9] and also for inhibition and shifting [10].

Compared to other digital technologies often used in educational settings, such as interactive whiteboards or e-books, video games offer different features that make them valuable for supporting both cognitive and social development [11,12]. Their interactive design, real-time feedback, and adaptive difficulty levels help sustain attention, foster intrinsic motivation, and promote problem solving and behaviour directed to a specific goal. For instance, Mao and colleagues [13] demonstrated that dynamic feedback adjusted to task difficulty, that is, giving simple hints for easy tasks and detailed explanations for complex ones, significantly enhances the motivation and performance in learners in a digital game-based environment. Specifically, students in the dynamic feedback group scored significantly higher on both a knowledge acquisition and a knowledge transfer test compared to other conditions. These results provide evidence of how video games, through real-time responsiveness and individualised challenges, can effectively support attention and goal-directed learning in school contexts.

In addition, compared to other digital tools, video games have been associated with improved executive functioning across a wide developmental span [14,15]. Specifically, video games' virtual environments encourage processes such as decision making, rule following, and cooperation or competition dynamics, which, in turn, foster social engagement and skills development [16]. This is particularly relevant in neurodivergent populations, who can benefit from structured and flexible learning contexts customised to their individual cognitive profiles. Research suggests that such environments can positively affect social development by engaging basic executive components and adapting to developmental needs [17,18].

Over the past fifty years, scientific research on the use of video games by developmental age groups has undergone significant expansion [19]. This research aims to evaluate the confirmation, modalities and effects of video game use on youth. The relationship between video games and learning has been studied since the 1980s; however, from 2010 on, articles reporting on the educational outcomes of video games have been multiplying [19]. Among these, some studies investigated the impact of video games on academic performance and obtained mixed results [20–25]. Other studies focused on cognitive development, suggesting beneficial effects of videogaming activity, both for children and adolescents with typical development [23–25] and clinical populations [5,26,27].

Specifically, recent research focused on studying the impact of video games on higher cognitive functions [28], such as Working Memory (WM) and Executive Functions (EFs). WM has been variously defined as a limited-capacity system that temporarily maintains and stores information [29] or as an attentional resource used for carrying out so-called attention-demanding processes [30]. Despite the numerous conceptualisations of WM, there is wide consensus that it represents one of the main predictors not only of learning processes [31], but also of a range of social competencies [32,33].

EFs are general control mechanisms that modulate the functioning of various cognitive processes and regulate the dynamics of human cognition [34,35]. The most accredited theoretical model of EFs [34] identifies three components, separated but significantly correlated with each other: inhibition, understood both as the ability to inhibit an automatic process and as the management of cognitive interference; attentional shifting, which is the ability to functionally move attention from one task to another; and updating (namely information refreshing) of WM. Similarly to WM, EFs are correlated with enhanced learning [36]. Plus, they are essential for emotional regulation, conflict resolution and the creation of positive social relationships [37].

A recent review by Bediou and coworkers [38] meta-analysed 105 cross-sectional studies comparing engaged video game players and non-video game players. The first tended to score higher than nonplayers on many cognitive skills, including WM and EFs, with an average effect size of g = 0.64.

In light of these findings, a significant number of researchers have initiated studies to explore the effectiveness of video games as a medium for enhancing WM and EFs, by either employing the different types of video games described above (i.e., action video games, exergames and serious games) or designing specific games [39].

To assess video games' impact on WM, Hassler-Hallstedt and colleagues [40] designed and implemented an intervention program called "Chasing Planets" with typical children aged 7 to 8 years old. The results showed significant improvements in WM both at the post-test and follow-ups at 6 and 12 months. Mondéjar and coworkers [41] investigated the differential effects of SGs and commercial video games on children between the ages of 8 and 12 with typical development, finding that the first ones could achieve a substantial enhancement in the domain of spatial WM.

On the other hand, the impact of videogaming on EFs has been primarily studied in adults: the results have shown that computer-based video game-like activities can improve executive functioning [42]. Based on this result, it was considered that similar training could have wider benefits if implemented earlier in development, when the neural circuitry of EFs is still maturing [43], and that it will be most effective if embedded in children's everyday activities [42] (p. 1).

In accordance with this rationale, Kolovelonis and coworkers [44] administered the ExG "Just Dance 2015" to a population of children aged 10 to 11 years old, to enhance their EFs. The results demonstrated significant enhancements in both the experimental group and the waiting-list control group following the administration of the same intervention training. Similar results were found by Flynn and Richert [45], who analysed the effects of ExGs, sedentary video games, physical activity and a control activity (small talk with the researcher) on neurotypical children aged 7 to 12 years old. The study found that both video game conditions led to greater improvements in EFs than physical activity or the control group, specifically in shifting and inhibition.

While an increasing number of studies have highlighted the role of video games in enhancing WM and EFs in neurotypical populations, it is equally, if not more, important to explore their application within neurodiverse developing groups. Children with neurodevelopmental disorders frequently exhibit deficits in WM and EFs [46], which are critical for academic achievement and everyday functioning [6,47]. For instance, the core symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD), such as inattention, impulsivity, and hyperactivity, are closely linked to impairments in EFs [6,35,48]. Similarly, children with Autism Spectrum Disorder (ASD) often struggle with WM, inhibitory control, planning and emotional regulation. Moreover, impaired executive control in this population is associated with challenges in emotional regulation, resulting in inappropriate emotional responses and difficulties in adapting to new or complex situations [7]. Lastly, children with

Specific Learning Disorders (SLDs) often experience a constellation of cognitive difficulties involving WM, EFs and attentional control, all of which contribute to diminished learning capacity [49].

Video games have been increasingly prioritised in recent research on neurodevelopmental disorders, not only because of their popularity among young people, but also because of their unique motivational characteristics. Compared to other traditional interventions (e.g., paper-and-pencil training; behavioural therapy), video games offer engaging environments that combine real-time feedback, adaptive difficulty and intrinsic motivation, fundamental elements for sustained cognitive engagement [50]. Additionally, their interactive nature allows for the ecologically valuable simulation of executive challenges, which can better generalise to real-life contexts [38,51]. This highly adaptable and intrinsically motivating format can foster inclusion by accommodating diverse cognitive profiles and learning needs. Notably, Rafiei Milajerdi and colleagues [52], in a recent systematic review, found that participation in video game-based interventions was associated with improved social behaviours in children and adolescents with atypical development. These findings underscore the role of video games not only in enhancing WM and EFs, but also in fostering social inclusion and reducing barriers to participation in educational contexts.

Given these considerations, the present review aims to explore the use of video games as tools for enhancing WM and EFs in children with ADHD, ASD and SLDs, three populations in which deficits in these processes are particularly salient, and to understand if and how video games may be relevant in terms of inclusion.

