People's Democratic Republic of Algeria

Ministry of Higher Education and Scientific Research
Kasdi Merbah Ouargla University

Faculty of Letters and Languages

Department of Letters and English Language

Dissertation submitted in partial fulfillment of the requirement for the Master's Degree in field of English language and literature

Major**: Linguistics**

Recognition of English Vocabulary to Students with Special Needs

Using Multimodal Language Learning: An AI-Based Approach

Presented and publicly defended by

Ilham BADIS

Supervised by

Dr. Saifeddine GUENDOUZ

Jury Members

Dr. Walid MESSOUDI	President	MCB	Kasdi Merbah Ouargla University
Pr. Ahmed Noureddine BELARBI	Examiner	Prof	Kasdi Merbah Ouargla University
Dr. Saifeddine GUENDOUEZ	Supervisor	MCB	Kasdi Merbah Ouargla University

Academic Year: **2025 / 2026**

Dedication

To my parents, for their endless sacrifices and unconditional love;

To my brothers Sohaib, Mortadha, and Louay, and my sister Sidra, for their unwavering support and warmth;

To my supervisor, ***Dr. Saifeddine Guendouz***, for his exemplary guidance and constant encouragement ;

And to my dear friends Yousra and Lina for their steadfast companionship.

To Hafid and Msimou. Issou, my Isra, who has been more than a friend—like a sister to me—for her unconditional love, kindness, and belief in me.

This thesis is also dedicated to all Special Needs Students.

Your resilience is the soul of this research.

May this work honour your voices and bring you closer to a world that truly sees, understands, and embraces you.

This achievement belongs to all who believed in me when I doubted myself.

— Ilham

Acknowledgments

Foremost, I offer my deepest gratitude to Allah, the Most Gracious and the Most Merciful. With sincere appreciation, I thank all who walked beside me on this path.

I express my deepest gratitude to my esteemed supervisor, ***Dr. Saifeddine Guendouz***, for his invaluable support, insightful guidance, and unwavering patience throughout this research journey. His expertise, thoughtful feedback, and encouragement were instrumental in shaping this work.

Above all, I am profoundly grateful to my family and friends for their unwavering love, sacrifices, and steadfast belief in me. This achievement is as much theirs as it is mine.

To all who offered quiet support in their own way: ***your presence made the difficult moments bearable and stood behind every step I took.***

And to the quiet strength within me: ***thank you for refusing to give up. This thesis is a testament to persistence, dedication, and love.***

With heartfelt gratitude,

Ilham.

Abstract

This thesis examines the effectiveness of Artificial Intelligence (AI)-based interventions to improve students' language acquisition and communication skills for students with Special Educational Needs (SEN). Considering the considerable communication barriers encountered by these learners, this study explores the possibilities of adaptive AI technologies (i.e., speech recognition tools, interactive digital platforms, and AI-enabled virtual learning assistants) in enabling personalized, flexible, and interactive pedagogical pathways. The research is grounded in the current cognitive, linguistic and multimodal learning theories and deals with the wider issues within special education classrooms where the emotional, cognitive and behavioral challenges of SEN students are discussed. Ultimately, the findings underscore the trans-formative potential of AI to foster an inclusive, comprehensive, and adaptive language learning environment. Concurrently, the study addresses critical structural challenges, emphasizing the necessity of digital accessibility, rigorous data ethics, and specialized professional development for special education teachers.

Keywords: Artificial Intelligence, Special Educational Needs, Classroom Interventions, Multimodal Language Learning, Inclusive Education.

List of Abbreviations

AI: Artificial Intelligence.

ABA: Applied Behavior Analysis.

AR: Augmented Reality.

ASD: Autism Spectrum Disorder.

BCI: Brain-Computer Interface.

DLD: Developmental Language Disorder.

DTT: Discrete Trial Teaching.

EIBI: Early Intensive Behavioral Intervention.

EFL: English as a Foreign Language.

ESL: English as a Second Language.

ICT: Information and Communication Technology.

LD: Learning Disabilities.

L2: Second Language.

MLL: Multimodal Language Learning.

NET: Natural Environment Teaching.

SEN: Special Educational Needs.

SPSS: Statistical Package for the Social Sciences.

VR: Virtual Reality.

List of Tables

List of Figures

Table of Contents

GENERAL INTRODUCTION

Background of the study

Language education is a broad term that involves holistic pursuit of knowledge, functional skills, and real-world experiences. This aligns with the classically understanding that education is the sum total of the experience shaping attitude and determining conduct (John Dewey, 1938). However, the English language instruction has shifted over the last few generations from teacher-centered, textbook-based instruction to learner-centered and technology-enhanced methods that incorporate interactive tasks, multimedia, and visual elements that foster language and cognitive development.

These elements are fruitful in developing children's cognitive skills. In particular, children who have troubles with typical mono-modal instruction, multi-modal language learning environments that combine spoken input, written text, visual cues, and gestures. Interestingly, all of the aforementioned elements have been tested to boost engagement and enhance their cognitive skills (Mayer, 2021).

AI-supported multi-modal instruction may offer specific pacing, repeated exposure, and multimodal scaffolding for students in special education, including learning disabilities, attention disorders, or sensory impairments. These components serve as a crucial implement to ensure that students acquire basic language skills and vocabulary, when the basic traditional interventions such as speech therapy, Applied Behavior Analysis (ABA), and structured teaching programs may not be feasible in all the Special Educational Needs (SEN) circumstances (Smith & Iadarola, 2015).

In a controlled, AI-driven avatars may demonstrate English traversing synchronized speech, facial expressions, and on-screen text, sustaining concentration and addressing a range of learning styles. An AI-based multi-modal approach may be particularly interesting for SEN learners, as evidenced by recent pilot projects using AI avatars in special needs contexts, which report improvements in motivation, classroom participation, and English language

performance. However, there is currently little empirical research on the specific difficulties teachers may encounter when implementing this strategy, as well as how such avatars can be used in English language classrooms for students with special needs in Algerian contexts.

Aim of the study

This study aims to investigate the use of AI-based multi-modal language learning, with a focus on animated avatars. To be more precise, teaching English to students with special needs in an Algerian educational setting. Moreover, it aims to assess vocabulary level for students of English with special needs as well as testing their basic language skills, and investigating whether they can be improved over a predetermined instructional period through avatar-mediated and multi-modal lessons.

More than that, the study intends to provide helpful recommendations for educators, school officials, and legislators interested in incorporating AI-based multi-modal tools into English language curricula for special needs students in Algeria and comparable contexts by capturing both learning benefits and implementation difficulties.

Significance of the study

The contribution of the present dissertation is to bring up an empirically proven understanding of whether AI-powered avatars can be a useful pedagogical tool to improve inclusive English language instruction for SEN students, as well as determining whether the existing circumstances taken in this approach is effective or not.

After evaluating the effectiveness of these AI-based interventions, it may also contribute to the expanding body of research in special education and technological pedagogy. That is to say, few have focused on AI avatars created especially for English language learning with SEN students.

Research questions

The present study seeks to answer the following questions:

To what extent does AI-based multimodal language learning, through avatars-assisted instruction, enhance the English proficiency of students with special educational needs?

To what extent is the implementation of a multimodal, avatar-based approach feasible for teaching English vocabulary to students in special education in Algeria?

Hypotheses

This study hypotheses that the Avatar-based Multi-modal Language Learning will significantly improve the English proficiency of students with special needs, especially in vocabulary recognition and simple sentence comprehension.

While teachers will perceive avatar-based MLL as engaging and potentially beneficial for SEN learners, might grow hindered by practical issues related to classroom management, infrastructure, and training in Algerian English language institutions.

Methodology

Tools of data collection

A sample of ten (10) students with special needs who are enrolled in a specialized center in Touggourt will be used in the study. Three (03) series of sessions centered around greetings and introductions, asking for help, and increasing engagements. During all the three sessions, students are going to be taught using avatars. Interestingly, the avatars are created using HeyGen application, and with each instructional video strictly limited to a one-minute duration.

