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Digital games and musical mediation to foster engagement also among learners with ASD. A systematic review

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Abstract. Digital games are increasingly used in education, but their value depends on alignment with learner characteristics, pedagogical aims and contextual conditions. This is particularly relevant for autistic learners, whose heterogeneous sensory, cognitive and communicative profiles require accessible and adaptable environments. Music, sound and rhythm may support attention, sensorimotor coordination and interaction, but may also cause sensory overload. This systematic scoping review examines how musical mediation is integrated into digital games for autistic learners and how emotional, behavioural and cognitive engagement is conceptualised. Following PRISMA-ScR, the literature was analysed through descriptive synthesis and comparative mapping. Findings highlight the need to distinguish enjoyment and participation from cognitive engagement and identify accessibility, customisation, sensory responsiveness and pedagogical intentionality as recurring design considerations for supporting learning and inclusion.

Keywords. Engagement; Videogame; Music; ASD; inclusion.

1. Introduction[1]

During the last decades, the strategic adoption of digital game-based learning has encouraged research on its educational use to support teaching and learning (Prensky, 2001). Serious games and edugames organise goals, feedback, repetition, challenge and learner choice; their value depends on design features, learner variability, curricular purposes and pedagogical mediation (Bonaiuti & Bruni, 2014). This is relevant when engagement is considered an outcome, since participation or enjoyment does not necessarily imply cognitive investment or transfer (Ben-Eliyahu et al., 2018; Fredricks et al., 2004; Hookham & Nesbitt, 2019). For autistic learners, sensory and cognitive heterogeneity complicates this issue. Predictability and repetition may support participation, whereas excessive auditory or visual stimulation and poorly calibrated feedback may generate discomfort or disengagement. Music and sound should therefore be considered educational mediators rather than universally beneficial stimuli. Rhythm may structure temporal expectation and sensorimotor coordination, while auditory feedback can make action and progress perceptible; however, intensity, repetition and user control

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should remain adaptable variables (Jones & Boltz, 1989; LaGasse et al., 2024; Marquez-Garcia et al., 2022; Robertson & Simmons, 2015). Technology-mediated musical experiences include sonification, robotic interaction and sound visualisation, although much evidence derives from therapeutic or rehabilitative settings (Cibrian et al., 2021; Feng et al., 2022; McGowan et al., 2021). Educational transfer therefore requires caution regarding curricular objectives and learner choice. The present review distinguishes direct evidence on music-mediated game environments from broader evidence on digital-game design. It examines games incorporating music, sound or rhythm, their relationship with emotional, behavioural and cognitive engagement, and their relevance to inclusive educational practice.

2. Videogame and ASD

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterised by marked heterogeneity in communicative, social, cognitive, behavioural and sensory profiles. Alongside differences in communication and social interaction and the presence of restricted or repetitive behaviours and interests, the literature describes highly variable cognitive configurations involving executive functions, social cognition, emotion processing, language, attention, visuospatial and motor abilities, learning and memory (Rezayi et al., 2023; Tomljenovic, 2025). This variability discourages uniform interpretations of autistic functioning and instead highlights individual profiles in which strengths and difficulties may be unevenly distributed. From an educational perspective, such heterogeneity requires flexible learning environments capable of adapting to different ways of perceiving, processing information, sustaining attention, organising action and participating in activities (Frith, 2025). Accessibility and personalisation therefore become essential conditions for digital games to support meaningful participation. Within this framework, Information and Communication Technologies and digital recreational environments have attracted increasing attention in interventions for autistic learners (Grossard et al., 2017; Talebi et al., 2024). Their educational potential lies partly in the possibility of creating predictable, repeatable and adaptable environments in which stimuli, feedback, task demands and difficulty can be progressively regulated according to the learner's responses (Rezayi et al., 2023). Videogames can also integrate visual information, sound, movement and immediate feedback, providing multisensory and relatively autonomous learning experiences. Their educational value, however, cannot be inferred simply from their capacity to attract and maintain attention. Engagement in serious games and edugames is a multidimensional construct that must be interpreted in relation to educational objectives (Friedricks et al., 2014; Hookham & Nesbitt, 2019; La Manna et al., 2024). Prolonged participation, enjoyment or repeated task completion do not necessarily indicate substantial cognitive investment or transfer to other learning contexts. Engagement therefore includes emotional, behavioural and cognitive dimensions (Ben-Eliyahu et al., 2018; Sugden et al., 2021). Emotional engagement concerns interest, pleasure and motivation, but also anxiety, boredom or frustration; behavioural engagement includes persistence, continuity and observable interaction; cognitive engagement involves sustained attention, mental effort, information

