Effects of Dopamine-Enhancing Activities on JHS Students with ASD: A Scoping Review

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ABSTRACT

This scoping review looks at two different phenomena: the role of autism and dopamine-enhancing activities on the processes of speech learning and acquiring a new language for junior high school students with Autism Spectrum Disorder (ASD). It analyzes the effects of physical activities, game-like interactions, and musical activities on speech sound production, vocabulary acquisition, and social interaction. The results support the hypothesis that dopamine stimulation enhances engagement, focus, and memory retention, which highlights its relevance in language learning interventions. This review also explores real-world classroom applications of these activities, ethical considerations of genetic profiling, and socio-economic barriers to implementation. Also, it emphasizes the need for longitudinal studies to assess the sustained impact of these interventions on ASD students' cognitive and social development. It documented technological innovations and genome-wide association studies in personalized education, pinpointing the study design's weaknesses and lack of external validity. Studies to come should focus more on addressing the ASD educational problem with longitudinal studies and interdisciplinary approaches.

Keywords: dopamine-enhancing activities, autism spectrum disorder, language acquisition

INTRODUCTION

Language development in individuals with autism spectrum disorder (ASD) is often described by challenges in social communication, speech articulation, and vocabulary acquisition (Minolin, et. al, 2022). Recent studies emphasize dopamine's vital role in motivation, reward processing, and cognitive learning, influencing engagement, attention, and memory retention. Ferreri, et. al (2021) state that activities that stimulate dopamine release—such as musical experiences, physical movement, and gamified incentives—show promise in enhancing educational outcomes across various populations.

However, several dopamine-enhancing activity studies have been conducted in an environment that is controlled rather than in real-world classrooms, which raises concerns about external validity. This review seeks to bridge the gap by incorporating research on classroom-based interventions and teacher-reported strategies.

This study examines the effects of dopamine-enhancing activities on language acquisition among junior high school students with ASD, concentrating on phonetic articulation, vocabulary growth, and social-communicative skills. Particularly, it investigates whether these activities improve overall learning results and explores how movement-based learning strategies affect engagement, attentional focus, and memory retention. Additionally, the study assesses the effectiveness of gamified language learning in boosting motivation and task engagement. It also evaluates the extent to which dopamine-enhancing activities help students with ASD achieve the content and performance standards in Grade 7 English.

Moreover, this scoping review expands the discussion on ethical concerns, particularly concerning genetic profiling in education, privacy considerations, and potential biases in personalized learning. Also, it addresses socio-economic barriers that may hamper the implementation of dopamine-enhancing interventions in

underfunded schools and marginalized communities.

Objectives

1. To map the existing literature on dopamine-enhancing activities and their effects on language learning among students with ASD.
2. To identify knowledge gaps and areas for future research in the field of dopamine modulation and educational interventions for ASD.
3. To explore the theoretical frameworks and methodologies used in studying dopamine-enhancing activities and language development in ASD.
4. To integrate real-world classroom applications and examine how teachers implement dopamine-enhancing activities in educational settings.
5. To analyze the ethical concerns associated with genetic profiling in education and its implications for inclusive learning.
6. To assess the socio-economic barriers affecting the implementation of dopamine-enhancing strategies, particularly in resource-limited schools.
7. To inform future longitudinal research on the sustained impact of dopamine-enhancing activities on ASD students' cognitive and social development.

METHODOLOGY

This scoping review is guided by the framework posited by Arksey and O'Malley (2005) and the enhancements made by Levac et al. (2010) of the said framework.

Five-stage framework for conducting a scoping review:

1. Identifying the Research Question

Clearly define the scope and focus of the review and emphasize the importance of clarifying the research question with clear objectives and defined population, concept, and context. The general question this study tried to answer is "How do dopamine-enhancing activities impact language learning outcomes in Junior High School students with ASD?"

2. Identifying Relevant Studies

Conduct a comprehensive search across multiple databases and sources. This scoping review used internet databases like Google scholar, ResearchGate, and online databases to identify related articles. It also used research related applications like Research rabbit, Zotero, and SciSpace to widen the areas where relevant publications can be discovered.

3. Study Selection

Establish inclusion and exclusion criteria to select relevant studies. It is also recommended to establish team collaboration during study selection to ensure consistency and reduce bias. This paper limited the search criteria selection by only selecting articles related to language learning, materials development, and language teaching that are related to respondents or subject focus with ASD.

