

Vocabulary Intervention for EFL/ESL Learners with Autism Spectrum Disorder - A Systematic Review

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ABSTRACT:

Vocabulary acquisition is essential for language development among learners with autism spectrum disorder (ASD), yet evidence on effective instructional interventions in EFL/ESL contexts remains limited. This systematic literature review, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, synthesizes empirical evidence on vocabulary interventions for EFL/ESL learners with ASD. Thirteen studies published between 2010 and 2026 were selected from ScienceDirect, Taylor & Francis, Sage Publications, and SpringerLink. The review examines instructional approaches, intervention effectiveness, methodological rigor, and conceptual gaps through thematic analysis. Findings indicate that visual supports, repetitive practice, contextualized learning, multimodal engagement, and technology-assisted interventions can enhance vocabulary acquisition, learner engagement, and vocabulary retention. However, the evidence is constrained by small sample sizes, short intervention durations, and methodological inconsistencies. Limited research on long-term vocabulary generalization, functional language use, and diverse educational contexts further highlights the need for rigorous investigation. The review recommends longitudinal research, comparative intervention designs, and contextually responsive strategies that address individual cognitive and sensory differences. These findings provide a foundation for developing inclusive and

Open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).	sustainable vocabulary instruction for EFL/ESL learners with ASD and provide practical guidance for teachers, researchers, and educational institutions seeking effective and inclusive language interventions in practice. Keywords: Instructional strategies, technology-assisted learning, learner engagement, language acquisition, vocabulary outcomes.
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1. Introduction

Autism Spectrum Disorder (ASD), as defined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, is characterised by ongoing differences in social communication and restricted or repetitive patterns of behaviour (Oberman & Kaufmann, 2020; Posar & Visconti, 2023). Beyond these defining features, language development in individuals with ASD often shows varied profiles, especially in semantic processing, pragmatic skills, and vocabulary organisation. While some learners display relatively strong structural language abilities, many experience clear challenges in vocabulary learning, including difficulties in categorising words (Floyd et al., 2021), generalising meanings (Hartley et al., 2020), and using language flexibly across contexts (Khalid et al., 2024). These challenges become more significant in school settings where vocabulary knowledge supports literacy, subject learning, and social interaction. Consequently, understanding and addressing these vocabulary learning difficulties is critical for designing effective educational strategies that support academic success and social participation among learners with ASD.

Vocabulary knowledge is a key predictor of reading comprehension, academic performance, and long-term educational success (Wang & Zhang, 2025; Masrai et al., 2021; Anderson, 2024). In second language acquisition research, lexical knowledge is widely recognised as central to communicative competence and academic achievement (Kaur, 2022; Stoffelsma et al., 2024). However, for learners with ASD who are learning English as a First or Second Language (EFL/ESL), vocabulary development involves two layers of complexity: managing the cognitive and language characteristics associated with autism while also learning in a non-native

language (Khalid et al., 2024). This intersection between neurodevelopmental differences and bilingual language learning remains underexplored and insufficiently synthesised in the literature, highlighting the need for systematic investigation to identify effective vocabulary intervention strategies tailored to this population. Vocabulary knowledge forms the foundation of language proficiency, academic achievement, and meaningful participation in classroom activities (Alsahafi, 2023). For learners with Autism Spectrum Disorder (ASD), vocabulary development is often uneven due to differences in semantic processing, limited ability to generalise word meanings, and difficulty using language flexibly across contexts (Cuneo et al., 2024; Lin et al., 2022). These challenges can influence both receptive and expressive vocabulary growth, thereby affecting literacy development, content learning, and overall academic performance. When English is acquired as a second language, these difficulties become more complex, as learners must simultaneously navigate neurodevelopmental characteristics associated with ASD and the cognitive, linguistic, and sociocultural demands of second language learning (Parween et al., 2025; Al Yatim, 2025; Andreou & Argatzopoulou, 2025). This dual challenge underscores the need for carefully designed vocabulary interventions that are responsive to both the cognitive profiles of learners with ASD and the specific demands of EFL/ESL contexts.

The broader literature on ASD interventions has largely focused on early behavioural programs, social communication training, and pragmatic language development, as reflected in empirical studies conducted by Schuetze et al. (2017), Awamleh (2025), Thomas and Bambara (2020), Swain et al. (2025), and Gengoux et al. (2019).

Although vocabulary instruction has been addressed within monolingual contexts, most intervention studies (Bengochea & Sembianti, 2024; Deng & Trainin, 2023) are situated in English-dominant settings where English functions as the first language. Consequently, limited attention has been given to learners with ASD who acquire English within multilingual or EFL/ESL contexts. This gap is particularly critical in regions where English serves as a second or foreign language within inclusive educational systems, underscoring the need for systematic research that identifies effective vocabulary interventions tailored to the linguistic and cognitive profiles of EFL/ESL learners with ASD. Inclusive education policies worldwide increasingly advocate equitable access to high-quality language instruction for neurodiverse learners (Luna, 2026). Ensuring that EFL/ESL learners with ASD receive evidence-informed vocabulary instruction is therefore both a pedagogical and ethical imperative. Despite growing recognition of neurodiversity within language classrooms, there remains no consolidated review specifically examining vocabulary intervention strategies tailored to EFL/ESL learners with ASD. Existing reviews tend to address either vocabulary intervention in ASD more broadly or second language vocabulary instruction within general learner populations, leaving the intersection between these two domains insufficiently examined (Bahameish et al., 2026; Urrea et al., 2024; Nunes et al., 2020; Rahmadani, 2025; Mohamed & Shaaban, 2024). This lack of integrated synthesis limits the ability of educators and researchers to draw evidence-based conclusions about effective practices for this unique learner group.