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processing and strategic regulation (Csikszentmihalyi, 2020; Ravaja et al., 2005). Observable behaviour can thus provide only partial evidence of underlying emotional and cognitive processes, since persistence and interest do not automatically imply deep or transferable learning (Boyle et al., 2012; Kniestedt et al., 2022). This multidimensional perspective is particularly relevant for autistic learners because game design may strongly influence participation, especially in the presence of sensory sensitivity. Excessive stimulation may interfere with attention and learning (Zappalà, 2023). Costello and Donovan (2022), in a preliminary study with participants with ASD, identified potentially distressing features such as sudden or loud sounds, flashing images, screen shaking and excessive difficulty, consistent with evidence linking sensory overload to reduced concentration, anger and anxiety (Watson, 2018). For this reason, duration of use, task completion or repetition cannot alone capture engagement. Multimodal assessment approaches increasingly combine observation, questionnaires, game metrics, physiological measures and behavioural data. The Engagnition dataset, for example, integrates expert ratings, gaze fixation, physiological responses, performance, execution time, movement, usability and cognitive load in children with ASD using a serious game (Kim et al., 2024). Similar approaches indicate a broader methodological shift towards analysing engagement through multiple and complementary indicators rather than a single observable variable (Henry et al., 2017). If videogames are used for cognitive or educational purposes, it is therefore insufficient to demonstrate that learners use them willingly or for prolonged periods. It is necessary to examine whether specific design features support attention, information processing, action regulation, strategy development and achievement of educational goals (Griffiths et al., 2013). At the same time, cognitive engagement cannot be separated from the emotional and behavioural conditions that make participation possible. Effective design requires a balance between accessibility, predictability and learner control on the one hand, and challenge, feedback, choice and progressive complexity on the other (Pittas et al., 2025). Engagement should consequently be understood not as an intrinsic property of the game but as the dynamic result of the interaction between game characteristics, learner profiles and preferences, educational objectives and forms of mediation (Hookham & Nesbitt, 2019; La Manna et al., 2024). This perspective becomes particularly relevant when considering multisensory mediation. In digital games, music, sound and rhythm can constitute structural elements of the experience rather than simple background features (Polus, 2021). Sound feedback, rhythmic regularity and audiovisual synchronisation may support attention, temporal organisation and participation, but sensory variability in ASD prevents these elements from being considered universally facilitating (Johnston, 2020). Intensity, frequency, complexity, repetition and control over sound therefore become genuine pedagogical and design variables. The central question is consequently not whether music makes a game more engaging, but through which mechanisms and under what conditions musical mediation can support the emotional, behavioural and cognitive dimensions of engagement in autistic learners.

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3. Music as an inclusive didactic mediator for learners with ASD

Music may be conceptualised as an inclusive didactic mediator insofar as it creates a multimodal field of participation in which sound, rhythm, movement, gesture, voice and bodily presence become interconnected pathways through which learners with autism spectrum disorder may access knowledge, communicate intentionality and participate in shared educational experiences. Its pedagogical value does not lie merely in attracting attention or providing pleasant accompaniment, but in reorganising the conditions under which participation becomes possible, particularly when classroom interaction relies predominantly on spoken language, rapid social interpretation and uniform response modes. Music can provide temporal regularity, perceptual coherence and predictable sequences while also allowing variation, improvisation and personal initiative. Early scholarship already suggested that music may connect nonverbal expression with linguistic communication, although this should not imply homogeneous musical abilities or responses among autistic learners (Darrow & Armstrong, 1999). Rather, music expands the semiotic resources available in the classroom through vocalisation, rhythmic movement, instrumental exploration, listening, imitation, turn taking and collective sound production. Research in early childhood settings indicates that familiar songs may support transitions, attention and understanding of daily routines, while songwriting and music stations can integrate literacy, communication, problem solving and peer interaction within structured but flexible activities (Vaiouli & Ogle, 2015). Their relevance lies in positioning the learner as an active participant whose gestures, preferences and initiatives can influence the activity. Interactive music making may therefore support shared attention, reciprocal action and social proximity while permitting different levels of verbal, motor and social involvement. Educators also perceive music as a valuable resource for emotional expression, relationships, connectedness and belonging, although a gap often persists between positive attitudes and the ability to implement differentiated musical strategies (Archontopoulou & Vaiouli, 2020). Music does not therefore become inclusive through its mere presence. Its mediating function depends on teachers' capacity to interpret individual responses, regulate auditory intensity and duration, select accessible instruments, differentiate tasks and provide multiple forms of meaningful contribution. Sensory responsiveness is particularly important, since sound may facilitate participation for one learner while causing discomfort or overload for another. Inclusive mediation may consequently require adjustments in volume, tempo, timbre, spatial organisation and verbal density, as well as opportunities to observe, pause or enter the activity gradually. Imitation similarly requires flexible pedagogical use. Although general music education frequently relies on vocal, rhythmic and motor modelling, learners with ASD may respond differently to expectations of reproducing teachers' or peers' actions. Instruction may become more accessible when imitation is divided into intelligible units, supported by visual and auditory cues and linked to learners' interests. Reciprocal imitation, in which adults or peers reproduce the learner's sounds or movements, can also recognise their contribution as meaningful and shift musical interaction from correction towards dialogue and co-construction (Scott, 2016). This relational perspective is

