



Promoting Learning of Students with Disabilities in an Inclusive Science Education Classroom Using Artificial Intelligence

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Abstract

For students with learning disabilities (LD), mastering basic skills or academic content can feel like an uphill battle. Many struggle to process spoken or written language in conventional classroom settings. Before AI entered the picture, science education often left these learners behind - lessons rarely adapted to individual needs, support systems were limited, and specialized tools were scarce. Teachers typically had to modify standard materials rather than develop truly customized learning approaches. Now, AI is changing the game. By creating systems that mimic human intelligence - capable of learning, problem-solving, and understanding language - we're opening new doors in science education. These smart technologies can finally provide the personalized, accessible learning experiences that students with disabilities need to thrive. Instead of forcing learners to adapt to rigid systems, AI allows us to build flexible educational environments that adapt to each student's unique way of learning. AI has a potential to personalize learning, enhance accessibility, and provide adaptive support, ultimately leading to improved learning outcomes and greater engagement for diverse learners. This paper highlights understanding learning disability, students with learning disabilities in science education, the inclusive science education classroom, the concept of AI, the role of AI in promoting learning of students with learning disabilities, Challenges to effective integration of AI in teaching of students with learning disabilities and finally the possible solutions to the challenges. The research concludes that AI should be actively incorporated into science classrooms to enhance accessibility and inclusivity, especially for learners with disabilities.

Keywords: Learning Disability, Students with Learning Disability, Inclusive Classroom

Introduction

Learning disabilities as special needs conditions have existed since ancient times. In traditional African societies, teaching and learning were deeply rooted in cultural heritage and gender-based role socialization. While these disabilities were not formally recognized at the time, individuals still struggled with learning challenges—such as following instructions, recalling names, counting, distinguishing objects or sounds, interpreting cultural symbols, or understanding the rhythms of ceremonial drums. The conceptualization of disability evolved through various stages without a standardized definition until 1963. Prior to Samuel Alexander Kirk's influential contributions, terms like

'minimal brain damage,' 'brain dysfunction,' and 'perceptual disorder' were used (Orim Unimuke, 2023). Over the past six decades, the field has faced ongoing debates, including the absence of a universally accepted definition for inclusive education. However,

The term learning disabilities broadly describes a diverse range of conditions characterized by substantial challenges in acquiring and applying foundational skills such as listening, speaking, reading, writing, logical reasoning, or mathematics (Obani, 2006). These conditions stem from neurobiological differences, likely caused by central nervous system



dysfunctions, and can persist throughout a person's lifetime.

Learning disabilities are neurologically based impairments that disrupt the typical operation of brain functions involved in learning. This disruption can hinder the efficient processing of information, leading to significant difficulties in mastering essential academic skills and subjects

In Nigeria, students with learning disabilities often study in regular classrooms alongside their peers but face significant learning barriers. Many schools remain reluctant to accommodate learners with special needs, while a lack of awareness among teachers leads to inadequate support. Additionally, some educators lack proper training to effectively address the needs of students with disabilities.

Overcrowded classrooms frequently prevent students with learning disabilities from receiving the individualized attention they require, severely disrupting the learning process and shifting focus away from student-centered instruction. Compounding this issue, many schools lack adequate infrastructure and resources to properly support these learners' needs (Orim, 2015). Additional challenges include insufficient parental and community engagement, as well as poor communication and coordination among teachers, peers, administrators, and education authorities.

Makwana (2022) highlights how labeling students by their disabilities fosters discrimination rather than inclusion. Many children with special needs resist being segregated, as it often leaves them feeling marginalized. This harmful practice of categorization demands immediate attention and reform within educational systems

Though these students with learning disability are faced with these impediments (dyslexia, dysgraphia, dyscalculia etc.), federal government still advocate for an inclusive science education classroom. The Nigerian National Policy on Education (2014) mandates inclusive education, requiring that learners with disabilities be integrated into mainstream schools alongside non-disabled students. Additionally, the policy guarantees free education for persons with disabilities at all levels, from primary through tertiary education. These provisions demonstrate Nigeria's recognition of inclusive education as a fundamental right for individuals with special

needs. An inclusive science classroom is a place where every student, no matter their abilities, background, or if they have a disability, feels welcome and gets the support they need to learn alongside their classmates in a standard classroom. According to Ainscow (2020), it's about building an environment where all kinds of learners can get a great science education and truly engage in scientific exploration

Research consistently demonstrates that inclusive education is achievable through collaborative efforts among parents, educators, and specialists (Sadikovna & Azimjon, 2023). As SalasPilco et al. (2022) emphasize, true inclusion embraces students from all backgrounds, fostering greater understanding of marginalized populations.

Experts are increasingly pushing for diversity and technology to be built into school lessons, especially to help students who haven't always had the same opportunities. In fact, creating a truly welcoming and inclusive environment actively helps all students grow and do better in school.