Although research on language intervention for individuals with ASD has expanded, much of the existing literature concentrates on monolingual English-speaking populations. Many intervention studies examine vocabulary instruction in first-language contexts, with limited attention to multilingual or EFL/ESL environments (Rahmadani, 2025; Kurzeja et al., 2024; Khalid et al., 2024). As a result, there is insufficient understanding of how vocabulary

interventions should be adapted for learners with ASD who are acquiring English as a second or foreign language. The absence of consolidated and synthesised evidence in this area constrains the development of context-sensitive and linguistically responsive instructional frameworks. Furthermore, current studies vary considerably in research design, instructional approaches, and outcome measures. A substantial number employ single-case experimental designs or small participant samples, which provide detailed individual insights but limit generalisability across diverse educational settings (Van Norman et al., 2024; Wilbert et al., 2022). There is also inconsistency in how vocabulary outcomes are conceptualised and assessed, including variations in the measurement of receptive versus expressive gains, short-term acquisition versus long-term retention, and generalisation across contexts (Sturrock & Freed, 2023). This methodological heterogeneity complicates cross-study comparison and weakens the cumulative evidence base. Without a systematic synthesis of findings, it remains challenging to determine which instructional approaches demonstrate consistent and replicable effectiveness for EFL/ESL learners with ASD, thereby underscoring the need for a comprehensive systematic review.

From a theoretical standpoint, vocabulary acquisition in learners with ASD intersects with several cognitive and linguistic frameworks. Theories such as dual coding theory (Kurniawan et al., 2022), weak central coherence theory (Tassini et al., 2024), and sociocultural perspectives on mediated learning (Cohen et al., 2022) provide distinct lenses for understanding how autistic learners process, organise, and internalise lexical input. However, the empirical literature remains fragmented, with intervention studies differing widely in design, including single-case experimental designs (Camarata et al., 2024) and quasi-experimental approaches (Nunes et al., 2020); in instructional modalities, such as visual supports (Bahameish et al., 2026), semantic mapping, and technology-assisted instruction (Bacotti, 2022); and in outcome

measures, including receptive versus expressive vocabulary (Bahameish et al., 2026). This heterogeneity makes it challenging to identify consistent evidence of effectiveness, particularly in EFL/ESL contexts, and underscores the need for a systematic review to synthesise findings, clarify theoretical applications, and guide the development of contextually responsive vocabulary interventions for learners with ASD.

Moreover, the theoretical foundations of vocabulary interventions for learners with ASD in EFL/ESL contexts remain fragmented and insufficiently integrated. Existing research frequently draws independently from special education, cognitive psychology, or second language acquisition, yet rarely synthesises these perspectives into a coherent and unified framework. This disciplinary separation constrains the development of comprehensive models capable of addressing both the linguistic demands of second language learning and the neurocognitive characteristics associated with ASD (Sukamolson, 2025). As a result, intervention practices may lack a strong conceptual basis that aligns instructional design with learners' cognitive and communicative profiles. Given these concerns, there is a clear need to systematically review and synthesise empirical studies on vocabulary interventions for EFL/ESL learners with ASD. A rigorous systematic review can identify prevailing instructional strategies, evaluate methodological firmness, clarify underlying theoretical orientations, and highlight persisting gaps in the evidence base. Such synthesis is essential for strengthening conceptual coherence, guiding future research agendas, supporting evidence-based instructional practice, and informing the development of structured, context-responsive vocabulary learning models tailored to EFL/ESL learners with ASD. Given this gap, a systematic review is warranted (i) to identify prevailing instructional approaches used in vocabulary interventions for EFL/ESL learners with Autism Spectrum Disorder (ASD), (ii) to evaluate the empirical support and effectiveness of these interventions across different contexts, (iii) to examine methodological rigor and limitations

within the existing studies, (iv) to delineate conceptual and theoretical gaps that can inform the development of structured, context-responsive vocabulary learning models.

2. Materials and Methodology

This study adopts the Preferred Reporting Items for Systematic Reviews and Meta Analyses PRISMA 2020 guidelines as the methodological framework to conduct a comprehensive systematic literature review. The included studies are appraised and organised using the 27 item PRISMA checklist together with the four-phase flow diagram to systematically address the research questions. The PRISMA procedure follows four structured stages, namely identification, screening, eligibility, and inclusion, thereby promoting methodological rigor, transparency, and replicability throughout the review process.

During the identification phase, relevant records are systematically retrieved from selected electronic databases using predefined search strings and inclusion criteria. In the screening phase, duplicate records are removed and titles and abstracts are examined for relevance. The eligibility stage involves a full text assessment of potentially relevant articles based on established inclusion and exclusion criteria. Finally, studies that meet all methodological and conceptual requirements are included for qualitative synthesis. This structured approach ensures a transparent selection process and strengthens the credibility and trustworthiness of the review findings.

Phase 1: Identification Phase

This study formulates five predefined criteria to guide the identification and selection of relevant articles. The systematic literature review is conducted across four academic databases, namely ScienceDirect, Taylor and Francis, Sage Publications, and SpringerLink, to locate studies within the domains of social sciences and humanities. These databases are selected due to their extensive coverage of high-quality scholarly publications that align with the objectives of the present study. The inclusion criteria specify that articles must be published between 2010 and

2026 and written in English. In addition, only open access empirical research articles are considered to ensure accessibility and transparency. The final requirement is the availability of full text versions to enable

comprehensive examination and analysis of the selected studies. Table 1 presents a detailed overview of the five inclusion criteria applied throughout the selection process.