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supported by action research showing a transition from using music primarily to teach isolated skills towards recognising it as a meaningful component of interpersonal encounters (McFerran et al., 2016). Musical action may therefore contribute not only to behavioural outcomes but also to educational relationships, expressive identity and reciprocity. Evidence from inclusive music settings further shows that autistic learners can participate in general music, choirs and instrumental programmes alongside peers, assuming meaningful roles and pursuing curricular learning rather than being included solely for therapeutic purposes (Draper, 2022). Such evidence supports a strength-oriented approach in which support is embedded within musical learning, cultural participation and learner agency. Physical presence in a mainstream music classroom, however, cannot be equated with substantive inclusion. Recent literature indicates that inclusion is often still implemented mainly as integration, whereas more developed practices are associated with student-centred pedagogy, peer interaction, collaboration, co-teaching and varied instructional approaches (Mommo et al., 2025). Music as a didactic mediator must therefore be embedded within a broader ecology of accessibility, professional collaboration and pedagogical responsibility. Teacher education is consequently a central condition of inclusive musical mediation. Greater confidence in teaching learners with ASD has been associated with stronger preparation in special education and more frequent collaboration with other professionals, together with the use of individual adaptations, curricular modifications and universal strategies (Brown et al., 2023). Educators should therefore have opportunities to experience active music making, analyse sensory and communicative barriers, practise differentiated instruction and collaborate with special educators and music therapists. Within such a framework, music can become a shared pedagogical language through which learners with ASD are not merely accommodated within an unchanged activity but can actively shape its rhythms, relationships and expressive possibilities, contributing to an educational environment in which difference becomes a generative dimension of collective learning.

4. Methodology

4.1. Review design and methodological orientation

The study was designed as a systematic scoping review because it aimed to map the extent, characteristics and conceptual organisation of a heterogeneous evidence base rather than estimate a single intervention effect. This approach is appropriate when studies differ in populations, technologies, outcomes and methodologies and when concepts must first be clarified before narrower effectiveness questions can be addressed (Arksey & O'Malley, 2005; Levac et al., 2010; Peters et al., 2020). Reporting followed PRISMA-ScR guidance (Tricco et al., 2018). The methodology combined numerical description with qualitative interpretation. Counts were used for study selection, design distribution and engagement dimensions, while inferential statistics were reported only as presented in the original studies. Narrative and thematic synthesis was preferred because pooling findings from heterogeneous

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empirical studies and systematic reviews would have produced a misleading summary.

4.2. Review questions, evidence corpus and PCC framework

No participants were recruited directly, as the unit of evidence was the publication. Seven studies entered the qualitative synthesis, while four formed the analytical focal subset because they provided detailed data on engagement, auditory or musical mediation, participants, procedures and outcomes. These studies were compared in Table 2, whereas the remaining studies contributed only to broader qualitative mapping. Review-level counts and primary participant samples were not aggregated to avoid double counting and false comparability. Eligibility followed the Population, Concept and Context framework for scoping reviews. Studies involved autistic participants and examined digital games or interactive environments in which music, sound or rhythm played a meaningful role. Educational, rehabilitative and therapeutic contexts were included when relevant to engagement or inclusive design. Direct music-mediated interventions were distinguished from broader contextual evidence on game design, motivation, feedback and attention.

4.3. Information sources, search strategy and time frame

The review covered publications from May 2020 to July 2026 to capture recent developments in digital games, immersive environments and technology-mediated musical practices. Searches were conducted in Scopus, Web of Science, ERIC, PsycINFO, PubMed, ACM Digital Library, IEEE Xplore and Google Scholar, with supplementary searching through APA PsycNet, targeted journals and related-record checking. The base strategy combined three concept families: ("ASD" OR "Autism" OR "Autistic") AND ("EDUGAME" OR "VIDEOGAME" OR "SOUNDSCAPES") AND ("Music" OR "Sound"), with syntax adapted to each database. Google Scholar and targeted searches increased sensitivity in a field characterised by inconsistent terminology. The PRISMA flow recorded 914 database records and 679 additional records, for a total of 1,593 before duplicate removal.