2. Materials and Methods

Following the PRISMA guidelines [53], the search for this systematic review was performed in four different databases—PsycINFO, PubMed, Scopus and Web of Science—using the following query: ("executive function*" OR "executive control" OR "cognitive function*" OR "working memory") AND ("video game*" OR "gaming"). The search was restricted to the abstract field and filtered according to the following criteria: (a) language: English only, (b) publication range: from 2013 to 2025, (c) publication type: peer-reviewed journal articles. This search strategy was selected to ensure relevant and comprehensive coverage of the literature in alignment with the inclusion criteria listed below.

The inclusion criteria concerned: (1) experimental or pilot designs featuring at least pre- and post-test measurements and investigating the use of video games to enhance EFs and/or WM capacity; (2) participants including primary school-aged children and adolescents; (3) atypical development, including children with ADHD, ASD or SLDs diagnosis; (4) type of publication: peer-reviewed journal; (5) language: English; and (6) year of publication: from 2013 to 2025. The exclusion criteria applied to studies involving individuals affected by other clinical conditions not falling under the third inclusion criterion, such as traumatic brain injuries or Internet Gaming Disorder.

The initial database search was conducted on 3 July 2024, yielding 1806 records. After removing duplicates, 410 unique articles remained. An additional nine records were excluded because they were not written in English. Title and abstract screening of the remaining records was completed by December 2024. To ensure that the review reflected the most current evidence, an updated search using the same search strategy but restricted to articles published between July 2024 and March 2025 was conducted on 26 March 2025. This final search identified 227 additional records. Of these, 103 were duplicates, and one was excluded for being non-English, leaving 123 new articles for screening.

In total, 524 records underwent title and abstract screening. Of these, 458 were excluded for not meeting one or more predefined inclusion criteria. The remaining 65 articles were assessed in full text, resulting in 12 studies meeting the eligibility requirements. An additional 13 relevant studies were identified through the reference screening of other systematic reviews, yielding a final total of 25 studies included in this review. All screening procedures were conducted by the first author. In cases of uncertainty, the second and third authors independently assessed the records, and discrepancies were resolved through discussion until a consensus was reached. The selection process is fully detailed in Figure 1, which outlines the identification, screening, eligibility and inclusion phases according to the PRISMA standards.

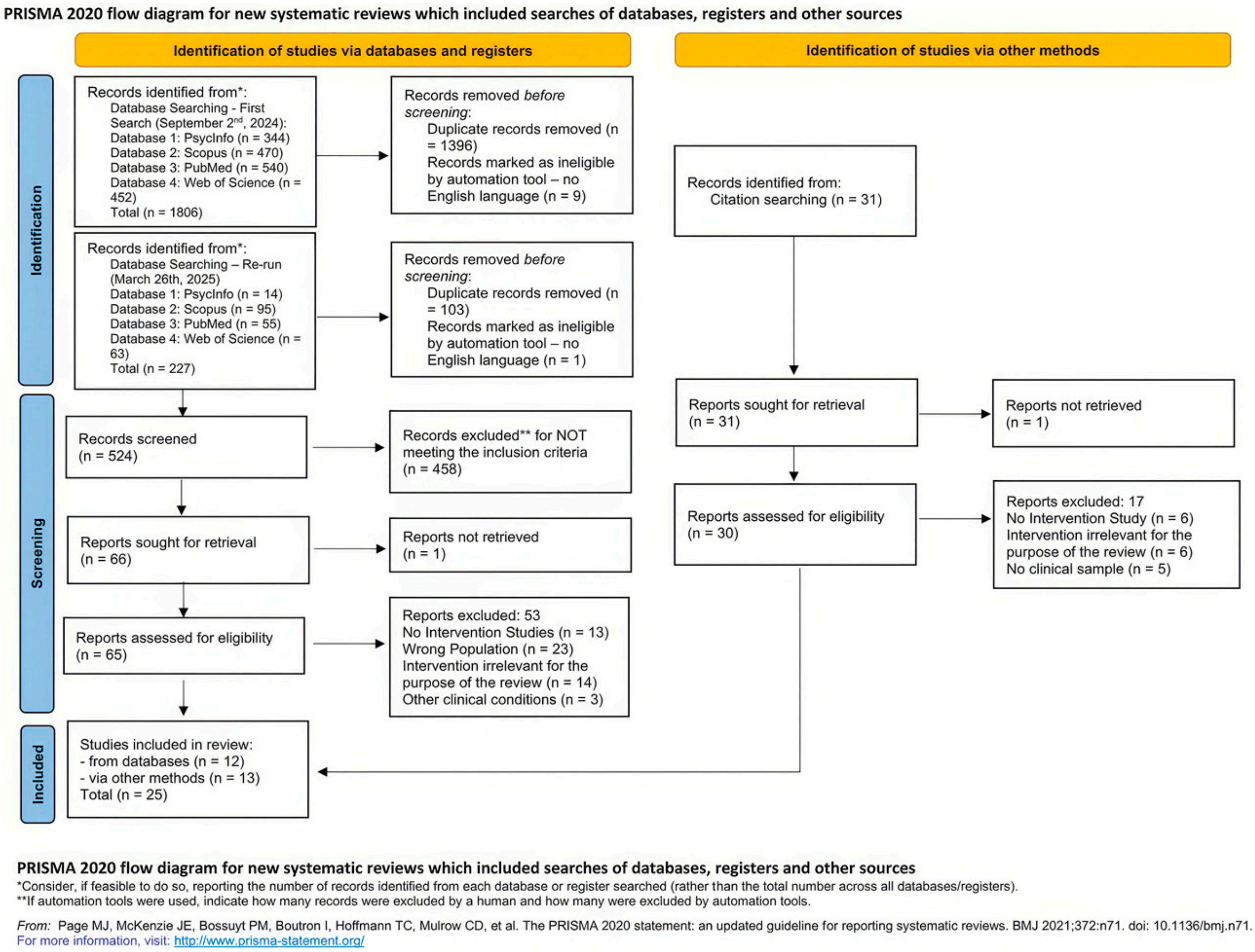

Figure 1. PRISMA 2020 flow diagram for new systematic reviews [53], which included searches of databases, registers and other sources.

The articles selected for the present review are detailed across three tables based on the cognitive process targeted in the video game-mediated intervention. Table 1 includes studies that used video games as tools to improve WM, while Table 2 presents studies aimed at enhancing EFs. Lastly, Table 3 summarises works targeting both WM and EFs simultaneously. Based on the previous literature involving neurotypical populations, which highlights the varying effects of different video game genres on WM and EFs, we outlined the primary cognitive domains impacted and included a dedicated section that categorises each type of video game and intervention program used as cognitive training tools.

Table 1. Studies included in the review on the impact of video games on WM ($N = 5$ studies).