Table 1: Inclusion and exclusion criteria for the articles

Criteria	Inclusion	Exclusion
Database	ScienceDirect, Taylors & Francis, Sage Publications, and SpringerLink	Other databases
Publication years	781-800	Articles before 2010
Language	English	Articles written in other languages than English
Document type	Research articles	Books, book chapters, seminar papers
Access to full text	Open access	Limited or no access

Table 1 outlines the systematic criteria applied to ensure consistency, relevance, and quality in the article selection process. The inclusion criteria restrict the search to four established academic databases, namely ScienceDirect, Taylor and Francis, Sage Publications, and SpringerLink, thereby ensuring that the retrieved studies originate from reputable and peer reviewed sources within the social sciences and humanities. Articles indexed in other databases are excluded to maintain methodological focus and manageability. The temporal boundary of 2010 to 2026 is set to capture contemporary research developments while excluding studies published prior to 2010, which may not reflect current theoretical perspectives or instructional practices. Only articles written in English are included to ensure linguistic consistency in analysis and

interpretation, while publications in other languages are excluded to avoid translation related bias. In terms of document type, the review includes empirical research articles and excludes books, book chapters, and seminar papers to maintain a focus on peer reviewed primary research with clearly defined methodologies and findings. Finally, access criteria limit inclusion to open access full text articles, ensuring transparency, replicability, and comprehensive evaluation of each study. Collectively, these criteria strengthen the rigor of the review by promoting relevance, quality control, and systematic comparability across the selected studies. Table 2 presents the structured search strings employed across the four selected databases to systematically identify relevant studies.

Table 2: Search strings used in all four databases for article identification

No.	Search Strings
1	("autism spectrum disorder" OR ASD OR autistic) AND (vocab OR "lexical development" OR "word learning") AND ("English as a foreign language" "English as a second language" OR EFL OR ESL "foreign language learning" "second language learning")

2	("autism spectrum disorder" OR ASD) AND ("vocabulary intervention" OR "vocabulary instruction" OR "lexical intervention") AND ("English language learners" OR ELL OR "bilingual" OR "multilingual")
3	(autism OR ASD) AND ("semantic mapping" OR "visual supports" OR "multimodal instruction" OR "explicit instruction") AND (vocabulary) AND ("foreign language" "second language")
4	("developmental disorder" OR autistic) AND ("vocabulary acquisition" OR "lexical acquisition") AND (EFL OR ESL OR "foreign language learners" "second language learners")

The search strategy from Table 2 integrates three principal conceptual domains: autism spectrum disorder, vocabulary or lexical development, and second language learning contexts. Boolean operators such as AND and OR are used to combine and refine keywords, ensuring both precision and comprehensiveness in retrieving relevant literature. Search String 1 captures studies that explicitly link autism spectrum disorder with vocabulary learning by incorporating terms such as vocabulary, lexical development, and word learning within contexts of English as a foreign or second language, EFL/ESL, or foreign or second language learning. This search string aims to retrieve studies addressing general vocabulary development among learners with ASD in second language environments. Search String 2 narrows the focus to intervention-oriented research by combining ASD with terms including vocabulary intervention, vocabulary instruction, and lexical intervention, together with descriptors such as English language learners, ELL, bilingual, or multilingual populations. This allows the identification of studies examining instructional approaches designed to enhance vocabulary acquisition among learners with ASD. Search String 3 further refines the search by incorporating specific instructional strategies such as semantic mapping, visual supports, multimodal instruction, and explicit instruction, alongside vocabulary and second language descriptors, enabling the retrieval of studies investigating pedagogical techniques applied in vocabulary instruction. Search String 4 expands the search parameters by including broader descriptors such as developmental disorder and terms related to vocabulary acquisition or lexical

acquisition within, EFL, or foreign/second language learner contexts. The inclusion of these alternative terms ensures that potentially relevant studies using varied disciplinary terminology are not overlooked. Overall, the combination of these four search strings enhances the breadth and rigor of the search process, facilitating comprehensive coverage of relevant literature while maintaining alignment with the objectives of the systematic review.

Phase II: Screening Phase

The studies retrieved in Phase I undergo a second-stage screening based on their titles. Each title is carefully examined to determine its consistency with the predetermined keywords. The abstracts are also reviewed to verify compliance with the specified inclusion and exclusion criteria. Articles that do not satisfy these criteria are subsequently excluded. To ensure precision and methodological rigor, duplicate records identified across the four databases are systematically removed.

Phase III: Eligibility Phase

A comprehensive evaluation is conducted to determine the suitability of the identified articles for further screening in the third phase. Only studies that satisfy all predefined inclusion and exclusion criteria are retained for the final selection stage. This phase is essential in ensuring that the selected publications are directly aligned with the research questions and objectives.

Phase IV: Exclusion Phase

Publications that satisfy the established eligibility criteria are selected for analysis during this phase, whereas those that do not meet the specified

requirements are excluded. The exclusion process encompasses various types of scholarly sources, including books, book chapters, conference proceedings, articles with restricted or unavailable full-text access, and publications

outside the 781-800 timeframe. Figure 1 presents the flowchart of the research article screening and selection process employed in this systematic review.