4.4. Screening phases and study selection

Study selection followed the manually updated PRISMA flow. Of 1,593 records identified, 914 came from database searches and 679 from other sources. After removing 10 duplicates, 1,583 records were screened; 1,554 were excluded at title/abstract stage and 29 underwent full-text assessment. Seven studies entered the qualitative synthesis, while four formed the quantitatively informative subset used for structured descriptive comparison rather than meta-analysis. Screening prioritised sensitivity initially and specificity at full-text stage, allowing potentially relevant records to be retained until the conceptual intersection among autism, digital games, auditory or musical components and engagement could be confirmed. Records lacking this intersection were excluded from the final synthesis. When a

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preprint had been peer reviewed before the July 2026 cut-off, the published version was used as the citable record, including the 2026 rhythmic training study.

4.5. Data-charting instrument and data collection

Data collection was organised through a structured charting matrix informed by scoping-review guidance and previous work on engagement and edugames (Peters et al., 2020). Seven studies entered the qualitative synthesis, while the most detailed extraction concerned the four quantitatively informative studies. The matrix recorded bibliographic and methodological characteristics, sample, setting, digital platform, intervention duration, function of music or sound, engagement indicators, outcome measures, statistical and qualitative findings, purposes, limitations and implications for inclusive practice. Engagement was operationalised across three dimensions. Emotional engagement included enjoyment, motivation, affective responses and acceptability; behavioural engagement included adherence, retention, time on task, persistence and interaction patterns; cognitive engagement included attention, executive functioning, strategic adaptation, rule processing and sensorimotor coordination requiring temporal prediction. Coding reflected the strongest relation between each measure and the framework rather than implying complete measurement of a dimension. Musical mediation was charted separately by distinguishing rhythm as temporal target, sound as exposure material, auditory feedback, motivational ambience and configurable sensory feature. This distinction avoided treating all uses of music as equivalent and supported more precise educational interpretation.

4.6. Data analysis and synthesis

The analytical procedure combined descriptive mapping, within-study interpretation and cross-study thematic synthesis. The seven studies retained in the qualitative synthesis were classified by design, type of musical or auditory mediation, population, setting and engagement dimension. A more detailed comparison was conducted on the four studies providing sufficiently explicit quantitative or mixed evidence. Primary studies were analysed through their participants, procedures and measures, whereas systematic reviews were treated as evidence syntheses rather than as independent samples. The narrative synthesis focused on four domains: how engagement was operationalised across emotional, behavioural and cognitive dimensions; the role of music, sound and rhythm within the game; design features supporting engagement, such as predictability, feedback, user choice and sensory customisation; and the potential transfer of findings to inclusive educational settings. Claims were retained only when traceable to included studies, while broader implications were framed as research propositions. No meta-analysis was conducted because methodological and conceptual heterogeneity prevented valid statistical pooling. The four focal studies therefore formed a structured quantitative/descriptive synthesis, with numerical findings interpreted within their original designs. Statistical results were reported only as properties of the source studies and considered alongside sample size, design and measurement limitations.

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4.7. Methodological safeguards and interpretive cautions

Several safeguards were adopted to limit overinterpretation. The review distinguishes direct music-mediated evidence from contextual game-design evidence and does not infer engagement from use or enjoyment alone. Cognitive engagement was coded only when measures were plausibly related to attention, executive processes, strategy, learning or regulation. Findings from home-based or therapeutic settings were not treated as evidence of classroom effectiveness, and educational implications were framed as inferential. Formal risk-of-bias scoring was not used because of the heterogeneity of study designs, but methodological quality was considered through sample size, comparators, duration, measurement sources, follow-up, self-report, missing data and generalisability. The screening audit documented selection decisions but did not allow calculation of inter-rater reliability. The manually entered PRISMA diagram was therefore used as the authoritative source for the numerical study flow.

5. Results

5.1. Search outcome and composition of the final corpus

The PRISMA flow retained seven studies in the qualitative synthesis, four of which formed the structured quantitative/descriptive subset examined in greatest detail. Published between 2023 and 2026, these included two empirical studies with autistic children and two systematic reviews. The empirical studies examined a tablet-based rhythmic serious game and a virtual reality intervention using voluntary exposure to problematic sounds, while the reviews addressed digital games for cognitive rehabilitation and related design features. The reduction from 1,593 records to seven included studies, and subsequently to four quantitatively informative studies, reflects the narrow intersection between music, autism, digital technology and multidimensional engagement. The evidence therefore appears more useful for identifying mechanisms, design conditions and methodological gaps than for supporting generalized claims of efficacy (T).