On the other hand, teachers in the institution will be called to participate in an unstructured questionnaire to get their opinions on the value of multi-modal language learning with avatars for students with special needs.

Tools of data analysis

To analyze the outcome data, the computer software system Statistical Package for the Social Sciences (SPSS) is used (IBM Corp., 2021). Utilizing descriptive statistical software simplified the interpretation of the quantitative performance metrics, allowing for a clear view

of how the students progressed during the treatment. SPSS enabled data interpretation trustworthy and made it effortless to identify patterns and connections within the data gather.

Limitation of the study

Despite the useful outcomes of this paper, several limitations affected the research process and the generalization of the findings. First, special needs students commonly need more time, individualized support, and repeated explanations; this can slow down the intervention and make it challenging to cover a lot of material in the allotted sessions.

Second, the time length at hand for data collection was limited due to potential obstacles on access to institutions that work with students possessing special needs and potential delays in formal administrative approval. In addition, the results are not sufficient because they are not applicable to all SEN students or schools in Algeria due to the small sample size and the research's narrow focus on one institution.

Structure of the dissertation

The dissertation will be divided into two main chapters in addition to the general introduction and conclusion. To begin with, chapter one will be devoted to theoretical issues. That is to say, It will define Multimodal Language Learning (MLL), list its primary forms while offering particular circumstances of how the implication of multiple modes that may assist in vocabulary learning and language proficiency. It presents an examination of how MLL can be embodied in AI, with a particular emphasis on avatars as AI-based agents that combine text, images, audio, video, and gestures to give a number of learners immersive English learning experiences.

As for chapter two, which is a practical part**,** will present the analysis and the discussion of the three sessions, as well the obtained results of the post-tests. Moreover, the analysis of the teachers' questionnaire will be analyzed and extensively discussed.

CHAPTER ONE:

THEORETICAL PART

Introduction

The following chapter discusses theoretical issues related to Multimodal language Learning and aspects related to Special Needs education. It provides the reader with clear understanding of how these elements interact to coin a methodologically applicable approaches to teaching special needs pupils.

Multimodal Language Learning (MLL)

MLL views language acquisition as a process of meaning construction that occurs across various semiotic modes, rather than being limited to spoken or written forms. In addition, it treats language learning as a process that happens through several modes at the same time, such as written text, spoken language, images, sounds, and gestures to construct and interpret meaning. Instead of presenting learners with decontextualized written texts or isolated audio tracks, MLL encourages tasks to present English through rich input, for example, videos with subtitles, picture supported stories, digital storytelling, and interactive tasks where learners empower their language and cognitive skills. (Kress, 2010).

To be more precise, this approach is supported by basic cognitive and sociocultural frameworks. Allan Pavio's (1986) Dual-Coding Theory and Richard Mayer's Cognitive Theory Of Multimedia Learning holds that learning is enhanced when information is encoded through verbal and non-verbal channels to improve the learner mental representations to recall the information. For instance, Mayer (2021) agree that the memory capture the information more effectively through words, audios and pictures. Moreover, Kress (2010) believe that sociocultural perspective also has a crucial role in meaning building, which in modern contexts tend to be multimodal, include visuals, computer interfaces, and interactive media. As a result, limiting language teaching to a single mode of input grows more contrary with the communicative practices learners experience beyond the classroom.

AI and MLL

AI is a broad term that involves the systems and technologies may replicate human intelligence to carry out tasks without human control. This term was firstly used in 1956 at a workshop held by John McCarthy and notable figures such as Claude Shannon at the Dartmouth College. This technology is built on algorithms that combine learning, reasoning, and self-improvement capabilities that are the foundation of AI, which allows computers to evaluate data, make conclusions, and generate suitable alternatives. Although, these systems are explicitly designed to sign activities that generally necessitate human intelligence, including language proficiency, pattern recognition, problem-solving, and decision-making in several context (Russell & Norvig, 2021).

In education, this system has made a significant contribution in language learning and teaching by the act of speech recognition and text to-speech. In addition, it gives access to several noted experiences such as to monitor students' proficiency, isolate specific learning blocks, identify their level, create personalized classroom stages and exercises as tailored vocabulary drills, pronunciation feedback, or grammar practice. Luckin et al. (2016) explain that when these adaptive AI features work together with multimedia tools, they may coordinate speech, text, images, and interactive elements to create highly personalized multimodal learning experiences for each student.

Emerging MLL with the AI-mediated classrooms represent an active and flexible process to language acquisition. Moreover, educators can use these technologies to gain time and modern materials that serves the learners challenges. AI-driven avatars and intelligent tutoring agents materialize MLL principles by integrating spoken language, on-screen text, facial expressions, and gestures during instructional interaction, and these systems also integrate text, voice, facial expression, gesture recognition, and emotional intelligence to simulate human-

like interactions that adapt individual learners, with animated interface agents' technologies that can interact with learners (Kessler, 2018).

2.1 AI for pedagogical purposes

According to Shaikh (2025), technology tools like Information and Communication Technology (ICT) can change how people teach and present lessons more dynamic and engaging. So that technologies have grown in order to improve the learning process in language education. This study explores innovative approaches to teaching English as a Second Language (ESL) by integrating technology to enhance learning outcomes, which can increase student motivation and engagement, and improve the language proficiency for ESL students in any learning context. Thus, technology integration allows teachers to customize learning experiences to meet the needs of individual students, and the use of educational technology tools helps to increase student engagement and promote positive language learning outcomes.

Pedagogically, Luckin et al. (2016), the literature constantly highlights that AI should serve as an addition to, rather than a substitute for, teacher expertise, with educators retaining primary responsibility for relational dynamics, ethical judgment, and higher-order instructional decision-making. In a similar vein, Holmes et al. (2019), present a study that is for a meaningful integration of AI into educational practice, careful alignment with curricular standards, intensive attention to ethical and privacy considerations, and thorough professional development for educators are needed.

2.1.1 AI in language education and adaptive teaching

As an increasing number of institutions implement AI-systems to track and assess the learning settings, it shows also lack in numerous contexts by the teachers' limited digital literacy and infrastructural deficits. In Algeria, despite the fact teachers are open to utilizing technology in the classroom, there are still many problems that render it hard to do so effectively. In that, such challenges include unreliable internet connections, a shortage of

equipment, and fragmented professional development programs (Bensaber & Belkacem, 2024).

These systemic limitations considerably hinder teachers' ability to provide contextually relevant, without solid foundational training in both teaching and technological skills, instructors cannot provide AI-enhanced instruction that corresponds with students' linguistic skills and sociocultural contexts.

2.1.2 Improving language learning and technology types

The deployment of technology in language learning refers to the integration of computers, and platforms into the process of learning and acquiring the four skills. AI-enabled platforms can adapt task difficulty, pacing, and feedback to each learner cognitive level, aiming to keep them within an appropriate setting of proximal development (Holmes et al., 2019).

These technologies incorporate software and hardware applications for electronics to make the acquiring experiences effective and easy, additionally it enhances the learners' capacities through generating dynamic, engaging, and interactive environments. Resulting in, it makes it achievable for individualized instruction, quick feedback, and exposure to a variety of resources, all of those are meant to enhance language learning. (Holmes et al., 2019).

Adaptive technologies utilize these ideas in different ways. On-screen apps use AI to schedule for vocabulary review and pronunciation in the language use. Online platforms in the other hand include texts, videos, listening exercises, interactive tests, and sometimes simple chat bots for practicing in writing and speaking. Thus, virtual environments can make language use more into real life contexts by allowing learners transfer smoothly in simulated settings and interact with language and avatars through multimodal activities to help students improve in a memorable and organized process. (Holmes et al., 2019).

2.2 AI in special education

AI technologies, such as wearable sensors and machine learning algorithms, are extensively utilized in the observation and comprehension of behaviors in children with special needs. AI use in special education central purpose is to help students whose learning abilities are different from those of most students because they have cognitive, sensory, behavioral, emotional, or communicative differences. (Aliu, 2024).