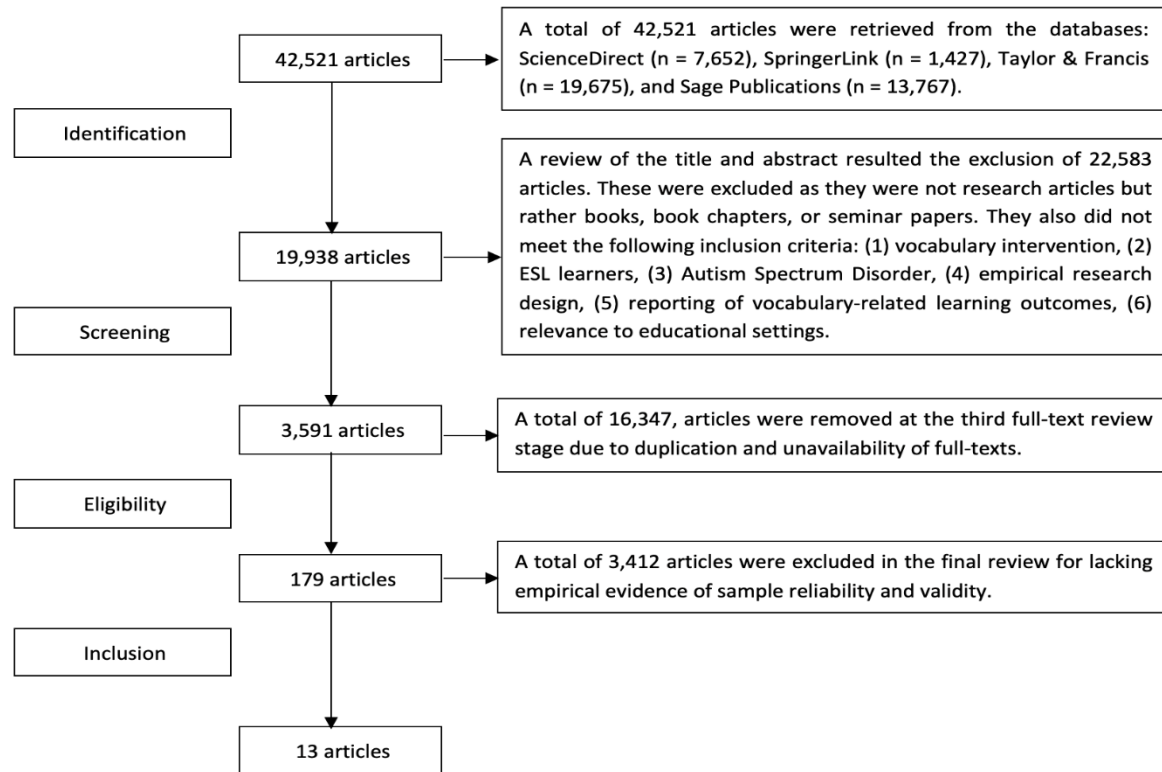


Figure 1: Flowchart of research articles screening and selection process

Figure 1 illustrates the systematic screening and selection process of research articles included in this review. Initially, 42,521 articles were identified from four databases, namely ScienceDirect, SpringerLink, Taylor & Francis, and Sage Publications. Following title and abstract screening, 22,583 articles were excluded for not meeting the inclusion criteria. A further 16,347 articles were removed during the full-text

review stage due to duplication and limited accessibility. Subsequently, 3,412 articles were excluded for lacking sufficient empirical evidence related to sample reliability and validity. Ultimately, 13 articles met all inclusion criteria and were selected for the final review. Table 3 presents the distribution of the selected studies according to their research methodologies.

Table 3: Number of articles by research methodology

Research Methodology	Quantity
Qualitative	2
Quantitative	10
Mixed Methods	1

Table 3 indicates that quantitative methodology was the most frequently employed approach, accounting for 10 out of the 13 selected studies. In contrast, only two studies adopted a qualitative approach, while one study utilised mixed methods. This distribution suggests a strong preference for quantitative designs in investigating vocabulary interventions among EFL/ESL learners with Autism Spectrum Disorder, particularly in measuring intervention effectiveness and learning outcomes.

3. Results and Discussion

A total of 13 articles were collected, examined, and recorded for this study. The chosen articles, published between 2010 and 2026, were selected to reflect current issues and trends, thereby increasing the study's relevance. This curated set of literature also serves as a solid basis for effectively addressing the research questions. Table 4 summarises thirteen studies on vocabulary and language interventions for children with Autism Spectrum Disorder (ASD), particularly in ESL or multilingual contexts.

Table 4: Details of the research articles

No.	Title	Year	Country	Research Method	Research Participant
1	Using AI to teach English to multilingual autistic children: a qualitative study	2025	Saudi Arabia	Qualitative Method	13 Participants
2	Pathways to learning: Exploring the impact of augmented reality on vocabulary development in children with autism spectrum disorder	2025	Qatar	Quantitative and Qualitative Methods	9 Participants
3	Effects of Dialogic Reading on the Vocabulary Knowledge of Preschoolers with Autism Spectrum Disorder	2021	Brazil and USA	Quantitative Methods	8 Participants
4	Efficacy of Handheld Electronic Visual Supports to Enhance Vocabulary in Children With ASD	2014	USA	Quantitative Methods	3 Participants
5	Instructional Practices in Enhancing Sight Vocabulary Acquisition of ESL Students with Autism	2013	Malaysia	Qualitative Method	8 Participants
6	Teaching Emotion Vocabulary to Children With Autism Spectrum Disorder	2022	USA	Quantitative Methods	4 Participants
7	Comparing in-Person Instruction and Computer-Assisted Instruction for Learning New Cognate Vocabulary in Bilingual Children With Level 1 ASD	2026	Puerto Rico	Quantitative Method	28 Participants
8	Technology-Based Shared Story Reading for Students With Autism Who Are English-Language Learners	2017	USA	Quantitative Methods	3 Participants