5.2. Emotional engagement and the limits of enjoyment as evidence

Emotional engagement was highly visible across the direct interventions but also prone to overinterpretation. In the rhythmic trial, enjoyment and perceived difficulty were similar in the intervention and control conditions, despite differential gains in rhythmic performance, suggesting that educational value should not be equated with greater enjoyment (Jamey et al., 2026). In SoundFields, five of seven completers reported reduced negative responses to target sounds, although changes varied and parent reports did not always match self-reports. Participants described the experience as enjoyable, but attention difficulties and headset discomfort were also noted, indicating that emotional engagement may include both positive and negative

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responses (Parkinson et al., 2023). The reviews similarly identify motivation, rewards and narratives as relevant design features, while cautioning against assuming that digital games are inherently motivating or effective (Rezayi et al., 2023; Rezayi et al., 2025).

5.3. Behavioural engagement as adherence, interaction and regulated participation

Behavioural engagement was most clearly documented through logged interaction. In the rhythmic trial, reports and device logs showed high adherence to the 300-minute target, while greater play time was associated with improved beat tracking within the rhythmic condition, although the small sample requires caution (Jamey et al., 2026). SoundFields offered a complementary model by making exposure-based participation voluntary. All completers used these mechanisms, but intensity varied and some reduced exposure over time, showing that engagement should not be equated with compliance at a fixed intensity. In sensory-sensitive populations, self-regulation may itself support access and agency (Parkinson et al., 2023). Broader reviews identify goal clarity, rewards, graded complexity and user choice as factors supporting persistence, while short interventions and heterogeneous measures limit conclusions about durable participation (Rezayi et al., 2023; Rezayi et al., 2025).

5.4. Cognitive engagement and the role of rhythm, attention and feedback

The strongest evidence for cognitive engagement emerged from the rhythmic training study, in which participants synchronised finger taps with musical beats while responding to visual targets. The active control retained music and motor demands but removed rhythmic synchronisation, allowing the specific contribution of rhythmic coupling to be examined. Improvements were reported in rhythmic skills and some executive-function measures, although effects were not consistent across all tasks, suggesting caution in claiming broad cognitive transfer (Jamey et al., 2026). SoundFields provided more limited cognitive evidence, as it involved attention, choice and rule understanding but did not directly assess learning or executive functioning (Parkinson et al., 2023). The two reviews identify attention, executive functions, learning and memory as recurrent targets and highlight progressive challenge, feedback, cues and user choice as potentially supportive of cognitive engagement. However, theoretically relevant design features should remain distinguished from direct measures of cognitive engagement (Rezayi et al., 2023; Rezayi et al., 2025).

6. Discussion

The mapping conducted in this review suggests that musical and auditory mediation in digital games for autistic learners should not be regarded as decorative, but as a potentially regulatory component whose educational value depends on how it structures temporal expectation, sensory experience, feedback, and learner control. The two direct empirical studies illustrate different mechanisms. Rhythmic training

uses music as an external temporal structure supporting sensorimotor coordination and executive processes, whereas SoundFields places sound at the centre of graded and voluntary interaction, addressing affective and behavioural responses to auditory stimuli (Jamey et al., 2026; Parkinson et al., 2023). The rhythmic study is informative because its comparison condition retained music, gameplay, and similar auditory-motor demands while removing beat synchronisation. This highlights the need to identify which game elements are expected to produce particular outcomes. A game may sustain participation without necessarily producing stronger emotional or cognitive effects, in line with a multidimensional conception of engagement in which emotional, behavioural, and cognitive components are related but not interchangeable (Ben-Eliyahu et al., 2018; Fredricks et al., 2004). The virtual reality study extends this perspective to sensory agency. SoundFields allows learners to select sounds, regulate intensity or distance, interrupt interaction, and return to the activity. In inclusive education, such customisation can be understood as a pedagogical resource for responding to individual sensory profiles (Parkinson et al., 2023). The systematic reviews situate these interventions within a wider field of digital games targeting executive functioning, social cognition, attention, learning, memory, and language, and identify recurring features such as progressive complexity, user choice, rewards, feedback, and auditory and visual cues (Rezayi et al., 2023; Rezayi et al., 2025). These features map onto the engagement framework adopted here: complexity may support cognitive engagement, rewards may influence emotional investment, while choice and clear feedback may sustain behavioural participation and autonomy. Calm auditory material and interpretable sensory cues further position sound design as an accessibility consideration. Across the studies, rhythm and sound emerge as active components of participation rather than passive background features. Their relevance lies not simply in whether a game is engaging, but in which dimension of engagement is activated, through which mechanism, and for which educational purpose. Engagement can thus be understood as a situated process arising from the interaction among learner characteristics, task demands, game mechanics, and pedagogical aims. This perspective has direct implications for inclusive education. Enthusiasm alone does not ensure meaningful participation if challenge, feedback, and strategy are disconnected from learning objectives. For autistic learners, sensory variables such as volume, timbre, rhythmic density, spatialised sound, visual complexity, and response mode should be conceived as adjustable parameters. Likewise, observing before acting, reducing stimulus intensity, pausing interaction, or choosing alternative response modalities can represent legitimate forms of participation. Music and sound may therefore function as inclusive didactic mediators capable of structuring interaction, regulating sensory experience, orienting attention, and providing feedback. Their educational value depends on a pedagogical design that considers accessibility, learner agency, and instructional purpose together. Future research should examine these mechanisms in authentic educational settings, particularly classroom mediation, curricular integration, collaborative participation, and the coexistence of individual sensory regulation with shared learning experiences.