Latest studies present that AI facilitates profound personalization of learning by tailoring facts and recommendations to each student's distinct requirements through adaptive and assistive technology. AI can enhance these practices by facilitating systems that simulate individual learning trajectories, adapt instructional parameters in real time, and supply multimodal supports customized to particular profiles of strengths and challenges (Aliu, 2024). One can clearly notice that these platforms enhance instructional content delivery while simultaneously offering new levels of interactivity and accessibility for students with cognitive limitations.

2.2.1 Successful cases of individualized AI-driven in special education

Recent advancements in AI have made way for more individualized and personalized learning tools for children with special needs. In a study conducted by Wang (2024), he emphasized the role of AI-driven intervention in language learning indeed and the effectiveness of development in AI emergence to tailor and customize educational tools for children with special needs.

Moreover, Adako et al. (2024) highlight the crucial role of personalization and individualization in AI-driven educational programs that focus on individualized planning, differentiated instruction, and assistive technologies. AI can improve these methods by creating systems that model each individual learning path, adapt the parameters of instruction in real time, and deliver multimodal supports that are model to each student strengths and weaknesses.

2.2.2 A Case Study: Personalized learning platforms

AI-driven personalized learning platforms are advanced tools for learning a second language as they change the way traditional lessons are delivered based on all of their pace, strengths, and weaknesses (Ziegler, 2016). These systems provide focused pronunciation feedback, adapted vocabulary exposure, and grammar correction in accordance with real-time performance assessments (Godwin-Jones, 2011). What sets them apart from traditional uniform instruction is their ability to improve skill development for people of all skill levels.

Empirical studies validate that these platforms notably improve learners' motivation and linguistic proficiency, especially in diverse classrooms where traditional approaches are insufficient (Kessler, 2018). When culturally responsive—integrating local pragmatic norms and contextual references—their influence becomes significantly trans-formative, resulting in considerable improvements in fluency and communicative confidence. This shows how AI would make a second language learning more personalized and accessible to each individual. (Al-Mekhlafi et al., 2025).

2.2.3 Social skills training for SEN students

Virtual and augmented reality (VR/AR) technologies show significant effectiveness across various special needs groups, including autism spectrum disorder (ASD), dyslexia, Attention-Deficit/hyperactivity Disorder (ADHD), and learning disabilities, by offering immersive environments tailored to individual cognitive and sensory profiles (Parong et al., 2023).

Systematic reviews show that VR interventions greatly improve social skills, recognizing emotions, and executive functioning within students with intellectual disabilities. Typical AR apps, on the other hand, help students with dyslexia and dyscalculia improve their reading comprehension and fine motor skills through interactive, multi-sensory scaffolds (Standing et al., 2024).

These platforms are beneficial at capture individuals engaged through gamified repetition and controlled complexity. This lets people safely practice real-world skills that traditional methods commonly hinder the learning process.

SEN students benefit from technology-enabled interventions via AR and VR as social skills training. Through virtual settings made possible through these VR tools, learners can mimic social interactions in a controlled yet engaging way. However according to a systematic assessment of 41 studies revealed significant gains in executive functioning, social awareness, cooperation, and emotion perception. Furthermore, AR and VR's engaging and motivating qualities were particularly helpful for maintaining focus and practicing social behaviors repeatedly, positioning the technology in a position to be significant supplements to inclusive educational systems (Mosher & Carreon, 2021).

2.2.4 Language Learning Apps

Mobile language learning apps have become highly effective tools for teaching a second language since their flexibility to personalize and contextualize students practice outside the classroom (Godwin-Jones, 2011). These platforms usually offer short, focused exercises in vocabulary, grammar, listening, and pronunciation, along with AI-driven tools like spaced repetition, speech recognition, and adaptive sequencing (Ziegler, 2016).

Systematic reviews emphasize the importance of pedagogical rigor in conjunction with intuitive interfaces and multimodal content integration to optimize instructional effectiveness (Plonsky & Ziegler, 2016). Most apps are ideal for receptive skills, but the most effective ones encourage real communication practice by using interactive scenarios and language in context.

2.2.5 Online Language courses

Online language courses tend to simply defined in collections of lectures and tests that have been recorded to fully functional platforms with interactive multimedia content, discussion

boards, synchronous sessions, and AI-enhanced features (Zhao, 2020). Many of these courses easily correspond with MLL concepts since they use multiple modes of instruction, including text, audio, video, and interactive tasks.

Within a single digital environment, students observe explanations, read transcripts, listen to conversations, take part in written or oral discussions, and finish graded tasks. As an example of AI features in online courses highlighted by Holmes et al, (2019), adaptive evaluation, automated feedback on spoken and written work, and recommendation systems that direct students to relevant resources are examples of AI features in online courses.

The transition toward e-language training has prompted reflection on efficient teaching strategies in digital settings. In addition to multimedia content and online activities, extended e-foreign language learning courses also have a strong pedagogy at their core that supports student autonomy and involvement. Additionally, the results show that by addressing the cognitive, effective, and social aspects of language acquisition, instructional design that is in line with solid theoretical frameworks maximizes the learning impact of the online environment. However, courses that incorporate these ideas through goal-setting, guided feedback, and responsive content have shown greater success in raising learner engagement and linguistic competency (Sadykova et al., 2020).

2.3. Exploring difficulties faced by students with special needs

2.3.1. Discrete Trial Training in Autism Education

The most popular solution in the education of people with autism is Discrete Trial Teaching (DTT), but both parents and teachers find it highly challenging to use it effectively. However, Booth and Keenan (2018) highlight the effectiveness of various training methods while addressing the difficulty parents encounter when implementing DTT techniques on their own. contrasting three approaches: animated courses, PowerPoint presentations, and text-based training.

The study was conducted to determine the most effective method for instructing parents on DTT at home. The results showed that animated tutorials were the most effective helping parents recognize and fix mistakes when performing DTT at home. This would imply that more interactive and participatory training materials are needed to acquaint parents with the subtleties associated with DTT, as standard text-based instruction may not be adequate.

In fact, the study indicates that training practices should be enhanced to help parents deal with issues they encounter, improve the quality of autism intervention over time, and create more effective learning opportunities for kids with ASD. (Booth & Keenan, 2018).

2.3.2 Early Intensive Behavioral Intervention (EIBI)

The ultimate objective of EIBI a methodical, evidence-based treatment based on Applied Behavior Analysis (ABA), is to address the major deficiencies of ASD in young children. EIBI generally begins before the age of six and consists of 20-40 hours per week of one-on-one therapy with the goal of improving socialization, communication, and adaptive behavior while reducing maladaptive behavior using systematic teaching methods like Natural Environment Teaching (NET) and DTT. Evidence suggests that EIBI has significant effects on language development, adaptive behavior, and IQ.

EIBI also emphasizes the significance of individualized treatment programs that take into account each child's needs and strengths. Therefore, parents' involvement, intensity of treatment and quality of supervision are all crucial achieving an impact on outcomes. Future researches should attempt to further intervention on EIBI protocols, identify predictive indicators of treatment, and explore long-term maintenance of early intervention gains (Eikeseth, 2017).

2.3.3. Incidental Teaching

Incidental teaching is a child-directed, naturalistic teaching approach that is derived from ABA. It takes advantage of naturally occurring situations to teach social and language skills

within the child's environment. Unlike structured teaching, Incidental teaching involves waiting for the child to initiate an interaction, followed by prompts or inquiries from the instructor to elicit more complex responses. This approach promotes generalization of skills between environments and contexts, the reason why Mazzuchelli (2006) highlights this notion as being especially suitable for improving language development because it is flexible enough to use on a regular basis, making it a useful tool for both educators and parents.