9	Using Instructive Feedback to Expand Second Language of Children with Autism Spectrum Disorder	2026	Spain	Quantitative Method	3 Participants
10	Non-social Language Exposure Facilitates Autistic Children's Language Learning	2026	Hongkong and New Zealand	Quantitative Method	107 Participants
11	Comparison of Tablet-Delivered and Instructor-Delivered Teaching on Receptive Identification in Children With Autism Spectrum Disorders	2019	Canada	Quantitative Method	7 Participants
12	Generalization Following Tablet-Based Instruction in Children With Autism Spectrum Disorders	2016	Canada	Quantitative Method	5 Participants
13	Effects of a Robot Peer on the Acquisition and Observational Learning of Sight Words in Young Adults With Autism Spectrum Disorder	2018	USA	Quantitative Method	2 Participants

The research from Table 4 encompasses multiple countries, including the USA, Canada, Brazil, Malaysia, Saudi Arabia, Qatar, Spain, Puerto Rico, Hong Kong, and New Zealand. Most studies employed quantitative methods to measure learning outcomes, while some adopted qualitative or mixed methods approaches to explore teaching practices and learner experiences. Participant numbers were generally small, ranging from 2 to 28, apart from one study involving 107 participants. The interventions investigated include AI-based instruction, augmented reality, dialogic reading, computer-assisted learning, tablet-delivered teaching,

electronic visual supports, shared story reading, and robot-assisted learning, reflecting the increasing use of technology in teaching vocabulary to children with ASD. Overall, Table 4 illustrates the diversity of methods, sample sizes, and digital and traditional approaches in this research area. Meanwhile, Table 5 summarises the authors of each study and outlines the focus and key findings of research on vocabulary and language interventions for children with ASD, emphasising the role of technology-mediated instruction, pedagogical strategies, learning outcomes, and learner engagement in ESL or multilingual contexts.

Table 5: Summary of findings from research articles

No.	Author(s)	Focus Area	Findings
1	Mohamed (2025)	AI-based English instruction for multilingual autistic children	AI provided personalised vocabulary support and adaptive learning, though implementation challenges included the need for specialised training, sensory overload, and human oversight alongside multisensory approaches.
2	Bahameish et al. (2026)	Augmented reality for vocabulary development in children with ASD	AR enhanced vocabulary performance and response accuracy, suggesting that interactive AR can support vocabulary acquisition in autistic children.

3	Nunes et al. (2020)	Dialogic reading interventions for preschoolers with ASD	Both protocols improved vocabulary knowledge, with interactive RECALL methods yielding greater gains, emphasising the importance of scaffolding and engagement.
4	Ganz et al. (2014)	Tablet-based visual supports for expressive vocabulary	Participants showed increased noun and verb use, fewer prompts required, and some spontaneous language gains, demonstrating that technology-mediated supports can enhance vocabulary.
5	Yahya et al. (2013)	Sight vocabulary acquisition for ESL students with ASD	Teachers facilitated vocabulary acquisition through L1-L2 bridging, adjusted complexity, and frequent practice, supporting sight word recognition and retention.
6	Intepe-Tingir and Whalon (2023)	Emotion vocabulary instruction in children with ASD	Structured teaching likely improved recognition and use of emotion-related terms.
7	Pacheco-Vera et al. (2025)	Comparing in-person and computer-assisted instruction for bilingual children with ASD	Computer-assisted instruction may produce similar vocabulary gains to human instruction, moderated by learner engagement and bilingual status.
8	Alison et al. (2017)	Technology-supported shared story reading for ASD ELL students	Improved WH-question comprehension and vocabulary access, showing that digital story reading can enhance literacy outcomes.
9	Rodriguez et al. (2026)	Instructive feedback for second language development in children with ASD	Systematic feedback likely increased vocabulary accuracy and response rates by reinforcing correct usage in naturalistic contexts.
10	Hwang et al. (2026)	Non-social language exposure for autistic children	Non-social exposure (e.g., video models) may enhance receptive vocabulary, especially when social-pragmatic constraints limit direct instruction.
11	Chebli et al. (2019)	Tablet-delivered vs instructor-led vocabulary instruction	Instructor-led instruction led to faster generalisation and fewer non-responses, though tablets provided supplementary support.
12	Chebli et al. (2016)	Generalisation following tablet-based instruction	Most participants demonstrated generalisation of vocabulary items, showing that tablets can support transferable learning when scaffolded.
13	Saadatzi et al. (2018)	Robot-assisted sight word acquisition in young adults with ASD	Participants achieved 100% accuracy in acquisition, maintenance, and generalisation, indicating robotic peers can enhance observational learning and engagement.

Table 5 summarises thirteen studies on vocabulary and language interventions for children with Autism Spectrum Disorder (ASD), highlighting the authors, year of publication, focus areas, and key findings. The research demonstrates a wide range of instructional approaches, with particular emphasis on technology-mediated interventions, including AI-based instruction, augmented reality, tablet-delivered teaching, computer-assisted learning, electronic visual supports, shared story reading, and robot-assisted learning. Other studies focused on pedagogical strategies such as dialogic reading, sight vocabulary teaching, emotion vocabulary instruction, and instructive feedback.