This is where AI in education really shines, particularly for students with learning disabilities. AI isn't just about new ways to teach; it also supports learning through multiple senses. When used well, these technologies create exciting, flexible learning spaces where every student feels valued. Studies even show that these kinds of genuine learning environments boost teamwork and social skills, ultimately fulfilling the main goal of inclusive education: making sure everyone has equal access to learning. (Collins, 2018; Shore et al., 2018).

Understanding Students with Learning Disabilities in Science Education

It can be really tough for students with learning disabilities (SLD) because they struggle with the basics, like understanding what they hear or read. This can make things like reading, writing, spelling, problem-solving, speaking, listening, or even math a real challenge.

It is important to remember that these difficulties aren't due to a lack of intelligence, physical problems, or their background or economic situation. The National Institutes of Health (NIH) points out that common learning disabilities include dyslexia (trouble with



reading), dysgraphia (trouble with writing), dyscalculia (trouble with math), and attention-deficit/hyperactivity disorder (ADHD). These are explained as follows

Dyslexia

When a child has dyslexia, their brain just processes language a bit differently. This often makes reading a real struggle. They might find it hard to read smoothly, recognize words quickly, or fully understand what they're reading. It's not about how smart they are; it's just how their brain handles written words.

Dysgraphia

Dysgraphia makes writing tough. Kids with dysgraphia might have messy handwriting, make lots of spelling and grammar mistakes, or find it hard to organize their thoughts on paper. It's like their hand and brain aren't quite on the same page when it comes to writing things down.

Dyscalculia

For kids with dyscalculia, numbers can be a mystery. Basic math, understanding amounts, or even just thinking through logical math problems can feel incredibly difficult. It's not that they're "bad at math," but that their brain struggles with number concepts.

Attention-Deficit/Hyperactivity Disorder (ADHD)

While not strictly a learning disability, ADHD can definitely throw a wrench into learning. Kids with ADHD often have trouble focusing, staying organized, and controlling sudden urges. Imagine trying to learn about chemical reactions when your mind keeps bouncing around, or you can't sit still for long. These challenges can really get in the way of doing well in school, especially in subjects like science that often require sustained attention and organization.

Challenges Faced by Kids with Learning Disabilities in Science Education

Because of these difficulties, science class can present unique hurdles for children with learning disabilities. They might struggle with reading complex textbooks, writing lab reports, doing calculations, or staying focused during experiments. It's crucial to understand these challenges so we can find ways to support them better.

To further explore these difficulties, scholars such as Orim, Orim, and Unimuke (2023), Lerner and Kline (2006), and Pierangelo and Giuliani (2006)

have analyzed the issue through three key perspectives:

Disability-based perspective (focusing on the inherent challenges of LD), Individual profile perspective (considering personal learning differences), and General perspective (examining broader educational and social impacts).

Learning disabilities transcend gender, race, age, socioeconomic status, and religion, with a high prevalence in Nigeria—affecting individuals in nearly every family, school, and community (Obani, 2006; Orim et al., 2017). Given this widespread impact, there is a critical need to better understand these disabilities through relevant theoretical frameworks, such as information processing theory, which explains how the brain receives, integrates, and processes stimuli during learning. A deep understanding of learning disabilities is essential, as it directly influences the quality of support and interventions provided to learners in both diagnostic and classroom settings.

The Inclusive Science Education Classroom

Inclusive education is a fundamental aspect of modern teaching, particularly in subjects like science. In a diverse classroom, students come from various backgrounds, with different abilities, learning styles, and needs. The concept of an inclusive science classroom goes beyond simply ensuring that every student is present in class; it is about creating an environment where all students feel valued, supported, and able to engage with the subject material meaningfully.

The principle of inclusion is straightforward—ensuring every learner is actively involved. An inclusive classroom is a learning environment where students of diverse abilities, learning styles, and needs collaborate and grow together. Rather than separating students, this model provides personalized support so each individual can engage with the curriculum effectively. By uniting all learners in one space, inclusion promotes a fairer and more balanced educational experience. In the same view of this study: Inclusive science education classroom is defined as an atmosphere that creates a free scientific bias, segregation and injustices treatment among students, and integrates cooperation, collaboration, group work, and student's responsibilities among themselves in science education classroom.



The United Nations (2017) established that inclusive education is grounded in moral principles - both religious and secular - along with values, viewpoints, and methodologies that provide all learners with meaningful and valuable education. A central aim of inclusion, as highlighted, is to ensure equitable learning opportunities for every student. Dalton (2017) maintained that genuine inclusion requires a comprehensive educational approach that embraces all learners, including those with significant disabilities, sensory impairments, cognitive challenges, as well as exceptionally gifted students. While certain instructional methods benefit all learners, others need customization to effectively teach groups containing students with mental health considerations. Importantly, inclusive education serves as a crucial mechanism for advancing broader social inclusion objectives.