It has been shown that incidental teaching is quite successful in improving the different skills of adolescents with ASD. For example, McGee et al. (1985) found that this intervention did lead to linguistic generalization between trainers and settings and the spontaneous use of prepositions. Additionally, McGee et al. (1983) demonstrated the effectiveness of the object identification training method with the ensuing improvement in receptive language. These results support the importance of incidental teaching in all-encompassing intervention programs for kids with ASD. The approach not only improves skill acquisition but also raises learners' levels of interest and engagement since learning is integrated into natural interaction.

2.3.4. Autistic students

In order to address the many developmental demands of children with ASD, educational interventions must be well-planned, team-based, and context-responsive. The National Autism Society of Malaysia (NASOM) facility in Kuantan performed a case study that examined how these kinds of educational interventions are provided. The results supported the need for tailored instruction and cooperation. The nature of services offered, difficulties faced by educators, and the significance of public awareness were the three areas of focus that the study determined based on the observations and questionnaires. (Dania et al, 2023).

The "Theory of the Stakeholder Convergence of the Ideal Ambiance for Children with Autism," an intriguing theoretical model put out by the researchers, calls for the coordinated efforts of families, educators, and society at large. As a result, this paradigm promotes

cooperative settings where problems like behavior control, student skill gaps, and public ignorance may be addressed with cooperation and assistance (Dania et al., 2023).

2.3.5. Emotional impairment

Students with Learning Disabilities (LD) typically encounter increased emotional difficulties like Anxiety, despair, and poor self-esteem which have an impact on their academic performance. These emotional difficulties are not accidental; rather, they are directly related to the widespread scholastic setbacks and social exclusion that many adolescent students with LD experience during their school years. Strong evidence for the presence of this link is presented by Stathopoulou and Karathanasi (2023), who emphasize that students with LD frequently feel overburdened by academic demands, which leads to feelings of inadequacy and despair.

This psychological burden can start a vicious cycle in which learning is hampered by psychological issues, and emotional anguish is exacerbated by academic failure. As a result, this emotional load may imprison the person in a vicious circle of negativity where psychological anguish hinders learning and low grades exacerbate emotional pain. (Karathanasin & Stathopoulou, 2023)

2.3.6. Cognitive impairment and Neuro-Educational Tecnologies

This study shows that interactive gaming and neuroscience could work together to create new models that help children with special needs learn and grow cognitively. Incorporating Brain-Computer Interface (BCI) technology into learning programs offers a tailored and interactive method to tackle the various cognitive difficulties encountered by students with disabilities, such as ASD, ADHD, and learning disabilities. (Karathanasin & Stathopoulou, 2023)

These game-based platforms improve motivation, keep attention, and improve executive functioning by giving instant feedback and changing to each person's neural activity patterns.

Special needs learners often have a lot of trouble in these areas. Recent neuron-educational research substantiates that adaptive BCI systems promote significant enhancements in working memory, emotional regulation, and academic engagement among neuron-diverse populations when judiciously incorporated into inclusive educational methodologies. (Fairclough, 2022)

2.3.7. Behavioral impairment

Students with special needs frequently display distinctive behaviors that profoundly influence their social interactions and educational settings. Extensive research conducted across various special education centers has systematically analyzed behavioral patterns in children aged 6-12 years with a range of disabilities, including ASD, ADHD, intellectual disabilities, and learning disabilities. Results consistently indicate pronounced inclinations towards social withdrawal, increased anxiety in unfamiliar contexts, and fixation on objects or reluctance to transition between activities or relinquish possessions. These behaviors make it very hard for students to interact with their peers, participate in class, and adapt to new situations in inclusive classrooms (Ayasrah et al., 2022).

Moreover, the found patterns stem from fundamental neuron-developmental issues, including compromised social reciprocity, sensory processing challenges, and executive function deficits. They require specific, evidence-based interventions to foster significant social competence and academic inclusion.

Comprehensive analyses show that special needs students have very different behavioral problems depending on their age, gender, and length of educational support. For example, male students and older children (usually over 10 years old) consistently show more externalizing behaviors like aggression and hyperactivity, while students who receive interventions for shorter periods of time show more internalizing problems like withdrawal and anxiety. These patterns show how important it is to intervene early and consistently to stop behavior from getting worse and help students develop adaptive skills across a range of disabilities.

Individualized support strategies that are tailored to the student's developmental stage and length of enrollment are still necessary to improve social and academic outcomes in inclusive school settings (Alkahtani, 2017; Sheldrick et al., 2019).

Conclusion

In conclusion, this chapter has shown that the combination of AI and customized teaching approaches significantly shifts the way that children with special needs learn, successfully meeting their varied cognitive, sensory, and behavioral needs. Teachers can use AI's adaptive skills to design inclusive, personalized, and stimulating learning environments for students with a variety of disorders, including dyslexia, autism, ADHD, and cerebral impairments.

The analysis emphasizes how crucial it is for educational researchers, technology developers, and practitioners to work together consistently in order to remove implementation obstacles and guarantee that all students with special needs have fair access to evidence-based digital learning solutions.

Literature Review

Introduction

Language acquisition poses significant challenges for children with special needs, including ASD, Developmental Language Disorder (DLD), dyslexia, attention deficit hyperactivity disorder (ADHD), and speech impairments, as conventional monodisciplinary methods often fail to address diverse cognitive, sensory, and attentional profiles. MLL as framed by Kressian social semiotics, facilitates meaning-making across linguistic, visual, gestural, spatial, and aural modalities, in accordance with Paivio (1986) and Mayer (2021) who assert that retention is enhanced through synchronized verbal and nonverbal channels.

AI enhances this framework through adaptive algorithms that tailor pacing, deliver real-time feedback, and provide scaffolding within Vygotskian Zones of Proximal Development (ZPD). This is especially crucial for SEN learners whose language development diverges from neurotypical standards (Holmes et al., 2019; Luckin et al., 2016).

Early AI applications in SEN language instruction demonstrated initial effectiveness. Xing (2023) showed that AI-powered robots and virtual agents can help people with ASD communicate better by using multimodal feedback loops that combine speech recognition, facial expression analysis, and gesture mirroring. This led to moderate gains in joint attention (d=0.72). El Shemy (2022) confirmed the efficacy of mobile augmented reality (AR) applications for vocabulary acquisition in individuals with ASD demonstrating that visual-auditory scaffolds enhance recall. These principles may also be applicable to phonological mapping in dyslexia through phoneme-visual integration. In addition to these, Porayska-Pomsta et al. (2018) were the first to use hybrid human-AI paradigms, where virtual agents helped ASD dyads take turns talking to each other. This led to a 40% improvement in reciprocity when a human was in charge, showing that this method works well for a wider range of SEN applications.

Advanced multimodal innovations use generative models to make them scalable. Adako et al. (2024) recorded LLM-driven avatars customizing MLL for autistic inclusive, adjusting content to ZPD gradients through real-time analytic and synchronized speech-gesture-text delivery. Li et al. (2025) documented quasi-experimental improvements in DLD expressive syntax (Cohen's d=1.04) resulting from classroom interventions that integrated AI analytics, gestural prompts, and tactile supports. Hartley (2019) identified atypical receptive-expressive disparities within SEN, promoting early structured multisensory interventions, whereas Núñez (2021) developed metacognitive EFL routines incorporating visual-gestural scaffolding, enhancing neurodiverse participation by 35%.

Synergies with immersive technologies further enhance outcomes. Wang (2024) emphasized VR-AI integrations for home-based therapy, that language-delayed children narrated scenarios through gamified multisensory loops, resulting in a 28% increase in spontaneous utterances. Parong et al. (2023) validated the effectiveness of VR in addressing social-emotional skills in individuals with ASD, dyslexia, and ADHD (Tau-U=0.98), while AR enhanced motor skills in dyscalculia through interactive scaffolds (Standen et al., 2024). In Algeria, unreliable connectivity and a lack of training make it necessary to use low-bandwidth avatar solutions like HeyGen, which were tested in Touggourt SEN centers.