The findings indicate that technology-enhanced interventions can provide personalised support,

improve vocabulary acquisition, and enhance engagement, particularly for children in ESL or multilingual contexts. However, studies also highlight the continued importance of human guidance for generalisation and scaffolding, as well as considerations of learner engagement, cognitive load, and social-pragmatic limitations. Participant numbers were generally small, ranging from 2 to 28, with one notable study involving 107 participants, reflecting the typical scale of intervention research in this area. Overall, Table 5 illustrates the diversity of methodological approaches, instructional strategies, and technological tools applied in supporting language and vocabulary development for children with ASD. Table 6 summarises thematic findings of vocabulary interventions for EFL/ESL learners with ASD.

Table 6 Thematic findings of vocabulary interventions for EFL/ESL learners with ASD.

No.	Author(s)	Instructional Approaches	Intervention Effectiveness	Methodological Rigor & Limitations	Conceptual / Theoretical Gaps
1	Mohamed (2025)	AI-based personalised vocabulary instruction	Moderate to high gains in receptive and expressive vocabulary	Small sample (13), qualitative; need for specialised training	Limited theoretical framework for ESL/ASD context
2	Bahameish et al. (2026)	Augmented reality-based vocabulary tasks	Improved accuracy and retention	Small sample (9), mixed-methods; context-specific limitations	Limited generalisability and ESL focus
3	Nunes et al. (2020)	Dialogic reading with scaffolding	Significant vocabulary improvement	Small sample (8), quantitative; short intervention duration	Limited ESL-specific adaptation in theory
4	Ganz et al. (2014)	Handheld electronic visual supports	Increased noun and verb use	Very small sample (3), quantitative; lack of control group	Limited theoretical underpinning

5	Yahya et al. (2013)	Sight vocabulary teaching	Positive gains with L1-L2 bridging	Small sample (8), qualitative; lack of follow-up	Limited theoretical grounding for structured vocabulary models
6	Intepe-Tingir and Whalon (2023)	Emotion vocabulary instruction	Likely improvement in recognition and use of emotion words	Very small sample (4), quantitative	Limited ESL focus and theoretical explanation
7	Pacheco-Vera et al. (2025)	Computer-assisted vs in-person instruction	Comparable gains across methods	Moderate sample (28), quantitative; bilingual considerations	Limited theory on bilingual ASD learners
8	Alison et al. (2017)	Technology-supported shared story reading	Improved WH-question comprehension and vocabulary	Very small sample (3), qualitative	Limited ESL-specific model
9	Rodriguez et al. (2026)	Instructive feedback for second language	Likely increased vocabulary accuracy	Very small sample (3), quantitative	Limited theoretical grounding
10	Hwang et al. (2026)	Non-social language exposure	Enhanced receptive vocabulary	Large sample (107), quantitative; limited context variation	Limited ESL-specific framework
11	Chebli et al. (2019)	Tablet-delivered vs instructor-led teaching	Instructor-led more effective for generalisation	Small sample (7), quantitative	Limited cross-context application of theory
12	Chebli et al. (2016)	Tablet-based vocabulary instruction	Successful generalisation observed	Very small sample (5), quantitative	Limited theoretical integration for ESL learners
13	Saadatzi et al. (2018)	Robot-assisted sight word acquisition	High accuracy in acquisition, maintenance, generalisation	Very small sample (2), quantitative	Limited ESL-specific theoretical grounding

Table 6 presents a synthesis of thirteen studies examining instructional approaches, intervention effectiveness, methodological rigour, and conceptual or theoretical gaps. The thematic analysis reveals a diverse range of instructional strategies, including technology-mediated interventions such as AI-based personalised learning, augmented reality tasks, tablet- and computer-assisted instruction, and robot-assisted interventions, alongside traditional pedagogical approaches such as dialogic reading, shared story reading, sight vocabulary teaching, emotion-focused vocabulary instruction, and instructive feedback. This diversity reflects the field's dual focus on leveraging innovative technologies to engage learners while maintaining pedagogically sound practices tailored to the linguistic and cognitive profiles of autistic EFL/ESL learners.

Most studies reported positive outcomes, with improvements in receptive and expressive vocabulary, comprehension, and generalisation, although results were often limited by small sample sizes, short intervention durations, and context-specific constraints. Quantitative designs predominated, while mixed methods and qualitative approaches provided complementary insights into learner engagement and teaching processes. A consistent limitation across studies is the lack of significant theoretical grounding, particularly regarding ESL-specific frameworks and structured, context-responsive models, highlighting opportunities for further research and development. In a nutshell, Table 6 illustrates that while vocabulary interventions for EFL/ESL learners with ASD are varied and generally effective, there is a need for larger, theory-driven, and methodologically rigorous studies that integrate evidence-based pedagogy, technological affordances, and ESL-specific considerations to optimise learning outcomes.

Instructional Approaches

The thematic analysis of the thirteen studies reveals a wide spectrum of instructional approaches targeting vocabulary acquisition for EFL/ESL learners with Autism Spectrum Disorder (ASD). A significant number of studies

integrated technology-mediated interventions, including AI-based personalised instruction (Mohamed, 2025), augmented reality tasks (Bahameish et al., 2026), computer-assisted learning (Pacheco-Vera et al., 2025), tablet-delivered teaching (Chebli et al., 2016; 2019), and robot-assisted learning (Saadatzi et al., 2018). Complementing these digital methods, several studies employed traditional pedagogical approaches, such as dialogic reading with scaffolding (Nunes et al., 2020), shared story reading (Alison et al., 2017), sight vocabulary teaching with L1-L2 bridging (Yahya et al., 2013), emotion vocabulary instruction (Intepe-Tingir & Whalon, 2023), and systematic instructive feedback for second language development (Rodriguez et al., 2026). This diversity indicates a dual focus within the field: firstly, leveraging interactive and adaptive technologies to engage learners and scaffold vocabulary acquisition, and secondly, maintaining pedagogically sound practices grounded in established teaching methods. Notably, interventions often combined multisensory elements with structured instructional strategies to cater to the heterogeneous learning needs of autistic EFL/ESL learners.