The process selection is limited from 2019-2025 and has been done in two tiers: reading the title and the abstract to identify its connection to the scoping review and then reading the papers in their entirety.

4. Charting the Data

Extract key information systematically, including study characteristics, methods, and findings. It is suggested to

do an iterative approach to data charting, allowing for continuous updating and refinement of the data extraction process.

5. Collating, Summarizing, and Reporting Results

Organize the data into themes, provide a narrative summary, and discuss implications and advocate for a qualitative thematic analysis to provide a more comprehensive interpretation of findings. One more this to emphasize is the need to consult with stakeholders to enhance the relevance and applicability of the review.

RESULTS AND DISCUSSION

This table provides a comprehensive overview of how each article contributes to understanding the Effects of Dopamine-Enhancing Activities on JHS Students with ASD:

Article Title	Theme	Summary	Relation to the Present Study
Augmented Reality-Enhanced Language Learning for Children with Autism Spectrum Disorder: A Systematic Literature Review	Technological Innovations in Language Learning	Examines the effectiveness of AR in enhancing language learning, social communication, and attention in children with ASD. Highlights marker-based AR for vocabulary improvement.	Relevant for exploring movement-based and gamified learning as dopamine-enhancing strategies to boost engagement and language acquisition.
Powerful Classroom Strategies from Neuroscience Research	Neuroscientific Approaches to Learning	Discusses dopamine-raising activities like breaks, social interaction, and concise tasks. Emphasizes the role of pleasure and reward in learning.	Supports the theoretical framework by linking dopamine-enhancing activities to improved attention and engagement in ASD students.
Brief Report: A Randomized Controlled Trial of the Effects of RECALL	Dialogic Reading and Emotion Understanding	Investigates the RECALL intervention's effects on comprehension, verbal participation, and emotional understanding in preschoolers with ASD.	Offers insights into social communication, relevant for assessing dopamine-enhancing activities' impact on social engagement.
Auditory-Motor Mapping Training Facilitates Speech and Word Learning	Multimodal Language Interventions	Demonstrates AMMT effectiveness in enhancing speech and word learning using movement and musical intonation.	Directly aligns with how movement-based musical activities influence phonetic articulation and vocabulary via dopamine modulation.
Dopamine Modulations of Reward-Driven Music Memory	Dopamine and Memory Consolidation	Explores dopamine's role in music-related memory retention. Shows pleasurable music enhances memory via dopaminergic pathways.	Supports the use of music as a dopamine-enhancing strategy that facilitates memory and language acquisition in ASD students.
Development of Audio-Visual Media of Language Learning for Children with Autism	Multimedia Language Learning	Analyses how audio-visual media aid language acquisition in children with autism. Highlights visual and multimodal communication.	Reinforces gamified and multimedia strategies as dopamine-enhancing tools for language development and engagement.

The Association Between Dopamine Receptor (DRD4) Gene Polymorphisms and Second Language Learning Style	Genetic Influences on Learning Styles	Investigates how DRD4 gene polymorphisms affect learning preferences (e.g., kinesthetic vs. visual).	Supports tailoring dopamine-enhancing activities to individual cognitive profiles based on genetic predispositions.
Language Learning with Mobile Augmented Reality	Augmented Reality in Language Acquisition	Explores how mobile AR creates immersive environments for language learning. Demonstrates improved vocabulary and usage.	Supports movement-based, gamified strategies as dopamine-enhancing methods to improve outcomes via immersive experiences.
Inclusive Early Childhood Education for Children with and Without Autism	Inclusive Education Strategies	Examines effective early education for ASD and neurotypical peers, emphasizing routines, sensory-friendly classrooms, and differentiation.	Supports inclusive teaching strategies, showing structured, engaging environments benefit ASD students.
Classroom-Based Peer Interventions Targeting Autism Ignorance	Social Integration and Peer-Mediated Learning	Studies peer-mediated strategies to reduce stigma and enhance inclusion for ASD students.	Reinforces the importance of social communication, relevant to dopamine-enhancing activities supporting social engagement.
Factors Influencing the Selection and Use of Strategies to Support Students with Autism	Teacher Decision-Making in ASD Education	Explores how teachers select strategies based on student needs, constraints, and resources.	Offers insights into the real-world challenges of implementing dopamine-enhancing activities.
Teacher-Reported Classroom Strategies and Techniques for Students with Autism Spectrum Disorder	Evidence-Based Teaching Practices	Highlights effective techniques like multimodal learning, reinforcement, and movement-based strategies.	Validates movement-based and gamified learning as dopamine-enhancing activities for ASD students.
Effects of the Class-Wide Function-Related Interventions for ASD	Behavioural Interventions and Classroom Management	Analyses how function-based strategies improve classroom behaviour and engagement.	Supports the study's focus on motivation and engagement through structured learning interventions.