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7. Methodological cautions and limitations

The review has several limitations that should be considered when interpreting its findings. Seven studies were included in the qualitative synthesis, while four formed the structured quantitative/descriptive subset. The coexistence of primary studies and systematic reviews creates some asymmetry, since review-level findings cannot be treated as independent participant data and may include overlapping studies. For this reason, no aggregated participant totals, pooled percentages or meta-analytic estimates were calculated. The restriction to publications from May 2020 to July 2026 increases the contemporaneity of the evidence but may exclude earlier relevant interventions, while the inclusion of accessible English- and Italian-language studies may introduce language and access bias. Terminological heterogeneity across serious games, digital interventions, virtual environments, sonification and sound-based technologies may also have limited retrieval despite supplementary searching. The marked reduction from 1,593 records to seven included studies reflects both the breadth of the initial search and the specificity of the conceptual focus. The engagement framework also requires caution, as emotional, behavioural and cognitive dimensions are closely interconnected. Outcomes such as sensorimotor synchronisation, executive functioning or reduced auditory distress should therefore be interpreted as possible mechanisms supporting participation rather than direct measures of educational engagement. Finally, no formal risk-of-bias scale or inter-rater reliability coefficient was applied. Future reviews should prospectively register protocols, adopt independent duplicate screening, report agreement statistics and use design-specific critical appraisal tools.

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Appendix:

Table 1. PCC framework and eligibility criteria

PCC element	**Inclusion criteria**	**Exclusion criteria**
Population	Autistic people or participants diagnosed with ASD, with priority given to children, adolescents and school-age learners.	Studies without an ASD population or without extractable ASD-specific evidence.
Concept	Digital games, video games, serious games, edugames or interactive virtual environments involving music, sound, rhythm or auditory features with relevance to engagement, learning, participation or rehabilitation.	Non-digital games; technology not used as an interactive game or virtual environment; auditory material unrelated to the intervention or to engagement-relevant design.
Context	Educational, school, home-based, clinical, therapeutic or rehabilitative settings where findings could inform participation or inclusive educational design.	Contexts with no interpretable relation to participation, learning, engagement or rehabilitation.
Publication characteristics	Accessible peer-reviewed publications in English or Italian from May 2020 to July 2026. Empirical quantitative, qualitative or mixed-methods studies and evidence syntheses were eligible when they directly informed the review questions.	Grey literature, conference proceedings, theses, dissertations, books, inaccessible full texts, publications outside the date window and publications in other languages.

Figure 1. PRISMA-ScR flow diagram based on the manually updated screening audit.