Intervention Effectiveness

Across the studies, interventions generally yielded positive effects on vocabulary development, with improvements observed in both receptive and expressive vocabulary, word recognition, comprehension, and generalisation. For instance, AI-based instruction and augmented reality applications were reported to produce moderate to high gains in vocabulary acquisition (Mohamed, 2025; Bahameish et al., 2026), while dialogic reading and shared story reading methods enhanced word retention and comprehension of WH-questions (Nunes et al., 2020; Alison et al., 2017). Tablet-based, computer-assisted, and robot-mediated interventions demonstrated high accuracy in acquisition, maintenance, and generalisation, particularly for sight words (Chebli et al., 2016; 2019; Saadatzi et al., 2018). Even smaller-scale interventions, such as emotion vocabulary teaching or instructive feedback, showed likely

improvements, suggesting that carefully designed interventions, irrespective of scale, can positively influence vocabulary outcomes. Overall, this demonstrates the effectiveness of both technology-supported and conventional pedagogical approaches, with digital tools providing additional engagement, repetition, and feedback mechanisms that may enhance learning outcomes in this population.

Methodological Rigor and Limitations

The methodological review highlights several recurring limitations across the literature. Sample sizes were predominantly small, ranging from 2 to 28 participants, except for Hwang et al. (2026), who reported a larger cohort of 107 participants. Quantitative designs predominated, though qualitative and mixed-methods studies were also represented. Common methodological issues included short intervention durations, lack of control groups, context-specific constraints, and insufficient follow-up, all of which limit the generalisation and replicability of findings. Additionally, several studies emphasised practical challenges in implementing interventions, including the need for specialised teacher training, bilingual considerations, and attention to sensory sensitivities in autistic learners (Howard et al., 2021; Davis et al., 2024; Mohamed, 2025). Furthermore, the findings highlight the importance of adapting instructional strategies to individual learner needs to enhance engagement, comprehension,

and long-term language development (Azimjonovna, 2025). Despite these constraints, the reviewed studies contribute valuable preliminary evidence regarding effective instructional practices, though more rigorous and large-scale studies are required to consolidate the empirical base.

Conceptual / Theoretical Gaps

A striking finding across all studies is the limited theoretical and conceptual grounding for vocabulary interventions in the context of EFL/ESL learners with ASD (Al Yatim, 2025). Most interventions lacked explicit frameworks integrating language learning theory, technology use, and ASD-specific pedagogy (Lewis, 2025; Alkhunini & Alkhunini, 2019). Bilingual and multilingual considerations were often underexplored, and few studies presented structured, context-responsive models to guide vocabulary instruction. This gap is particularly evident in technology-mediated interventions, where theoretical rationales for using AI, AR, or robotics were minimally articulated, and the ESL context was frequently underrepresented (Vurdién & Chambers, 2024; Design, 2026). Such gaps suggest a need for significant, theory-informed models that combine pedagogical strategies, digital tools, and language-specific considerations to support the diverse needs of autistic learners in multilingual settings. Table 7 summarises the coverage of key themes across the thirteen studies included in this review.

Table 7: Theme coverage percentages

Theme	Studies Reporting	Percentage
Instructional Approaches	13 / 13	100%
Intervention Effectiveness	12 / 13	92%
Methodological Rigor & Limitations	13 / 13	100%
Conceptual / Theoretical Gaps	13 / 13	100%

Table 7 shows the proportion of studies that addressed each thematic area, providing insight into the focus and consistency of research in vocabulary interventions for EFL/ESL learners

with Autism Spectrum Disorder (ASD). All thirteen studies (100%) reported on instructional approaches, indicating a strong emphasis on describing the teaching methods used, whether

technology-mediated or traditional (Herlitasari et al., 2026; Paul et al., 2023; Erb, 2023). Similarly, all studies (100%) addressed methodological rigour and limitations, highlighting the field's awareness of study design considerations, sample size constraints, and contextual factors affecting generalisability (Al Yatim, 2025). Conceptual and theoretical gaps were also noted in every study (100%), reflecting a recognised need for stronger theoretical frameworks to guide intervention design, particularly for ESL/ASD contexts (Fernandez, 2021). Intervention effectiveness was reported in twelve of the thirteen studies (92%), showing that while most research evaluated the outcomes of vocabulary

interventions, one study did not provide sufficient data on measurable results (Urrea et al., 2024). Thus, Table 7 emphasises that research in this area consistently examines teaching approaches, methodological considerations, and theoretical gaps, while most studies also provide empirical evidence of intervention outcomes. This suggests a solid foundation for understanding current practices but also underscores the ongoing need for theory-driven and outcome-focused research. Figure 2 presents a visual summary of the thematic focus across thirteen studies examining vocabulary interventions for EFL/ESL learners with Autism Spectrum Disorder (ASD).