Authors (Year)	Country	Study Type	Dependent or Observed Variable	Sample Age	Sample (n.)	Type of Video Game	Aim	Main Results
Bul et al. (2016) [9]	Netherlands and Belgium	Experimental - EG: SG training - CG: waiting list condition	WM (secondary outcomes)	8–12	ADHD (170)	SG “Plan-It Commander”	Examining the effects of this SG on time management skills (primary outcome), social skills of responsibility and WM (secondary outcomes).	EG achieved significantly greater improvements in WM ($p = 0.02$, Cohen’s $d = 0.51$). The CG reached the same results after receiving the training ($p = 0.001$, Cohen’s $d = 0.61$).
Chacko et al. (2013) [54]	USA	Experimental - EG: training condition - CG: placebo condition	WM	7–11	ADHD (85)	SG “Cogmed: Working Memory Training” (CWMT)	Determining the benefits of CWMT on various outcomes, including WM.	EG demonstrated significantly greater improvements in verbal and nonverbal WM (namely AWMA Digit Recall, $p = 0.005$, $d = 0.28$; AWMA Dot Matrix, $p < 0.001$, $d = 1.17$) but not in its updating (e.g., AWMA Listening Recall, $p = 0.728$).
Khalili Kermani et al. (2016) [55]	Iran	Experimental - EG: WM training - CG: no activity	Verbal WM	8–12	ADHD (60)	SGs (created for this investigation)	Verifying the effect of novel WM training in the form of structured games on ADHD children.	EG significantly enhanced verbal WM ($F(1, 58) = 5.326$, $p = 0.033$) compared to CG.
Łuniewska et al. (2018) [20]	Poland	Experimental - EG 1: AVGs training - EG 2: Phonological non-AVGs - CG: No training	Reading ability, phonological WM	9–13	Dyslexia (54)	AVGs “Rayman Raving Rabbids”	Testing how two forms of training, based on AVGs and on phonological non-action video games (PNAVGs), affect reading and other cognitive constructs, including phonological WM.	While EG 1 and 2 increased in phonological WM more than CG ($F(1, 52) = 15.53$, $p < 0.001$, $\eta^2 = 0.23$), the difference was not statistically significant (F (Group effect) = 0.01, $p = 0.94$; F(Group × Time) = 0.34, $p = 0.56$).

Table 1. *Cont.*

Authors (Year)	Country	Study Type	Dependent or Observed Variable	Sample Age	Sample (n.)	Type of Video Game	Aim	Main Results
Priya & Varathan (2025) [56]	India	Quasi-experimental - EG: training intervention	Visuo-spatial WM	11–16	ASD (30)	SGs and "Super Mario" with Leap Motion Controller	Evaluating the impact of gesture gaming on dexterity, grip strength and WM in individuals with ASD.	EG improved visuo-spatial WM in post-test in the Backward Span ($t = -42.8$, $p < 0.05$) and in the Forward Span ($t = -35.3$, $p < 0.05$). These enhancements are maintained at follow-up BS ($t = -42.7$, $p < 0.05$) and FS ($t = -33.5$, $p < 0.05$).

EG (experimental group); CG (control group); WM (working memory capacity); SGs (serious games); AVGs (action video games); PNAVGs (phonological non-action video games); ADHD (attention deficit and hyperactivity disorders); ASD (autism spectrum disorder); AWMA (Automated Working Memory Assessment); BS (Backward Span); FS (Forward Span).

Table 2. Studies included in the review on the impact of video games on EFs ($N = 7$ studies).

Authors (Year)	Country	Study Type	Dependent or Observed Variable	Sample Age	Sample (n.)	Type of Video Game	Aim	Main Results
Benzing and Schmidt (2019) [6]	Switzerland	Experimental - EG: training condition - CG: waiting list condition	Inhibition, shifting and updating	8–12	ADHD (51)	ExGs "Shape Up"	Investigating the effects of cognitively and physically demanding exergaming on EFs, ADHD symptoms and motor abilities.	EG improved the reaction times in inhibition ($F(2, 48) = 4.08$, $p = 0.049$, $d = 0.58$) and shifting ($F(2, 48) = 5.09$, $p = 0.029$, $d = 0.65$), no changes in updating ($F(2, 48) = 0.50$, $p = 0.482$, $d = 0.20$).

Table 2. *Cont.*

Authors (Year)	Country	Study Type	Dependent or Observed Variable	Sample Age	Sample (n.)	Type of Video Game	Aim	Main Results
Benzing et al. (2018) [57]	Switzerland	Experimental - EG: acute PA with ExGs training - CG: sedentary activity	Visual WM, inhibition and shifting	8–12	ADHD (46)	ExGs "Shape Up"	Verifying the effects of an acute bout of physical activity on multiple aspects of EFs (inhibition, switching, and visual working memory).	EG performed significantly faster RT in inhibition ($F_{\text{Flanker}}(2, 43) = 5.69$, $p = 0.022$, $\eta^2{}_p = 0.117$) and shifting ($F_{\text{Flanker}}(2, 43) = 5.50$, $p = 0.024$, $\eta^2{}_p = 0.113$), but there was no significant difference in the accuracy of the two tasks (congruent ($F_{\text{Flanker}}(2, 43) = 2.01$, $p = 0.157$, $\eta^2{}_p = 0.046$), incongruent ($F_{\text{Flanker}}(2, 43) = 0.09$, $p = 0.770$, $\eta^2{}_p = 0.002$) shifting trials ($F_{\text{Flanker}}(2, 43) = 0.26$, $p = 0.616$, $\eta^2{}_p = 0.006$) nor in visual WM ($F_{\text{Color span}}(2, 43) = 0.00$, $p = 0.995$, $\eta^2{}_p = 0.013$).
Di Giusto et al. (2023) [58]	Italy	Pilot study EG: VR training	Inhibition and shifting	7–11	SLDs (24)	Ad hoc video game training "Vitamin"	Examining whether a VR-rehabilitation program may have positive effects on the EFs of children with SLDs.	EG scores improve significantly for inhibition ($t = -2.985$, $p = 0.007$, $d = 0.609$) and shifting (Mazes Subtest: $z = -2.765$, $p = 0.006$, $r = 0.743$) in post-test and after 6 months follow-up.
Dörrenbächer & Kray (2019) [59]	Germany	Experimetal - EG: gamified training - CG: standard training	Motivation, shifting and inhibition	8–13	ADHD (26)	Ad hoc video game training "Watermon Battle"	Investigating how a game-based training environment influences motivational variables and executive control during task-shifting training.	EG improved in motivation, but not in shifting and inhibition: no significant group differences were found in shifting costs or incompatibility effects (both $p < 0.22$, $BF_{10} < 0.65$), nor in group × session interactions ($F(1, 24) = 3.41$, $p = 0.08$, $\eta^2{}_p = 0.13$, $BF_{10} = 1.49$); all group effects ($p > 0.16$, $BF_{10} < 0.76$).