The scoping review revealed several key points that contribute to understanding how dopamine-enhancing activities influence language learning outcomes, engagement, and cognitive development in students with ASD. These key points are organized into four main themes:

Dopamine's Role in Memory Consolidation and Learning Motivation

In terms of reward002Ddriven learning and memory consolidation, dopamine is essential. Ferreri and Rodriguez-Fornells (2021) have proven that gratifying musical experiences improve memory retention through dopaminergic pathways, highlighting the significance of reward-based learning in cognitive development. This finding recommends that activities stimulating dopamine release, such as music and gamified incentives, can effectively enhance attention and memory retention in students with ASD. The connection between musical

experiences and reward mechanisms supports the integration of music-based learning strategies in educational interventions, unswervingly aligning with the present study's aim to study dopamine-enhancing activities for language acquisition.

Technological Innovations and Multimodal Learning Approaches

The review highlights the potential of augmented reality (AR) and audio-visual media as effective dopamine-enhancing tools for language learning. El Shemy et al. (2024) demonstrated that AR involvement significantly enhances attentional behavior, social communication, and vocabulary acquisition in children with ASD by initiating immersive and interactive learning environments. Similarly, Khasawneh (2023) stressed the role of audio-visual media in compensating for verbal communication shortfalls through multimodal learning strategies. These technological innovations associated with movement-based and gamified learning approaches, which enhance cognitive engagement and motivation through dopamine release. The incorporation of AR and multimedia tools in language interventions supports the present study's objective of exploring how movement and gamification influence learning outcomes in ASD students.

Movement-Based Learning and Auditory-Motor Integration

Movement-based learning strategies, particularly auditory-motor mapping training (AMMT), have shown significant effects on speech production and word learning in children with ASD. Yan et al. (2021) demonstrated that AMMT enhances phonetic articulation and lexical tone acquisition through rhythmic intonation and hand-tapping activities. These findings emphasize the role of movement and rhythmic encounters in assisting language learning by engaging the mirror neuron system, which incorporates auditory and motor neural pathways. This is associates with dopamine's role in enhancing motor control and cognitive focus. The present study’s focus on movement-based learning strategies is supported by this evidence, as physical movement is linked to increased dopamine production, leading to improved attentional focus and memory retention.

Genetic Influences on Learning Preferences and Personalized Education

The scoping review also detected genetic influences on learning inclinations, specifically the role of dopamine receptor (DRD4) gene polymorphisms. Atabay et al. (2014) determined that students with the DRD4.7+ allele are more responsive to kinesthetic and auditory learning styles, whereas those with the DRD4.7- allele prefer visual and group-oriented approaches. This implies that genetic predispositions influence perceptual learning styles and cognitive engagement. These findings point out the worth of personalized educational strategies that consider individual genetic profiles. In the context of the present study, tailoring dopamine-enhancing activities to the genetic and cognitive profiles of students with ASD could optimize learning outcomes and social-communicative competencies.

The scoping review highlights the multifaceted influences of dopamine-enhancing activities on language learning and cognitive engagement in students with ASD. Reward-driven memory consolidation, immersive technological tools, movement-based learning strategies, and genetic-informed personalized education all contribute to a more inclusive and effective learning environment. These findings support the present study’s objectives by providing a comprehensive understanding of how dopamine-enhancing activities can improve vocabulary development, phonetic articulation, and social communication skills in JHS students with ASD. Future research should continue exploring these interdisciplinary intersections, emphasizing personalized and gamified educational strategies to maximize cognitive and emotional development.

Real-world application of Dopamine-Enhancing Activities in Classrooms

Recent studies underscore the effectiveness of classroom interventions that include dopamine-enhancing activities. Research suggests that peer-moderated procedures, organized games, and gamification by teachers increase students’ motivation and participation. Reported teacher strategies included active engagement in lessons, applying behavior modification, and the use of musical movement activities to motivate and engage students (Teacher Reported Classroom Strategies and Techniques for Students with Autism Spectrum Disorder, 2024).