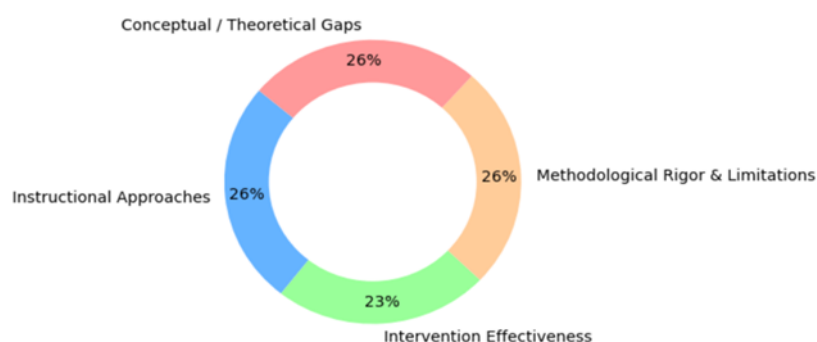


Figure 2: Distribution of theme coverage in vocabulary interventions for EFL/ESL learners with ASD

The donut chart in Figure 2 demonstrates that the majority of studies consistently reported on Instructional Approaches (26%), Methodological Rigour and Limitations (26%), and Conceptual / Theoretical Gaps (26%), indicating a strong emphasis on describing the teaching strategies employed, critically evaluating study design, and identifying theoretical shortcomings in the field (Kearns, 2023). Intervention Effectiveness (23%), although slightly lower, still represents a substantial portion of the research, reflecting that most studies assessed the outcomes of vocabulary interventions (Hambly & Farbonne, 2014), including gains in receptive and expressive vocabulary, comprehension, and generalisation.

This distribution highlights several key points. First, there is a clear focus on methodological

transparency and theoretical reflection, suggesting that researchers are aware of the limitations and conceptual needs in vocabulary intervention studies for autistic EFL/ESL learners. The literature often focuses more on reporting practical intervention outcomes than on linking them to language learning theories, showing a gap between classroom practice and second language acquisition theory (Al Yatim, 2025). Second, the slightly lower emphasis on intervention effectiveness indicates that while outcome measurement is common, some studies prioritise exploratory, descriptive, or qualitative insights over quantitative evaluation of learning gains. Fewer studies focus on intervention effectiveness, as many prioritize exploratory, descriptive, or qualitative findings rather than measuring learning gains quantitatively (Kearns, 2023). Finally, the near-equal proportions for

most themes suggest a balanced research landscape, where instructional design, methodological rigour, theoretical considerations, and effectiveness are all recognised as essential components for advancing the field. The similar proportions across themes show a balanced research focus, where design, methods, theory, and effectiveness are all considered important for developing the field (Gao, 2025). Collectively, Figure 2 underscores the importance of integrating evidence-based teaching practices with theoretically grounded, methodologically rigorous, and outcome-focused research to optimise vocabulary learning for autistic EFL/ESL learners.

5. Conclusion

The synthesis of current studies highlights that vocabulary acquisition for learners with ASD is significantly influenced by instructional approaches, intervention design, and learner-specific characteristics. Evidence consistently supports the efficacy of technology-mediated interventions, including tablet-based instruction, augmented reality, and robot-assisted learning, in promoting receptive and expressive vocabulary among children with ASD. Nevertheless, the effectiveness of these interventions is moderated by factors such as social engagement, attention, and individualised learning needs. Pedagogical strategies that integrate visual supports, repetitive practice, and contextualised vocabulary exposure were reported to facilitate higher learning gains. Despite the growing evidence base, research still demonstrates gaps in conceptual frameworks and long-term generalisation of vocabulary skills beyond structured intervention contexts.

6. Limitations and Recommendations for Future Studies

The studies reviewed exhibit several notable limitations that warrant careful consideration. First, there is considerable heterogeneity across the literature in terms of participant characteristics, intervention modalities, duration, and outcome measures, which constrains both the comparability of results and the generalisability of findings to broader

populations of learners with ASD. Second, many studies had small sample sizes, often under 30 participants, which limited statistical power and made it harder to identify significant intervention effects. Third, many interventions were implemented over relatively brief periods, frequently spanning only a few weeks, thereby restricting insights into the long-term retention, generalisation, and sustainability of vocabulary gains beyond the immediate instructional context. Such limitations introduce potential selection and measurement biases, thereby affecting the reliability and interpretability of the reported outcomes. These constraints highlight the need for more significant, methodologically rigorous, and contextually diverse research designs in future investigations of vocabulary interventions for learners with ASD. Accordingly, several recommendations for future research are proposed.

1. Larger and multisite trials: future research should include larger, more diverse groups across multiple schools or settings to improve generalizability. Including participants from different linguistic, cultural, and socio-economic backgrounds will help ensure findings are widely applicable.
2. Longitudinal assessments: studies should track learners over longer periods to see whether vocabulary gains are maintained and transferred to new contexts and everyday communication. This will also help understand how vocabulary develops over time in learners with ASD.
3. Comparative intervention designs: research should compare technology-based and teacher-led interventions to determine which works best for different learners. Studies could also explore combined approaches that use both technology and teacher guidance.
4. Integration of cognitive and social factors: future research should examine how attention, engagement, and language skills influence learning outcomes. Understanding these factors can help

create more personalized interventions for learners with ASD.

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8. Author Declaration

Ethical considerations

Not applicable.

Use of artificial intelligence (AI)

The authors declare that the generative artificial intelligence (AI) tool ChatGPT was used exclusively for language editing and/or grammatical improvement. The use of AI did not influence the scientific content, study design, data analysis, data interpretation, results, or conclusions of the manuscript. Full responsibility for the content remains with the authors.

Conflict of Interest

The authors declare no conflicts of interest.

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