Behavioral and cognitive impairments highlight the necessity for tailored interventions. In a study by Ayasrah et al. (2022), researchers identified specific patterns among children with special educational needs (SEN), such as social withdrawal, anxiety in new situations, and an intense focus on objects, that hinder their ability to interact effectively.

They noted that boys and older children, especially those over 10 years old, tend to display more pronounced externalizing behaviors. Intervention needs are contextualized by behavioral and cognitive deficits. Ayasrah et al. (2022) identified SEN patterns of social withdrawal, novel-situation anxiety, and object fixation impeding reciprocity, with males and older children

(>10 years) exhibiting heightened externalizing behaviors. Early, customized approaches to prevent escalation were highlighted by Alkahtani (2017) and Sheldrick et al. (2019), who matched AI avatars with incidental education derived from ABA (McGee et al., 1983) for realistic generalization.

Limitations still exist despite convergent data from engagement measures, pragmatics, and vocabulary: Limits of ASD-centrism DLD/dyslexia generalizability; algorithmic biases in neurodiverse training data are still not well studied; small-scale pilots lack longitudinal rigor. Interdisciplinary frameworks are necessary to address ethical imperatives such as data privacy, teacher agency, and cultural responsiveness, especially in situations with limited resources like Algeria (Bensaber & Belkacem, 2024).

Conclusion

To summarize, this analysis of research demonstrates how beneficial it may be to use intelligence to assist kids with unique challenges in learning languages. It helps students with autism, language impairments, dyslexia, attention deficit hyperactivity disorder, and speech issues by combining concepts like Kressian semiotics with Vygotskian scaffolding. Research has demonstrated the effectiveness of this approach. Pupils pick up vocabulary and improve their interpersonal communication skills. Additionally, people enjoy studying more when they use virtual reality and computer applications with avatars. These applications can be utilized in locations with sluggish internet. There are still certain issues, though the majority of these programs may not be effective for students with language difficulties because they are intended for students with autism. Additionally, the majority of these programs.

Additionally, the majority of these programs have only been tested for a short period of time, and we are unsure of their long-term viability. The developers of these programs must also ensure that they are equitable and effective for all students. This study in Touggourt

examines the effectiveness of a computer program called HeyGen. Teachers and researchers must work in the future to ensure that all students have equal access to language learning programs, which will help students with needs all over the world learn languages in a way that is equitable and effective for them.

CHAPTER TWO:

PRACTICAL PART

Introduction

This chapter presents the practical part of the study, which explores the role of AI-based multimodal language learning tools in enhancing English learning for students with special educational needs at a specialized center in Touggourt, Algeria. It includes the analysis of teachers' questionnaire responses and the interpretation of the case study sessions conducted with SEN learners using HeyGen avatars.

2. Interpretation of the Findings

2.1. Teachers' Questionnaire

The following table present the responses of teachers regarding different aspects of didatics and the use of AI-based multimodal tools in SEN education. To gather in-depth qualitative data, a semi-structured questionnaire was conducted with teachers working in the specialized center. The questionnaire questions were designed to examine teachers' perceptions of AI-based multimodal language learning, the educational needs of SEN learners, the benefits of avatar-based instruction, and the practical challenges involved in implementation.

Teachers' questionnaire Discussion Tables

Table 1: How do you describe the role of technology in supporting language learning for students with special educational needs?

Sample Responses	
Teacher 1: Technology makes learning more concrete and easier to understand, especially for students with attention and communication difficulties.	**Teacher 2:** Technology is useful as a support tool, but it should not replace direct teaching.

Disccussion:

Both teachers view technology positively, but Teacher 1 emphasizes accessibility and engagement, while Teacher 2 stresses the central role of the teacher.

Table 2: What are the main linguistic and behavioral difficulties faced by SEN students when learning English?

Sample Responses	
Teacher 1: Students have limited vocabulary, weak pronunciation, and difficulty remembering new words.	**Teacher 2:** Students also show shyness, anxiety, and reluctance to participate orally.

Disccussion: The two teachers agree on vocabulary and attention difficulties, but Teacher 2 gives greater importance to emotional and participation-related issues

Table 3: How effective are multimodal tools, such as avatars combining speech, text, and gestures, in attracting students' attention and supporting learning?

Sample Responses	
Teacher 1: These tools are very effective because students learn better when they see, hear, and observe actions at the same time.	**Teacher 2:** They are effective, especially for simple language, but their success depends on how the teacher uses them.

Disccussion: Both teachers recognize the pedagogical value of multimodal tools, although Teacher 1 focuses more on student engagement and Teacher 2 on instructional use.

Table 4: To what extent do you think avatar-based instruction can improve vocabulary acquisition and basic language comprehension among SEN learners?

Sample Responses	
Teacher 1: It can improve vocabulary significantly through repetition and visual support.	**Teacher 2:** It can help, especially with simple words and expressions, but it works best with teacher explanation.

Disccussion: Both teachers believe avatar-based instruction supports vocabulary learning, but Teacher 2 sees it as more effective when combined with teacher-led repetition.

Table 5: What advantages do you observe in using AI-based multimodal tools compared with traditional teaching methods?

Sample Responses	
Teacher 1: Lessons become more attractive, and students are more motivated.	**Teacher 2:** The same content can be presented in different forms, which helps diverse learners.

Disccussion: Both teachers see AI-based tools as beneficial, but Teacher 1 highlights motivation while Teacher 2 highlights flexibility and adaptation to learner differences.

Table 6: What challenges might teachers encounter when integrating AI-based tools into SEN classrooms?

Sample Responses	
Teacher 1: The main challenge is the lack of equipment and unstable internet connection.	**Teacher 2:** Teacher training is also a major challenge, even when equipment is available.

Disccussion: Both responses identify implementation barriers, but Teacher 1 focuses on infrastructure and Teacher 2 on professional training.

Table 7: How do classroom conditions affect the use of technology in your teaching context?

Sample Responses	
Teacher 1: Technology is useful when the classroom has the necessary devices and internet access.	**Teacher 2:** Time management is also important because SEN students need more explanation and repetition.

Disccussion: Both teachers agree that classroom conditions are decisive, while Teacher 1 stresses material resources and Teacher 2 stresses time constraints.

Table 8: How do classroom conditions affect the use of technology in your teaching context?

Sample Responses	
Teacher 1: Teachers need practical training with simple demonstrations and examples.	**Teacher 2:** Teachers also need continuous support, follow-up workshops, and technical assistance.

Disccussion: Both teachers agree on the importance of training, but Teacher 2 emphasizes ongoing professional development rather than one-time training.

Table 9: How suitable is avatar-based instruction for different categories of SEN students, such as children with ASD or language difficulties?

Sample Responses	
Teacher 1: It is especially suitable for students with ASD because they respond well to visual structure and predictable patterns.	**Teacher 2:** It is suitable, but it must be adapted to each child's level and pace.

Disccussion: Both teachers consider avatar-based instruction appropriate for SEN learners, while Teacher 2 gives greater importance to individual adaptation.

Table 10: What recommendations would you give for improving the use of AI-based multimodal language learning in special education settings in Algeria?

Sample Responses	
Teacher 1: Better equipment, stable internet, and more training are necessary.	**Teacher 2:** The content should also be adapted to the local context and the students' daily learning needs.

Disccussion: Both teachers recommend improvements, but Teacher 1 focuses on infrastructure and training, whereas Teacher 2 emphasizes contextual relevance of content.

2.1.2 Conclusion

In summary, the results of this study suggest that teachers have a generally positive attitude towards AI-based multimodal language learning for students with special educational needs. The questionnaire responses demonstrate that these types of tools, and avatar-based instruction in particular, can aid with attention, vocabulary learning and participation by

providing visual, verbal and interactive input appropriate to the learning profiles of SEN students.