Table 2. *Cont.*

Authors (Year)	Country	Study Type	Dependent or Observed Variable	Sample Age	Sample (n.)	Type of Video Game	Aim	Main Results
Makkar et al. (2022) [60]	India	Experimental - EG: VG and transcranial therapy - CG: only VG	Inhibitory control and shifting	10–16	ADHD (61)	AVGs "Prince of Persia"	Determining the effectiveness of transcranial direct current stimulation (tDCS) compared to AVGs on the EFs in children with ADHD.	The CG (only VG condition) obtained no statistically significant results in shifting ($F = 0.639$, $p = 0.530$) and significative enhancements in inhibition ($F = 5.733$, $p = 0.003$), but less than EG.
Rafiei Milajerdi et al. (2021) [8]	Iran	Experimental - EG 1: SPARK training - EG 2: ExGs training - CG: treatment as usual	Inhibition and shifting	6–10	ASD (60)	ExGs "Kinect Tennis" and SPARK program	Investigating the effects of two types of interventions, Sports, Play and Active Recreation for Kids (SPARK) and ExGs (Kinect), on motor skills and EFs.	EG 2 displayed the main effects of more correct responses in inhibition and shifting ($F(2, 53) = 5.43$, $p < 0.01$, *partial* $\eta^2 = 0.17$) than children in the other two groups.
Sepehri Bonab et al. (2024) [7]	Iran	Experimental - EG: ExG and sedentary VG - CG: no activity	Inhibition and shifting	7–10	ASD (40)	ExG "Kinect Sports Season 2" and sedentary VG "Kinect Adventures" in VR	Evaluating the efficacy of ExGs and sedentary VG on EFs and emotional regulation on children with ASD.	EG significantly improved in inhibition ($t(19) = 5.99$, $p = 0.001$) and shifting ($t(19) = 7.37$, $p = 0.001$).

EG (experimental group); CG (control group); WM (working memory capacity); EFs (executive functions); RT (reaction time); VG (video game); AVGs (action video games); ExGs (exergames); VR (virtual reality); ADHD (attention deficit and hyperactivity disorders); ASD (autism spectrum disorder); SLDs (specific learning disorders); tDCS (transcranial direct current stimulation); SPARK (Sports, Play and Active Reaction for Kids)

Table 3. Studies included in the review on the impact of video games on both WM and EFs (N = 13 studies).

Authors (Year)	Country	Study Type	Dependent or Observed Variable	Sample Age	Sample (n.)	Type of Video Game	Aim	Main Results
Bikic et al. (2018) [61]	Denmark	Experimental - EG: computerised training - CG: treatment as usual	Spatial WM, inhibition and shifting (secondary outcomes)	6–13	ADHD (70)	Ad hoc video game training "ACTIVATE™"	Exploring the effects of a computer training program targeting multiple cognitive functions	EG found no significant beneficial effects on secondary outcome measures (spatial WM, $p = 0.096$; inhibition, $p = 0.093$; shifting, $p = 0.13$).
Dovis et al. (2015) [62]	Netherlands	Experimental - EG 1: full-active condition - EG 2: partially active condition - CG: placebo condition	Visuospatial WM, inhibition and cognitive flexibility	8–12	ADHD (89)	Ad hoc video game training "Braingame Brian"	Evaluating the short- and long-term effects of a gamified training intervention targeting specific cognitive abilities. Additionally, assessing the specific effects of the inhibition and cognitive flexibility training task.	Only EG 1 showed improvement in the measures of visuospatial STM and WM (CBTT-forward: $F(1, 59) = 11.03$, $p < 0.01$, $\eta^2{}_p = 0.16$; CBTT-backward: $F(1, 59) = 5.98$, $p < 0.05$, $\eta^2{}_p = 0.09$) and interference control ($F(1, 59) = 6.53$, $p < 0.05$, $\eta^2{}_p = 0.10$. Inhibitory performance improved in EG 1 ($F(1, 59) = 5.73$, $p < 0.05$, $\eta^2{}_p = 0.09$) and EG 2 ($F(1, 56) = 4.22$, $p < 0.05$, $\eta^2{}_p = 0.07$).
Franceschini et al. (2017, Study 4) [5]	Italy	Quasi-experimental - EG 1: AVGs training - EG 2: Non AVGs training	Shifting and phonological WM	7–14	Dyslexia (28)	AVGs "Rayman Raving Rabbids"	Testing reading skills, phonological working memory and attentional shifting in English-speaking children with dyslexia.	EG 1 enhanced phonological WM (F (1, 25) = 5.277, $p = 0.030$, $\eta^2 = 0.174$) and attentional shifting ($t(15) = 1.765$, $p = 0.049$, Cohen's $d = 0.65$) after AVGs training.

Table 3. *Cont.*

Authors (Year)	Country	Study Type	Dependent or Observed Variable	Sample Age	Sample (n.)	Type of Video Game	Aim	Main Results
Johnstone et al. (2017) [63]	Australia	Experimental - EG: WM, inhibitory control training - CG: waiting list control	WM and inhibitory control	7–11	ADHD (85)	SG "Focus Pocus"	Examining the efficacy of combined WM, inhibitory control and neurofeedback training in children with ADHD and subclinical ADHD.	EG significantly improved in inhibitory control ($F(2, 39) = 5.286$, $p = 0.007$, *partial* $\eta^2 = 0.12$), but not in WM after training.
Luo et al. (2024) [64]	China	Pilot Study - EG: ADHD sample - CG: typical sample	WM and inhibition	6–12	ADHD (55) Typical (55)	SG "Save the Muse Home"	Assessing the effectiveness of SG therapy software for children with ADHD and evaluating its suitability and effectiveness in improving the cognitive ability of neurotypical children.	EG's improvements in WM (BRIEF MI ($B = 11.05$, $p < 0.05$; fewer early saccades: $B = 0.34$, $p < 0.05$). Inhibition is not improved in BRIEF BRI ($p > 0.05$), but in CPT (commission errors: $B = 15.47$, $p < 0.001$) and the anti-saccade task (correct rate: $B = -10.65$, $p < 0.05$).
Martin–Moratinos et al. (2025) [65]	Spain	Experimental - EG: SG training and treatment as usual - CG: treatment as usual	Spatial WM, inhibition and shifting	7–18	ADHD (76)	SG in VR "The Secret Trail of Moon"	Evaluating the impact of 20-session treatment with this SG in VR on emotional regulation and executive functioning.	EG obtained significant improvements in spatial WM ($F(1, 55) = 4.08$, $p = .05$, $\eta^2 = 0.06$), inhibition ($F(1, 55) = 3.89$, $p = 0.05$, $\eta^2 = 0.06$) and shifting ($F(1, 66) = 4.06$, $p = 0.04$; $\eta^2 = 0.05$).
Medina et al. (2021) [10]	Spain	Experimental - EG: educational SG - CG: commercial no educational VG	Visuo-spatial WM, inhibitory control and shifting	8–11	ADHD (29)	SGs "KAD_SCL_01 Program" (different SGs in a platform)	Comparing training with a smart, digital, cognitive stimulation program (KAD_SCL_01) and training with 3 commercial VGs to evaluate the most effective in neurocognitive rehabilitation.	EG only improved in visuo-spatial WM ($\beta = -0.84$, $SE = 0.38$, $t(27) = -2.24$, $p = 0.03$), inhibitory control (reduction in commission errors: $p = 0.03$, Hedge's $g = -0.62$) and shifting ($t(14) = 2.32$, $p = 0.03$).