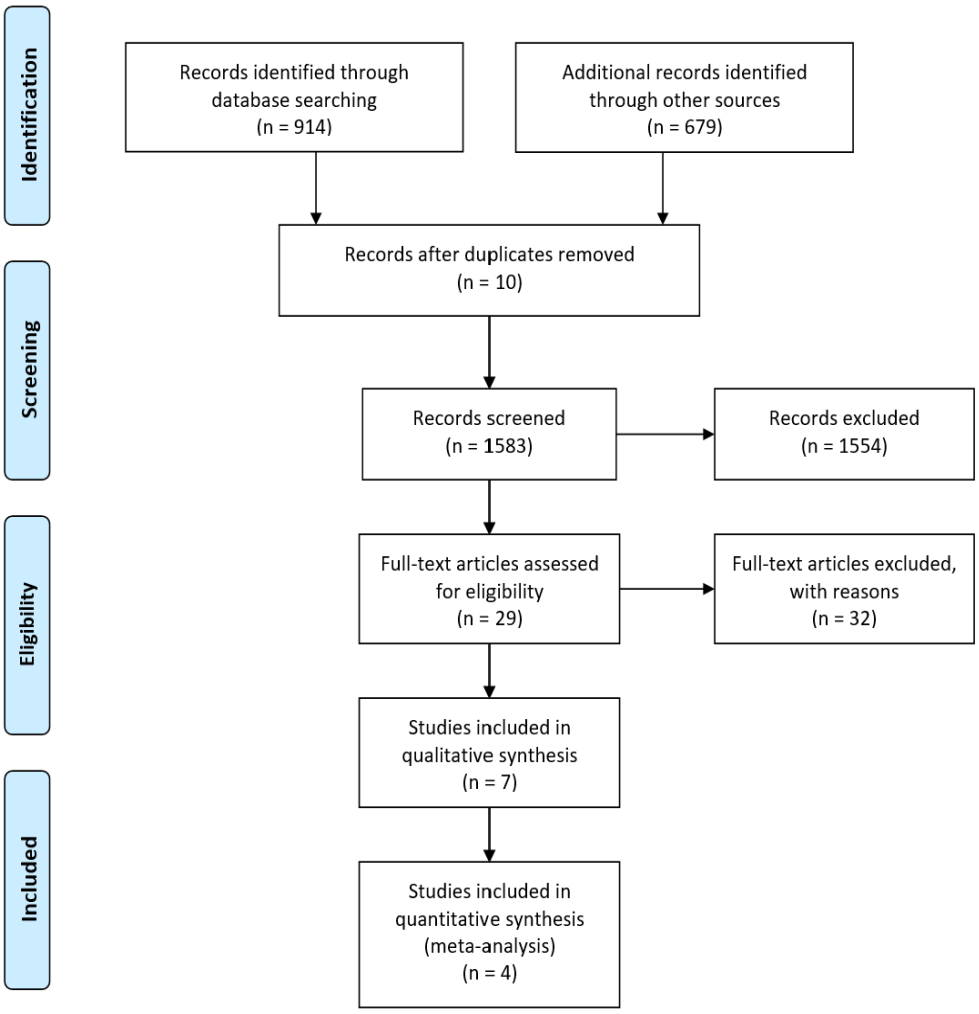


Table 2. Characteristics and findings of the four studies entering the structured quantitative/descriptive synthesis

Study	Design and population	Game and musical or auditory mediation	Engagement evidence	Principal findings and cautions
Jamey, K., Laflamme, H., Foster, N. E. V., Rigoulot, S., Hyde, K. L., & Dalla Bella, S. (2025). Enhancing sensorimotor and executive functioning in autistic children with a rhythmic videogame: A pilot study [Preprint]. Research Square. https://doi.org/10.21203/rs.3.rs-5790839/v1	Randomized proof-of-concept study. Autistic children aged 7-13 years, n = 26, with 13 participants in each condition. Two-week home-based protocol.	Rhythm Workers on tablet. Finger tapping synchronised to musical beats, graded rhythmic complexity, moving visual targets and real-time performance feedback. Active control used comparable music and motor demands without rhythmic synchronisation.	Emotional evidence through enjoyment and perceived difficulty. Behavioural evidence through retention, adherence, training duration and device logs. Cognitive evidence through rhythmic skills and executive-function measures.	High retention and adherence with similar enjoyment across conditions. Rhythmic training produced greater improvements in rhythmic skills, with improvement related to training duration and autistic traits. Executive-function gains were observed at composite level, although not all task components were significant. Small sample and proof-of-concept scope limit generalisation.

Study	Design and population	Game and musical or auditory mediation	Engagement evidence	Principal findings and cautions
Parkinson, S., Schumann, S., Taylor, A., Fenton, C., Kearney, G., Garside, M., & Johnston, D. (2023). SoundFields: A virtual reality home-based intervention for auditory hypersensitivity experienced by autistic children. Applied Sciences, 13(11), 6783. https://doi.org/10.3390/app13116783	Longitudinal feasibility study. Nine autistic children recruited and seven completed, ages 8-13 years. Ten-week home-based protocol with approximately 30 minutes of weekly use.	SoundFields in consumer virtual reality. Binaural spatial audio embedded problematic sounds within four voluntary exposure mini-games. Reward mechanics, user-selected target sounds and graded virtual distance shaped exposure.	Emotional evidence through self-reported emotional response and participant or parent feedback. Behavioural evidence through tracked voluntary interaction time and exposure levels. Cognitive engagement was not measured through a learning or executive-function instrument.	Negative emotional responses to target sounds decreased for five of seven completers. All participants interacted voluntarily with exposure mechanics, but interaction amount and exposure choices varied. Qualitative reports suggested improved real-world tolerance for some participants. Small sample, self-report, parent-report divergence and flexible exposure undermine causal certainty.