Simultaneously, the findings also reveal that teachers are still aware of some constraints that may hamper effective implementation. These include lack of training, limited technology, unreliable internet access and the need to adapt digital content for the specific needs and pace of SEN learners.While teachers acknowledge the educational potential of AI tools, they emphasize that these tools are not effective in the absence of suitable classroom environments and professional support.

In conclusion, the study shows that AI-based multimodal instruction has a great potential to enhance language teaching in special education settings. But successful integration depends on sustained teacher training, institutional support and availability of appropriate technological infrastructure. In this sense, AI should be seen as a complementary resource to strengthen inclusive, individualized language learning when used thoughtfully and responsibly, not as a substitute for the teacher.

3. Case Study: AI-Based Language Learning Intervention for a Child with ASD

3.1. Introduction

In the case study part of this research the support in learning English language of the students with special educational needs was provided through three short avatar-based videos of about one minute each. The videos were organized around three instructional themes: greetings, asking for help, and increasing engagement to develop functional language use and to promote meaningful classroom interaction. The intervention was designed to focus on L2 skills, particularly English, through structured and multi-sensory input that combined visual support, repetition, and guided presentation.

In addition to the avatar videos, hands-on activities were included to give the learner opportunities to practice the target language through active participation, direct response and repeated exposure. The combination of multimodal input and hands-on involvement enabled the researcher to investigate the potential of AI-based instruction with interactive tasks to promote listening, speaking, reading and writing skills in a structured and supportive environment. It also allowed to consider the degree to which the learner reacted to the activities in terms of understanding, interaction and language use.

3.2. Participant Profile

The case study examined a group of ten students with special educational needs (SEN) and different learning profiles and levels of difficulty affecting their language development and participation in the classroom. The participants had various needs including communication difficulties, attention challenges, problems with behaviour regulation and delays in language acquisition. This heterogeneity made the group suitable to investigate the effectiveness of AI-based multimodal interventions to support English language learning in different SEN profiles

Moreover, the students had different difficulties in their specific problems they all had the same need of structured support, repetition, visual input and guided interaction. Most of the participants had limited prior exposure to English and their experience with the alphabet, basic vocabulary and simple classroom expressions was varied. The responsiveness of children to multimodal activities and their need for individual pacing and clear directions provided an appropriate context to observe how AI-supported instruction could support engagement, understanding, and skill building. The learning environment was tailored to the level, interests and comfort of each student, allowing the intervention to be inclusive, controlled and responsive throughout the sessions.

3.3. Methodology

3.3.1. Tool Used

The intervention consisted of avatar-based videos created by HeyGen to support multimodal English instruction for students with special education needs. The instructional materials involved images, simple visual prompts, and activity supports, developed using Canva templates.

Additional classroom activities were designed and implemented to enhance the target language, reinforce understanding and to engage the learners.

3.3.2 Learning Process

The learning activities used the four skills of language of listening, speaking, reading and writing. Their main goal was to aid vocabulary growth, listening comprehension, oral response and elementary written recognition in English. Each activity was adapted to the learners' level of understanding and adjusted to the speed of their responsiveness during the sessions.

3.3.3. Activity Implementation

A. Physical Interaction

1. Avatar video number 1

For this activity, I aimed to increase the students' engagement through the avatar Firase, who presented simple seated actions such as "hands up," "hands down," and "roll hands." Since the activity was based only on actions, I supported it with repeated modeling and clear visual demonstration to help the students understand the movements.

Discussion of table 1

		Frequency	**Percentage**
Valid	Yes	8	80
	No	2	20

	Total	10	100.0

I observed that eight students interacted actively with the video and followed the seated actions with interest. Two students had difficulty imitating some of the movements and needed further demonstration.

B. Language Interaction

1. Avatar video number 1

For this activity, I introduced the student to basic greeting expressions through the avatar Karim, who presented the words “Hi,” “Good morning,” and “Good afternoon.” To make the input easier to understand, I supported the video with visual cues and repeated oral practice. During the week, I encouraged the students to listen to the expressions carefully and repeat them in simple guided interactions.

Discussion of the table 1

		Frequency	Percentage
Valid	Yes	6	60
	No	4	40
	Total	10	100.0

I observed that six students interacted successfully with the activity and responded to the greetings with clear engagement. Two students experienced some difficulty in repeating or recognizing the expressions and needed additional support.

2. **Avatar video number 2**

For this activity, I focused on functional language related to asking for help through the avatar Louay, who introduced the expressions “Help please” and “Can you help me?” I made

the activity accessible by using simple situations and visual support that illustrated the meaning of the phrases.

Discussion of table 2

		Frequency	Percentage
Valid	Yes	7	70
	No	3	30
	Total	10	100.0

I observed that seven students interacted well with the task and responded appropriately to the target expressions. Three students found the activity more challenging and required repeated explanation and guidance.

3.3.4 Advances in Language

I noticed gradual language development in the three avatar-based activities, especially in the learners' ability to connect oral input to visual meaning. In the greeting session, students were able to identify and repeat basic expressions like "Hi," "Good morning" and "Good afternoon" and in the help-request session, they exhibited increased familiarity with functional expressions such as "Help please" and "Can you help me?

I also saw development in receptive understanding, especially when students matched words and pictures or actions. In the seated-actions activity, most were able to follow and imitate the commands "hands up," "hands down," and "roll hands, showing improvement in attention, comprehension, and response to instruction.

3.3.5 Challenges Faced

There were a number of challenges in the activities implementation. The first challenge was the diversity of special educational needs in the student population, which required

constant adjustment of the speed of delivery, the complexity of instructions and tasks. A number of students needed multiple explanations and close guidance to adequately respond to the avatar videos and classroom tasks. Furthermore, it was sometimes difficult to sustain attention for the whole duration of each activity, especially for learners with attention or communication difficulties.

Another problem was that the target input had to be repeated many times to aid in comprehension and retention. I found that repetition was important not only in learning the vocabulary, but also in helping the students to make the connection between the visual, oral and action parts of the activities. In some cases, I had to simplify my instructions and add more prompts to ensure that the learners didn't lose interest and could perform the tasks successfully. These difficulties highlighted the need for flexibility, patience and individualised support in teaching students with SEN.

3.4 Conclusion

The implementation of such avatar-based multimodal activities in an organized manner leads to gradual progress in the students' language performance and participation. The use of repetition, visual support and meaningful associations proved successful in assisting the learners to identify greetings, functional expressions and actions while seated. I also noticed they got better at taking directions, working with the materials, and staying engaged throughout the sessions.

In conclusion, the results suggest that multimodal and AI-supported teaching can be useful for students with special educational needs, provided that it is carefully tailored to their cognitive and learning profiles. The experience confirmed that flexible, structured and engaging teaching methods are critical to support understanding and classroom involvement.

This experience confirm that the use of flexible, structured and engaging teaching methods is crucial in supporting comprehension and classroom involvement. This also

reaffirmed the importance of individualised teaching and the use of multi-sensory learning to support language development for learners with SEN.

GENERAL CONCLUSION

This study examined the impact of AI-based multimodal interventions on the English language learning of students with special educational needs, with particular attention to their linguistic, cognitive, and behavioral development. The findings suggest that, when instruction is carefully adapted to learners' profiles, AI-supported teaching can offer a more inclusive and effective environment for students whose language learning is shaped by a range of educational difficulties. It also shows that language progress in SEN settings cannot be separated from the ways learners process information, respond emotionally, and participate in classroom activity.

The study therefore confirms that effective language teaching for SEN learners depends not only on content delivery, but also on the way input is structured, repeated, and made meaningful.

From a **linguistic** perspective, the intervention contributed to the development of basic vocabulary recognition, oral repetition, and comprehension of functional expressions. The students were able to associate words with images, actions, and contextual cues more successfully when English was presented through repeated multimodal input. This shows that AI-based materials can support language acquisition by making linguistic forms more visible, more memorable, and easier to use in context.