Table 3. *Cont.*

Authors (Year)	Country	Study Type	Dependent or Observed Variable	Sample Age	Sample (n.)	Type of Video Game	Aim	Main Results
Nekar et al. (2022) [66]	South Korea	Experimental - EG: ExGs in AR training - CG: conventional cognitive training	WM, inhibition and shifting	6–18	ASD (24)	ExGs in AR "UINCARE"	Investigating the effects of AR using motivational games with cognitive–motor exercises on RRBs, EFs, attention and reaction time in patients with ASD.	EG obtained significant improvements in WM (Time × Group: $F = 11.407$, $p < 0.01$), shifting (RT: $F = 7.184$, $p < 0.05$; AR: $F = 6.349$, $p < 0.05$) and inhibition (RT: $F = 5.200$, $p < 0.05$; AR: $F = 4.351$, $p < 0.05$).
Revollo-Carillo et al. (2024) [67]	Colombia	Pilot Study - EG: training intervention - CG: waiting list	WM, inhibition and cognitive flexibility	8–12	ADHD (34)	Ad hoc video game training "Braingame Brian"	Assessing the potential of this intervention on EFs in children with ADHD	EG improved in WM ($F(1, 32) = 19.172$, $p < 0.05$, $h^2{}_p= 0.98$), inhibition ($F(1, 32) = 5.008$, $p < 0.05$, $h^2{}_p= 0.58$) and cognitive flexibility (number of categories achieved (F $(1, 32) = 10.874$, $p < 0.05$, $h^2{}_p= 0.89$); number of errors ($F(1, 32) = 4.668$, $p < 0.05$, $h^2{}_p= 0.55$).
Rodrigo-Yanguas et al. (2023) [39]	Spain	Experimental - EG: TSTM training - EG 2: TC training - CG: no intervention	WM, inhibition and shifting	12–22	ADHD (105)	SG "The Secret Trail of Moon"	Evaluating the efficacy of TSTM or TC as add-ons in stable, optimally medicated ADHD patients.	EG 1 and EG 2 did not improve WM ($p = 0.99$), inhibition ($p = 0.60$) or shifting ($p = 0.39$) abilities after both training.
Smith et al. (2020) [68]	USA and China	Experimental - EG: training condition - CG: treatment as usual	Verbal WM and inhibition (secondary outcome)	5–9	ADHD (92)	Ad hoc video game training "IBBS" (Integrated Brain, Body and Social intervention)	Evaluating the efficacy of an IBBS intervention (computerised cognitive remediation training, physical exercises and a behaviour management strategy) for children with ADHD.	EG showed significant improvement in a verbal WM task ($F(1, 69) = 4.00$, $p = 0.049$, $d = 0.27$); however, this result disappeared after correcting for multiple group comparisons.

Table 3. *Cont.*

Authors (Year)	Country	Study Type	Dependent or Observed Variable	Sample Age	Sample (n.)	Type of Video Game	Aim	Main Results
Van der Oord et al. (2014) [69]	Netherlands	Experimental - EG: training condition - CG: waiting list condition	WM, inhibition and cognitive flexibility	8–12	ADHD (40)	Ad hoc video game training "Braingame Brian"	Testing the short- and long-term efficacy (9 weeks follow-up) of executive functioning remediation training with game elements for children with ADHD.	EG showed significantly more improvement than those in the CG on parent-rated WM, inhibition and cognitive flexibility (BRIEF total EFs score ($F(1, 35) = 6.84$, $p < 0.05$, $\eta^2 = 0.16$). Effects were maintained at follow-up.
Wexler et al. (2020) [70]	USA	Quasi-experimental - EG 1: cognitive training (t_1) + treatment as usual (t_2) - EG 2: treatment as usual (t_1) + cognitive training (t_2)	WM and inhibition	6–8	ADHD (73)	Ad hoc video game training "C8 Sciences"	Evaluating the effectiveness of an integrated programme of cognitive training exercises, both computer-based and physical.	EG 1 and EG 2 improved in WM (pre-post mean, from 9.4 to 14.1, $p = 0.009$) and inhibition (Flanker incongruent accuracy (from 85% to 91%, $p = 0.02$); RT reduction in correct trials (from 1.4 s to 0.9 s, $p = 0.003$); no-go accuracy (from 33% to 44%, $p = 0.01$)) after receiving training.

EG (experimental group); CG (control group); WM (working memory capacity); EFs (executive functions); STM (short-term memory); RRBs (restricted and repetitive behaviours); RT (reaction time); VGs (video games); SGs (serious games); AVGs (action video games); ExGs (exergames); AR (augmented reality); VR (virtual reality); ADHD (attention deficit and hyperactivity disorders); ASD (autism spectrum disorder); TSTM (The Secret Trail of Moon); TC (therapeutic chess); t_1 (tempo 1); t_2 (tempo 2); CBTT-forward (Corsi block-tapping task—forward); CBTT-backward (Corsi block-tapping task—backward); BRIEF (Behavioral Rating Inventory of Executive Functions); BRIEF MI (Behavioral Rating Inventory of Executive Functions—Metacognition Index); BRIEF BRI (Behavioral Rating Inventory of Executive Functions—Behavioral Regulation Index); CPT (continuous performance test)

3. Results

This review includes a range of studies conducted primarily in Europe and the United States, with additional research from South America and several East Asian countries. Various types of video game-based training interventions aimed at enhancing WM or EFs in neurodiverse populations are investigated. Out of the 25 selected records, 18 focus on children with ADHD; only three studies involve children with SLDs, while four pertain to the ASD population. In the following sections, the impact of the different types of video games on either WM or EFs (or both) is detailed (see the "Main results" column of Tables 1–3 for the statistical indices of the scrutinised studies).