Ethical Consideration in Genetic Profiling for Education

The use of genetic profiling to establish learning preferences has raised concerns about privacy, consent, and potential discrimination. Learning could be further stereotyped where students are presumed to be certain learners simply because they possess certain genetic traits. More work is required to develop policy guidelines to educate and train teachers on the interaction between the use of genetic information and educational programs about ethical issues (The Association Between Dopamine Receptor (DRD4) Gene Polymorphisms and Second Language Learning, 2014).

Socio-Economic Barriers in Implementing Dopamine-Enhancing Strategies

One of the most challenging aspects of applying dopamine-enhancing intervention in schools is the socio-economic disparity in access to resources. Schools with constrained funding may have trouble providing gamified learning tools, musical programs, and augmented reality technologies. Furthermore, upskilling for teachers in neuroscience-based strategies is often unavailable in lower-income areas. Future policy recommendations should include cost-effective solutions, such as non-digital gamification and low-cost physical movement activities (Factors Influencing the Selection and Use of Strategies to Support Students with Autism, 2024).

Limitations

This scoping review does seek to gather and interpret existing literature on dopamine-enhancing activities that aid with language acquisition for JHS students with ASD which, however, has several shortcomings that must be stated.

This review is based on a few selected studies that focus on the broad areas of dopamine modulation and augmented reality, auditory-motor training and their impacts, and learning genetics. Most of the studies were performed in laboratory settings or with limited participants which influences the results and their application in different educational contexts. In addition, the participants' cultures and demographic composition were not sufficiently represented, which can impact the capacity to generalize the findings to other populations.

The research involved in this review employed varied methodologies, from randomized controlled trials to qualitative analysis. This heterogeneity in study designs, data collection, and outcome measures yields direct comparison and synthesis of results challenging. For instance, some studies used subjective measures of motivation and engagement, while others depended on neurobiological measures, resulting in variations in reported findings.

The majority of the studies were short-term interventions or cross-sectional, which restrain the capacity to make causal inferences or measure the long-term impacts of dopamine-enhancing activities on language development among ASD students. Longitudinal studies are vital to determine sustained cognitive and behavioral outcomes regarding memory retention, social communication skills, and academic performance.

The availability of genetic research, such as the investigation of dopamine receptor (DRD4) gene polymorphisms, also generates ethical issues with genetic profiling within the educational environment.

The possibility of individualized learning approaches derived from genetic propensities demands vigilant consideration of ethics, data confidentiality, and informed consent. Furthermore, the nature of genetic influences on learning profiles is complicated by gene-environment interactions that were not adequately examined in the discussed studies. The review mainly consisted of peer-reviewed publications in English and hence might introduce language bias and publication bias. Research published in other languages or not-indexed journals might have additional information not included in this review. Therefore, the results may not entirely be representative of the worldwide research on ASD language learning with dopamine-enhancing activities.

The reviewed studies did not always control for confounding factors like socioeconomic status, cognitive functions, comorbidities, or educational support systems. These factors might have a strong impact on language

learning outcomes and levels of engagement, thereby influencing the validity of the reported effects of dopamine-enhancing activities.

CONCLUSION

This scoping review encapsulated existing literature on dopamine-enhancing activities and their effects on language learning outcomes among JHS students with autism spectrum disorder (ASD). The review synthesized salient themes such as the role of dopamine in reward and memory consolidation, including its role in reward-driven memory consolidation, the effect of technological innovations such as augmented reality and audio-visual media, the effectiveness of movement-based learning approaches, and the influence of genetic predispositions on learning preferences. These results underscore the potential of dopamine-enhancing activities—such as gamified incentives, musical experiences, and physical movement—in refining vocabulary acquisition, phonetic articulation, and social-communicative competencies in neurodiverse learners.

The review demands the weight of genetic and cognitive profiling to devise personalized educational strategies to optimize learning for students with ASD. However, challenges related to ethical concerns, socio-economic barriers, and study design heterogenicity remain. Future research should focus on classroom-based applications, ethical considerations in genetic profiling, and long-term impact studies.

RECOMMENDATION

1. Future research should conduct longitudinal studies to understand how dopamine-enhancing activities impact language learning, social interactions, and cognitive skills in students with ASD over time.
2. The policies in education must address the socio-economic barriers by fostering affordable dopamine-enhancing activities in public schools.
3. More ethical discussions on genetic profiling should be integrated into education research to ensure responsible and equitable application.
4. Upskilling programs for teachers must include neuroscience-based strategies to facilitate effective dopamine-enhancing learning environments.

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