Study	Design and population	Game and musical or auditory mediation	Engagement evidence	Principal findings and cautions
Rezayi, S., Shahmoradi, L., & Tehrani-Doost, M. (2025). Systematic review and thematic analysis of digital games for cognitive enhancement in children with autism spectrum disorder: Toward a conceptual framework. Cognitive Computation, 17, Article 60. https://doi.org/10.1007/s12559-024-10395-w	Systematic review of 28 studies on computerized game-based cognitive interventions for autistic children. Fifteen studies used a control group and 13 evaluated an experimental group only.	Computer and digital cognitive games across multiple platforms. Music was not a universal intervention component, but auditory cues and game-based motivational features were present within the broader design space.	Engagement was usually indirect. Behavioural persistence and motivation were discussed as advantages of game formats, while cognitive outcomes covered executive functions, social cognition, attention, learning, memory and language.	Seventeen studies reported positive effects on all evaluation scales and additional studies reported partial or non-statistical positive outcomes. Social cognition and emotion outcomes were prominent. Common limitations included small samples, short interventions or follow-up, heterogeneous populations, limited controls and restricted generalisability.

Study	Design and population	Game and musical or auditory mediation	Engagement evidence	Principal findings and cautions
Rezayi, S., Tehrani-Doost, M., & Shahmoradi, L. (2023). Features and effects of computer-based games on cognitive impairments in children with autism spectrum disorder: An evidence-based systematic literature review. BMC Psychiatry, 23, Article 2. https://doi.org/10.1186/s12888-022-04501-1	Systematic review and thematic analysis of 34 digital-game studies for cognitive enhancement in autistic children, integrating design analysis with expert-informed thematic work.	Digital games across PC, mobile, tablet, virtual and augmented environments. Relevant design elements included auditory and visual cues, calm melodies, narratives, rewards, progressive complexity, customisable choices and child-therapist-parent interaction.	Emotional engagement was connected to motivation, enjoyment and frustration avoidance. Behavioural engagement was connected to continued use, task completion and interaction. Cognitive engagement was represented through targeted skills, attention, social cognition, learning and language outcomes.	Twenty-five studies reported positive effects in real autistic participants and nine involved usability evaluation only. The synthesis emphasised user-centred design, appropriate feedback, achievable challenge and autonomy. The review also identified small samples, methodological variability, selection issues and cultural bias as constraints.

Table 3. Mapping of engagement dimensions in the four-study analytical subset

Study	Emotional engagement	Behavioural engagement	Cognitive engagement	Evidence status
Jamey, K., Laflamme, H., Foster, N. E. V., Rigoulot, S., Hyde, K. L., & Dalla Bella, S. (2025). Enhancing sensorimotor and executive functioning in autistic children with a rhythmic videogame: A pilot study [Preprint]. Research Square. https://doi.org/10.21203/rs.3.rs-5790839/v1	Directly measured through enjoyment and perceived difficulty.	Directly measured through retention, adherence, training duration and device logging.	Directly assessed through rhythmic performance and executive-function tasks.	Direct core evidence

Study	Emotional engagement	Behavioural engagement	Cognitive engagement	Evidence status
Parkinson, S., Schumann, S., Taylor, A., Fenton, C., Kearney, G., Garside, M., & Johnston, D. (2023). SoundFields: A virtual reality home-based intervention for auditory hypersensitivity experienced by autistic children. Applied Sciences, 13(11), 6783. https://doi.org/10.3390/app13116783	Directly measured through emotional-response ratings and qualitative feedback.	Directly measured through voluntary interaction time and exposure-level logs.	Indirect evidence through game choice and attention, without a dedicated cognitive-engagement measure.	Direct core evidence
Rezayi, S., Shahmoradi, L., & Tehrani-Doost, M. (2025). Systematic review and thematic analysis of digital games for cognitive enhancement in children with autism spectrum disorder: Toward a conceptual framework. Cognitive Computation, 17, Article 60. https://doi.org/10.1007/s12559-024-10395-w	Indirectly represented through motivation, anxiety and social-emotional outcomes across reviewed interventions.	Indirectly represented through participation, game use and intervention completion.	Extensively represented through cognitive outcome domains across 28 studies.	Contextual synthesis evidence
Rezayi, S., Tehrani-Doost, M., & Shahmoradi, L. (2023). Features and effects of computer-based games on cognitive impairments in children with autism spectrum disorder: An evidence-based systematic literature review. BMC Psychiatry, 23, Article 2. https://doi.org/10.1186/s12888-022-04501-1	Represented through motivation, enjoyment, reward and frustration-related design principles.	Represented through interaction, continued use, task goals and usability.	Represented through targeted cognitive skills, attention, learning and design mechanisms supporting processing.	Contextual synthesis evidence

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