3.1. The Impact of Video Games on WM

Among the five studies which have explored the effectiveness of video games in enhancing the WM capacity, Bul and colleagues [9] used an online adventure SG called "Plan-It Commander" on a population of children aged 8 to 12 years old and diagnosed with ADHD. The participants were randomised into two groups: the first received 10 weeks of SG training in addition to standard WM treatment, followed by another 10 weeks of standard treatment only; the second group received a crossover intervention (i.e., 10 weeks of standard treatment followed by 10 more weeks of joint SG training and standard intervention). The findings showed significant improvements in the parent-rated WM score in the first group, with these enhancements maintained or further improved over the following 10 weeks. Similarly, Khalili Kermani and coworkers [55] developed an ad hoc SG and employed it in 12-week training in individuals with ADHD (8–12 years old), comparing an experimental group to a passive control group. Assessments at post-test and 6-month follow-up showed improvements in WM exclusively in the experimental group. Priya and Varathan [56] evaluated the effects of a set of four Leap Motion-delivered video games: three SGs, that is "Basketball", "Pin Bowling", "Leap Ball Game" and one commercial video game "Super Mario", in a population with ASD (11–16 years old). The training had positive effects on visuo-spatial WM: the backward span performance significantly improved from pre- to post-test. Similar results emerged for the forward span. A four-week follow-up confirmed these effects. Lastly, some improvements occurred in other measured variables, such as hand grip strength and dexterity. These results suggest that SGs and the Leap Motion technology, used together, can successfully improve visuo-spatial WM in ASD individuals. Indeed, the use of real-time physical interaction offers additional cognitive benefits for learners with sensory or attentional issues. This design may represent a productive direction for targeting WM, rather than employing only SGs or interactive feedback technologies separately. Lastly, Chacko and coworkers [54] studied the effects of the "Cogmed–Working Memory Training", ad hoc video game training, in children with ADHD aged 7 to 11 years. The authors highlighted improvements in both verbal and non-verbal WM capacity but not in its updating. Overall, all the studies listed above provide solid evidence showcasing the efficiency of video games in enhancing at least some components of WM. Among those examined, the only evidence that diverges from the general trend is that of Łuniewska and coworkers [20], who compared three groups of dyslexic children aged 8 to 13 years old. The first group played with the "Rayman Raving Rabbids" AVG, the second used a non-action phonological video game, while the last one was a passive control group. While WM improved in both experimental groups, these changes did not reach statistical significance compared to the control group.

3.2. The Impact of Video Games on EFs

Seven studies have investigated the effectiveness of video games in improving EFs, most of which employed ExGs. For instance, Benzing and coworkers [57] studied children with ADHD aged 8 to 12 years old, finding that the use of “Shape Up”, a fitness ExG, improved both inhibition and shifting but had no positive effects on visual WM. In another study, Benzing and Schmidt [6] confirmed the benefits of “Shape Up” in the experimental group for inhibition and shifting, although no significant differences emerged between the groups for updating. Recently, Rafiei Milajerdi and coworkers [8] compared the ExG, “Kinect Tennis”, with a structured exercise program (SPARK Program) in children with ASD aged 6 to 10 years old, finding significant improvements in shifting only in the ExG group. Finally, Sepehri Bonab and colleagues [7] compared the effects of mixed virtual reality (VR) training, including the ExG, “Kinect Sports Season 2”, to those of the sedentary video game, “Kinect Adventures”, in individuals with ASD and aged 7 to 10 years old. The ExG condition produced significantly more positive effects on inhibition, shifting and emotional regulation compared to the sedentary one.

In another group of studies, researchers used ad hoc video game training. Dörrenbächer and Kray [59] employed “Watermon Battle”, a structured activity designed principally to promote motivation, but the authors also analysed changes in inhibition and shifting in children with ADHD (8–13 years old). Improvements emerged only in motivation, but not in inhibition and shifting. Di Giusto and coworkers [58] employed a series of VR SGs designed to improve EFs in children with SLDs, finding enhancements in inhibition, with stability maintained at 6-month follow-up. They also found improvements in shifting and planning, shown by a better performance in the Mazes Subtest from pre-test to post-test and from pre-test to the follow-up phase. Positive effects on Design Fluency emerged only between the post-test phase and follow-up, overall suggesting both immediate and delayed benefits of the VR intervention.

In contrast with the studies detailed above, Makkar and colleagues [60] compared two groups of children with ADHD aged 10 to 16 years old. The first group underwent training with the commercial AVG, “Prince of Persia: Sands of Time” and transcranial stimulation therapy, while the second only employed the AVG. The finding showed that the AVG-only group achieved minimal changes in EFs compared to the “double intervention” one.

3.3. The Impact of Video Games on Both WM and EFs

Franceschini and coworkers [5] used a set of mini games derived from the commercial Wii video game, “Rayman Raving Rabbids”, with a sample of English-speaking children with dyslexia, aged 7 to 14 years old. Specifically, the participants were divided into an experimental group, playing AVGs, and an active control group, playing non-AVGs. The results showed significant improvements in phonological WM and shifting in the experimental group.

Nekar and colleagues [66] evaluated the efficacy of “UINCARE,” a device utilising a Kinect system to integrate body movement with cognitive task performance, in individuals with ASD aged 6 to 18 years old. UINCARE incorporates all the features of ExGs through the application of augmented reality (AR). The participants were assigned to either an experimental group, which received UINCARE-based training, or a control group, which underwent conventional cognitive training. The results indicated that significant improvements in WM, inhibitory control and shifting were observed exclusively in the experimental group.

Other investigations have employed SGs as cognitive training tools. Notably, Medina and colleagues [10] compared the cognitive outcomes of an educational platform comprising fourteen SGs with those of commercial video games in children aged 8 to 11 years old diagnosed with ADHD. Only participants engaging with the SGs platform exhibited statistically significant improvements in spatial WM, inhibitory control and cognitive shifting.

Similarly, Luo and coworkers [64] examined the effects of the SG, "Save the Muse Home", on two cohorts of children aged 6 to 12 years old, one with ADHD and one neurotypical. The intervention led to significant enhancements in WM and inhibition. Martin-Moratinos and coworkers [65] investigated the impact of a virtual reality-based SG, "The Secret Trail of Moon", in a similar clinical population, further confirming its efficacy in improving WM, shifting and inhibition. In contrast, Rodrigo-Yanguas and coworkers [39] compared a chess-based therapeutic game and "The Secret Trail of Moon" in adolescents with ADHD (aged 12 to 22 years old), finding no significant changes in the global executive function index as measured by the Behavior Rating Inventory of Executive Function-2 (BRIEF-2). Johnstone and colleagues [63] evaluated the SG, "Focus Pocus" in children with ADHD aged 7 to 11 years old, observing improvements in EFs, particularly inhibitory control (albeit with a small effect size), though no significant gains were noted in WM.

Further studies have explored the efficacy of ad hoc video game interventions. Van der Oord and coworkers [69] assessed "Braingame Brian", a training program consisting of 25 targeted sessions focusing on WM, inhibition and cognitive flexibility, in children aged 8 to 12 years old with ADHD. The intervention yielded significant improvements across all three executive domains, with some effects persisting at a nine-week follow-up. Significant effects were found for the BRIEF Total EFs score, but not on the specific BRIEF subscales, such as WM, shifting and inhibition. On the other hand, gaming performance data showed significant enhancements across all trained EFs, with strong within-subject effects. While parents' evaluations yielded mixed results, specific advances in EFs' domains emerged during the gameplay performance, thus suggesting that those improvements were strictly linked to the executive skills stimulated by the video game, with a limited transfer effect.