Experts like Mag et al. (2017) strongly believe schools should welcome students from all backgrounds and give every learner the chance to reach their full potential. At its core, inclusive education rests on three pillars: making sure everyone feels accepted, ensuring everything is accessible, and changing how we assess students. This approach aims to create classrooms where students feel safe, valued, and happy with their learning. To achieve this, schools must figure out what adjustments are needed for their diverse students, which means teachers really need to understand their students and adapt their teaching methods.

In science education, being inclusive means changing how we teach so that every student can fully participate and understand the material, no matter their individual challenges or background. This way of teaching recognizes that every learner is different and works to remove any obstacles by offering various ways for students to engage. Effective inclusive science instruction keeps the curriculum flexible, allowing students to learn at their own pace. Practical ways to make science class inclusive include using Universal Design for Learning (UDL), which creates lessons accessible to everyone from the start, using inquiry-based approaches where students investigate questions like real scientists, and encouraging peer tutoring and collaborative learning.

When science classrooms embrace inclusion by accommodating individual needs and varied learning styles, they create ideal conditions for incorporating artificial intelligence. AI applications can be customized to match different learning preferences, thereby improving accessibility and engagement in science education while deepening students' comprehension and interest in scientific concepts.

Overview of Artificial Intelligence

Technology has fundamentally transformed modern life, revolutionizing not just daily routines but also reshaping professional environments, educational approaches, and social interactions. Continuous technological innovations regularly emerge, enhancing efficiency and practicality in both personal and professional spheres. Among recent advancements, artificial intelligence (AI) has gained significant attention for its human-like capabilities. This groundbreaking technology has now entered the educational domain, introducing AI-powered learning assistants and educational bots. As technological progress accelerates, the education sector must evolve accordingly, particularly in integrating information and communication technologies, to enhance and modernize learning experiences

Artificial Intelligence (AI), as described by Attah and Nwonu (2025), refers to machines programmed to mimic human cognitive functions such as learning, reasoning, and problem-solving. Wang (2020) defines AI as a field that applies STEM (science, technology, engineering, and mathematics) to solve complex problems. Yang (2022) emphasizes AI's importance in education due to its ability to integrate interdisciplinary knowledge and advanced technologies. Similarly, Nemorin et al. (2023) argue that AI is essential in modern education.

Inclusive education, as noted by Salas-Pilco and Oshima (2022), promotes equity, enhances learning quality, and fosters a fairer society. Hardy and Woodcock (2023) highlight its role in supporting diversity and equality in schools. Kielblock and Woodcock (2023) stress the need for policies that address student needs effectively. According to UNICEF (2014), inclusive education is a continuous process that reduces learning barriers, while UNESCO (2023)



underscores its role in valuing every student. Sadikovna and Azimjon (2023) add that successful inclusion requires collaboration among parents, teachers, and specialists.

AI is increasingly used in education, including for students with special needs (Chen et al., 2020; Hwang et al., 2020). Its features—such as writing aids, grammar checkers, and speech-to-text tools—enhance assistive technology. Holmes et al. (2023) and Hwang et al. (2020) explain that AI simulates human intelligence through machine learning algorithms, helping identify and solve problems. Castañeda and Selwyn (2018) note that AI shifts education from passive knowledge transfer to active student-guided learning. Vincent-Lancrin and van der Vlies (2020) argue that this approach helps students analyze and apply information more effectively.

AI also makes learning more engaging and interactive (Nemorin et al., 2023). Teachers must guide students in using AI ethically while leveraging its benefits, such as personalized learning and improved cognition. Becker et al. (2018) and Seldon and Abidoye (2018) highlight AI's ability to provide instant feedback, helping students refine their skills and allowing educators to adjust instruction.

Additionally, AI enhances student engagement, fosters self-directed learning, and ensures access to quality education regardless of socioeconomic status (Holmes et al., 2023; Hwang et al., 2020). It also improves teacher-student communication through interactive methods like gestures and sketches. Most notably, AI can generate human-like responses, further enriching the learning experience.

The Role of AI in Promoting Learning of Students with Learning Disabilities

AI offers unique capabilities that can enhance learning experiences and support individuals with learning disabilities. Some ways in which AI can aid in learning processes include according to Adeniyi. Cyril et al (2025):

Tailored Learning Experiences: AI can analyze how individuals learn, their preferences, and what they struggle with. This allows AI to customize educational materials, adjust the pace of learning, and modify teaching methods to perfectly suit each student's needs.

Dynamic Evaluations: AI-driven assessments can adapt as a student responds, offering specific feedback and pinpointing areas where they excel or need improvement. This gives educators clear insights into student progress, enabling them to fine-tune their teaching strategies.