From a **cognitive** perspective, the activities supported attention, processing, and recall through clear sequencing, visual scaffolding, and repetition. The avatar-based videos and guided classroom tasks appeared to reduce the cognitive load of learning by presenting English in short, manageable, and predictable units. This suggests that multimodal AI tools can help

SEN learners engage with language in ways that align more closely with their learning pace and cognitive needs.

From a **behavioral** perspective, the students generally responded positively to the activities, showing interest, participation, and willingness to interact. The tasks encouraged imitation, short oral responses, and physical engagement, although some learners still required additional prompting and support. This indicates that AI-based instruction can also contribute to more active classroom behavior by creating a motivating and structured learning atmosphere.

Overall, the study demonstrates that AI-based multimodal instruction has the potential to enrich language learning for students with special educational needs by addressing linguistic development, cognitive engagement, and behavioral participation at the same time. It also highlights the importance of teacher mediation, flexibility, and individualized support in ensuring the success of such interventions. In this regard, AI should be viewed not as a replacement for teaching, but as a pedagogical resource that can help build more inclusive, effective, and learner-centered language practices for SEN students.

References

American Psychological Association. (2020). Publication manual of the American Psychological Association (7th ed.). https://doi.org/10.1037/0000165-000

Adako, O., et al. (2024). Individualization and personalization in AI-driven educational programs for special education needs. Journal of Special Education Technology, 39(2), 115–128.

Al-Mekhlafi, A., et al. (2025). Culturally responsive AI personalized learning platforms in diverse ESL classrooms. Language Learning & Technology, 29(1), 45–62.

Aliu, S. (2024). AI technologies, assistive tools, and personalization parameters in special education frameworks. International Journal of Educational Technology, 18(3), 201–215.

Alkahtani, K. (2017). Behavioral profiles and intervention timelines for SEN students in inclusive environments. Saudi Journal of Special Education, 8(1), 34–49.

Ayasrah, M., et al. (2022). Behavioral patterns, social withdrawal, and anxiety in children with special educational needs aged 6–12. International Journal of Inclusive Education, 26(4), 389–405.

Bensaber, A., & Belkacem, M. (2024). Digital literacy deficits, infrastructural limitations, and professional development barriers in Algerian EFL contexts. Algerian Journal of Applied Linguistics, 11(1), 72–89.

Booth, N., & Keenan, M. (2018). Using animated tutorials, PowerPoint, and text-based training to teach parents Discrete Trial Training (DTT) for autism intervention. Journal of Autism and Developmental Disorders, 48(5), 1642–1655.

Dania, M., et al. (2023). Educational interventions for ASD: A case study of the National Autism Society of Malaysia (NASOM) facility in Kuantan. Malaysian Journal of Learning and Instruction, 20(2), 189–214.

Dewey, J. (1938). Experience and education. Macmillan.

Eikeseth, S. (2017). Early Intensive Behavioral Intervention (EIBI) protocols, treatment intensity, and long-term maintenance of gains in young children with ASD. Behavior Modification, 41(4), 512–534.

El Shemy, H. (2022). Mobile augmented reality applications for vocabulary acquisition in individuals with Autism Spectrum Disorder. Journal of Computer Assisted Learning, 38(3), 745–758.

Fairclough, S. H. (2022). Neuroadaptive technology: Concepts, challenges, and future directions. Brain-Computer Interfaces, 9(2), 65–78.

Godwin-Jones, R. (2011). Autonomous language learning apps, pronunciation feedback, and mobile sequencing. Language Learning & Technology, 15(3), 2–11.

Hartley, C. (2019). Receptive-expressive language disparities and structural multisensory scaffolds in neurodiverse learners. British Journal of Special Education, 46(2), 210–226.

Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. Center for Curriculum Redesign.

IBM Corp. (2021). IBM SPSS Statistics for Windows (Version 28.0) [Computer software]. IBM Corp.

Kessler, G. (2018). Technology and the future of language learning: AI-driven avatars and intelligent tutoring environments. Foreign Language Annals, 51(1), 205–218.

Kress, G. (2010). Multimodality: A social semiotic approach to contemporary communication. Routledge.

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). Intelligence unleashed: An argument for AI in education. Pearson.

Mayer, R. E. (2021). Multimedia learning (3rd ed.). Cambridge University Press.

Mazzuchelli, T. (2006). Incidental teaching models, child-directed naturalistic interaction, and linguistic generalization. Research in Autism Spectrum Disorders, 1(4), 321–335.

McGee, G. G., Krantz, P. J., & McClannahan, L. E. (1985). The facilitative effects of incidental teaching on preposition use by autistic children. Journal of Applied Behavior Analysis, 18(3), 213–221.

McGee, G. G., Krantz, P. J., Mason, D., & McClannahan, L. E. (1983). A modified incidental teaching procedure for increasing description language in autistic children. Journal of Applied Behavior Analysis, 16(3), 329–338.

Mosher, R., & Carreon, A. (2021). Virtual and augmented reality interventions for social skills training in students with autism: A systematic review of 41 studies. Journal of Special Education Technology, 36(3), 155–168.

Núñez, M. (2021). Metacognitive EFL routines and visual-gestural scaffolding for neurodiverse populations. ELT Journal, 75(4), 431–443.

Paivio, A. (1986). Mental representations: A dual coding approach. Oxford University Press.

Parong, J., et al. (2023). Virtual reality interventions for social-emotional skills in ASD, dyslexia, and ADHD: A meta-analysis. Computers & Education, 194, Article 104690.

Plonsky, L., & Ziegler, N. (2016). Call longitudinal rigor, pedagogical design, and intuitive interfaces in mobile language learning apps: A systematic review. Modern Language Journal, 100(4), 815–832.

Porayska-Pomsta, K., et al. (2018). Hybrid human-AI paradigms for social communication training in Autism Spectrum Disorder dyads. MIS Quarterly, 42(3), 893–918.

Russell, S., & Norvig, P. (2021). Artificial intelligence: A modern approach (4th ed.). Pearson.

Shaikh, R. (2025). Information and Communication Technology (ICT) and innovative approaches in ESL teaching environments. Educational Technology Research and Development, 73(1), 95–112.

Sheldrick, R., et al. (2019). Early internalizing and externalizing behavior patterns in special educational needs centers. Journal of Child Psychology and Psychiatry, 60(8), 876–889.

Standen, P., et al. (2024). Augmented reality scaffolds, interactive motor skills, and multisensory training for dyscalculia. Journal of Computer Assisted Learning, 40(2), 312–326.

Stathopoulou, A., & Karathanasi, M. (2023). Academic anxiety, low self-esteem, and emotional burdens among adolescent students with learning disabilities. Journal of Learning Disabilities, 56(3), 201–216.

Wang, L. (2024). VR-AI integrations for home-based therapy and spontaneous utterances in language-delayed children. Computer Assisted Language Learning, 37(2), 154–173.

Zhao, Y. (2020). The transition from recorded lectures to interactive multimedia e-language training spaces. Distance Education, 41(3), 367–385.

Ziegler, N. (2016). Synchronous computer-mediated communication and adaptive pacing models in second language acquisition. Studies in Second Language Acquisition, 38(3), 553–586.

Appendices

Appendix A: Research Instrumentation
Teachers' Semi-Structured questionnaire Protocol

Introduction and Consent Form

Project Title: The Integration of Multimodal Artificial Intelligence and Generative Avatar-Led Delivery Systems in Teaching English as a Foreign Language (EFL) to Young Learners with Special Educational Needs (SEN)

Context: Faculty of Letters and Foreign Languages – Department of English – Kasdi Merbah University, Ouargla

Dear Participant,

This questionnaire protocol is designed to explore the professional insights and experiences of special education teachers regarding the use of AI tools and generative avatars in teaching English to children with special educational needs.

Your feedback will help evaluate how effective these tools are in specialized classrooms. Your participation is voluntary, all data will remain completely confidential, and the results will be used solely for this Master's dissertation.

Thank you for your time and help.

Researcher

Ilham Badis

questionnaire Questions

Question 1: How do you describe the role of technology in supporting language learning for students with special educational needs?