In a similar randomised study, Dovis and colleagues [62] divided children with ADHD into three groups: a fully active training condition (targeting WM, inhibition and cognitive flexibility), a partially active condition (training inhibition and shifting with WM in a placebo) and a placebo group. Significant improvements in WM, visuospatial short-term memory and inhibitory control were observed exclusively in the full-active training group. The partially active group showed gains in inhibition only, while no significant effects were observed in shifting across groups. Recently, Revollo-Carillo and coworkers [67] applied "Braingame Brian" to a Spanish-speaking population of children aged 8 to 12 years old with ADHD, corroborating its positive effects on WM, inhibition and cognitive flexibility. Additionally, Wexler and colleagues [70] developed "C8 Sciences", a platform that integrates computerised cognitive training with cognitively enriched physical activity. Their findings demonstrated improvements in WM and inhibition among children with ADHD aged 6 to 8 years old. While most of the scrutinised studies reported encouraging results, some others have reported null findings. Smith and coworkers [68] investigated the "Integrated Brain Body Social Intervention" in children aged 5 to 9 years old with ADHD, but found no significant changes in WM or inhibition. Similarly, Bikic and colleagues [61], evaluating the digital training program "ACTIVATE™", observed no significant benefits in WM, inhibition or shifting.

4. Discussion

The present review aimed to investigate the role of video games as tools for improving WM and EFs in children with ADHD, ASD and SLDs. The overarching objective was to assess their efficacy as cognitive training tools and explore their broader implications for promoting inclusion.

Some studies [9,54], supported by medium and large effect sizes, reported that video game-based training significantly improved WM performance. In contrast, other studies [39], based on parent-rated measures or gameplay performance indexes, did not show statistical improvements in WM or shifting. This divergence highlights the importance of differentiating between perceived enhancements and measured cognitive improvements. A similar pattern emerged for EFs. ExGs, such as "Shape Up" and "Kinect Tennis", were associated with significant enhancements in inhibition and shifting skills, while other interventions, such as "Watermon Battle" [59] or commercial video games [20,60], did not promote relevant executive changes. Lastly, tools like "Braingame Brian" showed mixed results, with significant improvements in the global scores index of EFs if parent-rated, but not in specific subscales of WM or inhibition.

From a comparative perspective, while SGs and ad hoc training programs, such as "Plan-It Commander" and "Cogmed", showed relevant effects on WM, other interventions like "Braingame Brian" and commercial video games, such as "Prince of Persia", produced more limited or restricted improvements in some specific executive domains, especially when based on parent-related assessments or game-related performance, without an external solid validation across standardised instruments.

Despite a few mixed results, the findings from this review suggest that various categories of video games may positively influence WM and EFs in children and adolescents with neurodevelopmental disorders.

To better scrutinise the differential impact of video games on the targeted cognitive processes, we differentiate three thematic clusters. The first concerns enhancements in WM capacity, which were most prominently associated with SGs and ad hoc video game interventions. For instance, programs such as "Plan-It Commander" [9] and "Cogmed" [54] promoted significant improvements in WM, particularly within individuals diagnosed with ADHD. Priya and Varathan [56] demonstrated how SGs in the Leap Motion version may improve WM more successfully than passive video game experiences. These findings align with evidence that indicates how body interaction and multimodal feedback can improve cognitive engagement, in particular in ASD populations [56]. However, differences in age, in WM measures and feedback design make it difficult to directly make comparisons with other studies that involve SGs [9]. This aspect highlights the need for more standardised protocols for future research. Conversely, studies employing AVG training without interactive components failed to yield significant results [6].

The second cluster includes studies focused specifically on EFs. While not all interventions yielded positive results [60], ExGs featured prominently in this category. Interventions such as "Shape Up" promoted notable gains in inhibitory control and cognitive flexibility among children with ADHD [6,57]. Comparable improvements were documented in children with ASD through ExGs like "Kinect Tennis" [8] and "Kinect Sports Season 2" [7]. Overall, ExGs seem to positively affect inhibition, likely thanks to the combination of structured tasks and body movements needed to accomplish the game's requests. Conversely, AVGs stimulate cognitive processes with fast-paced environments and multiple perceptive stimuli, thus requiring rapid decision making and attentional control. Some studies e.g., [5] imply that this type of video game is particularly valuable to empower shifting; however, their impact on inhibition and WM is less consistent. Notably, the impact of different features and modalities of the video games can vary based on the neurodevelopmental profile of the participants: children with ADHD seem to take more progresses from ExGs, which have explicit goals and are more structured, while AVGs can be more useful for children with dyslexia, thanks to their attentional load.

The third cluster encompasses investigations examining the combined influence of video games on both WM and EFs. Numerous studies across different neurodevelopmental conditions have reported significant benefits using various game formats. For example, AVGs have been shown to improve phonological WM and shifting in children with dyslexia [5], while ExGs demonstrated efficacy in enhancing WM, inhibition and shifting in ASD individuals [8]. Moreover, SGs [10,56,66] and ad hoc video game programs [69,70] have consistently produced significant improvements in both WM and EFs both in ADHD and ASD populations.

A further relevant aspect that must be taken into account is how different games can be tailored to the specific needs of children with different neurodevelopmental disorders. SGs are developed with explicitly educative or therapeutic aims, and they allow a greater personalisation of content and regulation of task difficulty. This makes them particularly useful for children with ADHD, who benefit from clear objectives, constant reinforcements and structured environments [9,10,54,63]. Instead, ExGs integrate motor activation and empowerment of EFs, promoting self-regulation and inhibition across body movement in association with cognitive tasks. For this reason, these video games are suitable for individuals with ASD, who can benefit from sensory integration and an experiential approach [7,8,66]. Lastly, AVGs are characterised by dynamic environments and high stimulating intensity; these aspects make them particularly useful for children with dyslexia [5], who might benefit from handling a significant cognitive load. In this sense, different video games offer distinct forms of adaptability and the possibility to be customised based on intervention goals and the specific characteristics of children with neurodiverse development.

While most studies support the employment of video games as tools for cognitive enhancement, some findings seem to be inconsistent, especially with respect to specific populations. For example, Benzing and Schmidt [6] found that ExGs led to significant enhancements in inhibition and shifting in children with ADHD, while Makkar and coworkers [60], using a commercial AVG in a similar population, did not report significant benefits in cognitive abilities for the video game-only condition. These discrepancies may depend on several factors—first, the nature of the game itself: cognitive complexity, feedback system and physical involvement can greatly affect executive functioning. Second, the duration and intensity of the intervention change widely among studies, with a subsequent impact on the consolidation of cognitive improvements. Third, the participants' interindividual differences, such as age, severity of diagnosis and comorbidities could moderate the effects of the interventions. Lastly, the measures used in these studies are not homogeneous. In some cases, scholars used parent-rated or self-reported scales, in others, standard neuropsychological tasks, thus focusing on different aspects of cognitive functioning.