Smart Content Delivery: AI algorithms can suggest appropriate learning resources, modify content based on a student's skill level, and give immediate feedback. This personalized method keeps students engaged and supports their unique learning paths.

Language Support: AI's natural language processing capabilities can help students with reading challenges by converting text to speech, highlighting crucial information, and offering interactive learning opportunities.

Challenges to Effective Integrative of AI in Teaching of Students with Learning Disabilities

The incorporation of Artificial Intelligence (AI) into education presents tremendous opportunities, yet it also introduces several critical challenges that must be carefully navigated. This section examines the primary obstacles hindering effective AI integration in learning environments, including issues of accessibility, concerns surrounding data privacy and security, the persistence of the digital divide, and the risk of algorithmic bias within AI systems.

1. A major hurdle in bringing AI into schools is making sure every student can access AI learning tools, no matter their family's income or where they live. Even though AI can greatly improve how students learn and offer personalized teaching, the reality is that many students don't have equal access to technology or the internet. This can make the existing gaps in education even wider. Students from disadvantaged communities or remote areas often lack the computers, software, or internet needed to use AI-powered learning platforms. On top of that, AI technologies aren't always built with the needs of students with disabilities in mind, which further excludes them from these benefits (Chiu, et al., 2023; Božić, 2023; Johansson, et al., 2021).



2. A significant hurdle in using AI for education is the risk of biased algorithms. These biases can worsen existing inequalities and make AI-powered learning tools unfair or ineffective. Bias in AI can stem from several sources: Flawed training data: If the data used to teach AI reflects past inequities in education or resource access, the AI might unintentionally continue these unfair patterns. Algorithm design choices: The way an AI is built can also introduce or amplify biases. Societal prejudices: Existing biases in society can be encoded within the data that trains AI models. (Akgun, and Greenhow, 2022; Borenstein, and Howard, 2021).
3. Integrating AI into education brings up some complicated ethical questions that we need to address carefully to make sure these technologies are used responsibly and fairly. This section looks at important ethical points, like keeping student data private and secure, reducing bias in AI algorithms, making AI use transparent and accountable, and understanding the ethical impacts of AI when it evaluates student performance.

Furthermore, the growing adoption of AI-driven educational platforms and learning analytics systems heightens vulnerabilities related to data security. These technologies, while beneficial, create opportunities for cyber threats such as unauthorized data access, exploitation of student information, and potential breaches by bad actors. The ramifications of such security lapses in education can be severe—ranging from compromised personal identities and fraudulent academic activities to the unlawful disclosure of confidential student records.

Possible Solutions to these Challenges

Artificial Intelligence (AI) offers promising solutions for integrating into the education of students with learning disabilities by enhancing accessibility, to mitigate biases in AI algorithms etc

1. **Promoting Inclusive AI Solutions**
To overcome accessibility challenges, stakeholders—including educators, policymakers, and developers—must

prioritize creating AI tools that cater to diverse learners. This involves ensuring affordability, user-friendly interfaces, and compatibility with assistive devices, alongside comprehensive training for educators and students. However, the widespread use of AI in education relies on extensive student data collection, which introduces critical privacy and security risks (Pedro et al., 2019; McCardle, 2002).

2. **Mitigating Algorithmic Bias**
Combating bias in AI systems requires a commitment to fairness, accountability, and transparency. Developers and educators should rigorously assess training datasets for biases, employ fairness-aware machine learning techniques, and conduct regular audits to prevent discriminatory outcomes, particularly for marginalized communities (Bogina et al., 2021; Xivuri & Twinomurinzi, 2023).
3. **Protecting Student Data Privacy**
Safeguarding student information is essential in AI-driven education. Schools and tech providers must enforce robust data protection measures and ethical standards to prevent unauthorized access or misuse of sensitive data.
4. **Navigating Legal and Ethical Frameworks**
Institutions and providers must comply with stringent regulations like the U.S. Family Educational Rights and Privacy Act (FERPA) (Rights and Act, 2014), balancing innovation with responsible data practices to protect student confidentiality.

The incorporation of artificial intelligence into educational systems presents transformative potential to revolutionize learning experiences, particularly for students with learning disabilities. When implemented effectively, AI technologies can facilitate personalized learning pathways, enhance academic achievement, automate routine administrative functions, and develop dynamic educational ecosystems. These advanced tools empower educators to tailor instruction, foster deeper student engagement, simplify operational workflows, and cultivate next-generation learning



experiences that equip learners for our rapidly evolving digital landscape.

Nevertheless, successful implementation demands strategic foresight, dedicated resources, and multi-stakeholder cooperation. Educators, policymakers, and technologists must work in concert to ensure these innovations are deployed with careful consideration of ethical implications and accessibility requirements. Only through such deliberate, inclusive approaches can we fully realize AI's potential to serve the varied needs and ambitions of every student while maintaining responsible technological stewardship

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