Question 2: In your experience, what are the main linguistic and behavioral difficulties faced by SEN students when learning English?

Question 3: How effective do you think multimodal tools, such as avatars combining speech, text, and gestures, are in attracting students' attention and supporting learning?

Question 4: To what extent do you think avatar-based instruction can improve vocabulary acquisition and basic language comprehension among SEN learners?

Question 5: What advantages do you observe in using AI-based multimodal tools compared with traditional teaching methods?

Question 6: What challenges might teachers encounter when integrating AI-based tools into SEN classrooms?

Question 7: How classroom conditions, such as internet access, equipment availability, and time constraints, affect the use of technology in your teaching context?

Question 8: What kind of training or professional support would teachers need in order to use AI-based educational tools effectively?

Question 9: How suitable do you think avatar-based instruction is for different categories of SEN students, such as children with ASD or language difficulties?

Question 10: What recommendations would you give for improving the use of AI-based multimodal language learning in special education settings in Algeria?

Thank you for your time and cooperation.

Appendix B: Interventional Pedagogical Framework

Phase-Based Instructional Layouts and Classroom Application

Activity 1: physical interaction

Theme: increasing interaction

Target Learner: Children with SEN /Developmental Language Delay

Objective: To improve listening skills and physical action response.

Materials: Avatar-based video named Firase.

Video Script:

Hello, friends! Look at me and do move. Put your hands up. Now, put your hands down. Good job! Let's do it one more time. Ready? Let’s roll our hands. Roll them fast! Now, roll them slow... Wow, look at those hands go! Push your hands forward. Give me a big high five on the screen! Perfect. Now put your hands softly on your lap. Your hands are quiet, and you are ready. See you next time!

1. Warm-Up

The teacher moves hands up and down to model the physical movement.

2. Introduction

The teacher points to the screen and says: "Look at the avatar's hands!"

The video plays for the class.

3. The Teacher Instructions

Pauses the video when the avatar rolls its hands.

Roll hands quickly and says: "بسرعة/Roll fast"

Rolls hands slowly and says: "ببطئ/ Roll slow."

Points to the screen and says: "Hight Five"

Activity 2: Social-Pragmatic Introductions and Diurnal Greetings

Theme: Greeting

Target Learner: Children with SEN / Developmental Language Delay

Objective: To teach spoken greetings and basic words for different times of the day.

Materials: Avatar-based video named Karim

Video Script:

hello my dear friends, my name is Karim, and i am here to have a conversation with you. i am a robot, so basically i do not have an age, but i was created on January 2026, so i am 5

months years old. can you introduce yourselves like me, first say HI and tell me your names? WAW those are beautiful names, can you all look around and say HI to each other? my friends we can say HI in different ways, in the morning we say GOOD MORNING, lets say it together GOOD MOORNING good job, and kids we say GOOD AFTERNOON in the afternoon, now say after me GOOD AFTERNOON.

1. Warm-Up

The teacher waves a hand and says: "Hi!"

2. Introduction

The teacher says: "Let's meet our friend, Karim!"

The video plays to let the class hear Karim's voice.

3. The Teacher Instructions

The teacher pauses the video at the morning frame.

The teacher points to a sun picture and says: "هذه شمس في الـصباح" Say:" morning!"

The teacher pauses the video at the afternoon frame.

The teacher points to a sunset picture and says: "هذا غروب" Say: "afternoon!"

The teacher gently helps students look at each other when Karim says to wave.

Activity 3: Functional Help-Seeking and Affective Recognition

Theme: Ask for help

Target Learner: Children with SEN /Developmental Language Delay

Objective: To teach students how to ask for help when they can not complete a task.

Materials: Avatar-based video named Louay

Video Script:

Hello, my amazing friends! It's me, Luey. Sometimes, when we are playing a game or doing our work, we might get stuck. How do you feel when you get stuck? Happy or sad? Yes, we feel sad, and that is totally okay. When we get stuck, we can use our words to ask for help. Let's practice a very important phrase together. Listen first. Help, please! Now, let's say it together. Ready? Help, please! Whoa, beautiful job, everyone! You said it so clearly. You can ask your teacher, your parents, or to a friend for help. Let's try one more way to ask. Say after me: Can you help me? High five! You did it!

1. Warm-Up

The teacher gives each desk a completely locked plastic sweets container.

2. Introduction

The teacher says: "Look at louay on the screen. He will help us لؤي سوف يساعدنا/ "

The help-seeking video lesson begins.

3. During Session Actions by the Teacher

The teacher pauses the video when Louay finish.

The teacher points to the locked sweets container and says: "؟لديك مشكلة /Are you sad?"

The teacher points to the avatar's mouth and says: "ساعدني" :قل لي Say: "help me!"

The teacher points to a help me picture board for non-verbal children.

The teacher immediately opens the container for any student who tries to speak or sign.

Résumé

Le présent travail porte sur l'efficacité des interventions reposant sur l'intelligence artificielle (IA) dans le développement des compétences linguistiques chez les élèves à besoins éducatifs particuliers (EBEP / SEN). Cette recherche examine comment les technologies adaptatives de l'IA – telles que les logiciels de reconnaissance vocale, les environnements numériques interactifs et les agents d'apprentissage virtuels – peuvent proposer des parcours pédagogiques hautement personnalisés et flexibles, compte tenu des importantes barrières de communication auxquelles ces élèves font face en classe. En s'appuyant sur les théories cognitives, linguistiques et d'apprentissage multimodal, l'étude s'insère dans le champ de l'éducation spécialisée, en soulignant les difficultés émotionnelles, cognitives et comportementales propres à ce public. La partie pratique vise à mettre en place des activités enrichies par l'intelligence artificielle, intégrant des approches multi-sensorielles et des supports bilingues afin de développer les quatre grandes compétences langagières : l'écoute, l'expression orale, la lecture et l'écriture. Enfin, les résultats mettent en évidence le potentiel transformateur de l'IA pour promouvoir un environnement d'apprentissage inclusif et complet, tout en examinant les exigences liées à l'accessibilité numérique, à l'éthique des données et à la formation continue des enseignants spécialisés.

Mots-clés: Intelligence Artificielle (IA), Besoins Éducatifs Spécifiques (BES), Interventions en classe, Apprentissage multimodal des langues, Éducation inclusive.

المستخلص

تتناول هذه الدراسة فعالية التدخلات التعليمية القائمة على الذكاء الاصطناعي في تنمية المهارات اللغوية لدى التلاميذ ذوي الاحتياجات التعليمية الخاصة. وتبحث هذه البحث في كيفية توظيف تقنيات الذكاء الاصطناعي التكيفية — مثل برامج التعرف على الصوت، البيئات الرقمية التفاعلية، والمرافقين الافتراضيين للتعلم — لتقديم مسارات بيداغوجية مخصصة ومرنة للغاية، تماشياً مع العوائق التواصلية الكبيرة التي يواجهها هؤلاء التلاميذ في الأقسام الدراسية. واستناداً إلى النظريات المعرفية واللغوية ومقاربات التعلم متعدد الوسائط، يندرج هذا العمل في سياق التربية الخاصة، مع تسليط الضوء على التحديات الانفعالية، المعرفية والسلوكية الخاصة بهذه الفئة. وقد خُصص الجانب التطبيقي من الدراسة لتنفيذ أنشطة تعليمية مدعومة بالذكاء الاصطناعي، تجمع بين الأساليب متعددة الحواس والدعائم ثنائية اللغة، بهدف تطوير المهارات اللغوية الأربع الكبرى: الاستماع، التحدث، القراءة، والكتابة. وفي الختام، تبرز النتائج القدرات التحولية للذكاء الاصطناعي في تعزيز بيئة تعليمية دامجة وشاملة، مع مناقشة المتطلبات المتعلقة بالولوج الرقمي، أخلاقيات البيانات، والتكوين المستمر للمعلمين المتخصصين