In sum, despite some contrasting results [39,68], this review underscores the promising role of video games in supporting the development of WM and EFs.

These findings can be interpreted at many theoretical levels. First, while different models of EF have been proposed during the last 25 years, most tend to agree on the prominent role of three "core" EFs, namely WM updating, inhibition and shifting [34,35]. The present review offers a detailed examination of how each of them is selectively impacted by video game-mediated training, thus providing relevant theoretical and practical insights into their differential impact. Secondly, the effectiveness of ExGs can be viewed throughout the embodied cognition theory, according to which motor involvement fosters cognitive and emotional processing and regulation. This perspective highlights how cognitive abilities can emerge from the dynamic interaction between body, brain and environment, evidencing the role of sensory-motor experiences in the development of high cognitive functions [71]. In terms of educational inclusion, the emerged evidence is aligned with the principles of the Universal Design for Learning (UDL), a framework that promotes adaptability and personalisation of educational tools to face the variety of cognitive and social needs of learners. This framework offers a design of flexible contexts of learning, that can give multiple modalities of representation, expression and involvement, to guarantee the same opportunity for all students [72].

Starting from this evidence, we now intend to answer our original question: In how many ways can video games make education more inclusive? We argue that there are at least three.

First, higher-level cognitive processes such as WM and EFs are systematically linked to better social functioning. Research shows that deficits in WM, especially in its central executive component, have been associated with greater peer rejection, higher levels of aggression and poorer conflict resolution skills in neurotypical children [32]. Similarly, EFs such as inhibitory control, shifting and self-monitoring are considered central predictors of emotional regulation and prosocial behaviours, which, in turn, facilitate positive peer interactions and group integration [37]. Importantly, interventions aimed at improving EFs and emotional regulation have been found to significantly enhance social participation and emotional functioning in children with ASD [7]. Other recent contributions suggest that video games can contribute to the development of better emotional regulation and social communication, fundamental skills for children with ASD [73,74]. Consistent with these results, another study [9] demonstrated that an SG intervention for children with ADHD significantly enhanced not only WM but also a set of social skills, thus supporting better social functioning in daily life. Martin-Moratinos and colleagues [65] found significant improvements in WM, inhibitory control and organisational skills in children with ADHD after SG training. While direct effects on social competencies were not measured, the authors found improvements also in emotional regulation, which, paired with the aforementioned EFs, can facilitate positive peer relationships.

Collectively, these findings suggest that targeting WM and EFs may be a valuable strategy for promoting social competence and, in turn, facilitating peer inclusion.

At a second level, video games contribute to making learning environments more inclusive and favourable for children and adolescents with neurodevelopmental disorders [75]. Indeed, achieving meaningful inclusion requires accessible, usable technological tools and adaptive learning contexts. The integration of digital technologies, including video games, can play a crucial role in advancing this goal [76]. Owing to their adaptability to individual performance and player-specific characteristics, video games can offer highly individualised learning experiences. This is evident in studies that employed adaptive video game training designed specifically for neurotypical developmental populations [54,59,65,66,69], thus ensuring accessibility and participation [77]. By enabling the customisation of learning tasks and trajectories, video games can improve both cognitive and learning outcomes and support a more effective and inclusive educational experience [78,79].

At a third level, numerous studies have characterised video games as tools capable of supporting children with various challenges by fostering engagement without reinforcing stigmatising differences [80,81]. Notably, VR and structured digital play environments offer motivating, adaptable settings that promote individual strengths while minimising frustration [58,82]. SGs, in particular, stand out for their capacity to engage children with ADHD more effectively than traditional training approaches [9], while AR-based interactions may enhance engagement in children with ASD by providing self-paced and low-stress environments [8]. In this regard, Di Giusto et al. [58] emphasised that VR-based games enable the development of generalisable skills transferable beyond the classroom, within safe and motivating environments. Such evidence supports the broader implementation of video games as valuable tools in inclusive education and cognitive development for children with neurodevelopmental disorders.

Based on this evidence and reflections, we argue that the flexible and adaptive nature of video games can facilitate their integration into diverse contexts, offering inclusive experiences that emphasise individual potential rather than limitations.

To conclude, despite the encouraging results, the methodological limitations of the scrutinised studies must be considered. Many of them involved small or pilot samples, reducing statistical power and limiting generalisability. In some cases, the absence of a long-term follow-up restricts conclusions about the stability of effects over time. Additionally, the heterogeneity of the assessment tools, ranging from standardised neuropsychological tasks to subjective ratings by parents or teachers, may have introduced a bias. Last, variations in training protocols, particularly in timing and intensity, do not allow a direct comparison across studies. Future research should aim for experimental designs with larger samples, standardised evaluation tools, and longitudinal follow-ups to strengthen evidence and support a broader application of the findings.

5. Conclusions

The findings of this review emphasise how video games can serve as inclusive tools for enhancing WM and EFs in children with neurodevelopmental disorders. A deeper analysis suggests that SGs and ad hoc training show significant improvements in WM, while ExGs yield consistent improvements in inhibition and shifting in ADHD and ASD populations. AVGs have more variable effects, with some impact found on shifting, but limited evidence on other EFs. These distinctions are important to justify the alignment of game genre and design with the targeted cognitive skills.

Notably, while video games are intrinsically engaging, their adaptability depends on specific elements, such as task structure, feedback mechanisms and the modality of interaction, which must be aligned with the cognitive and emotional profile of neurodivergent learners to maximise their effectiveness.

In light of this, practical recommendations can be made about the use of video games in educational and rehabilitative contexts. First, video games cannot have educational value if used with a one-size-fits-all approach. Conversely, they have to be selected and customised based on scientific principles and the specific needs of the learner. Second, video games should be integrated into structured educational environments and matched with formal training for teachers and operators. Directly connected to this, educational policies should focus on promoting technological inclusion and reducing the digital divide, also acknowledging video games as innovative educational tools.

By only taking into account all these recommendations, it will be possible to unlock the multiple ways in which video games make education inclusive for neurodivergent learners by offering meaningful, customisable and motivating learning experiences.

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Abbreviations

The following abbreviations are used in this manuscript:

ADHD	Attention Deficit and Hyperactivity Disorder
ASD	Autism Spectrum Disorder
AR	Augmented Reality
AVG(s)	Action-Video Game(s)
BRIEF(2)	Behavioral Rating Inventory of Executive Functions (Version 2)
EFs	Executive Functions

ExG(s)	Exergame(s)
HBSC	Health Behaviour in School-aged Children study
SG(s)	Serious Game(s)
SLDS	Specific Learning Disorder
UDL	Universal Design for Learning
VR	Virtual Reality
WM	Working Memory

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