IRGS Journal of Arts, Humanities and Social Sciences
Website: www.irgspublisher.com
Email: office@irgspublisher.com
Vol-1, Iss-1, May–June 2026
ISSN: 2839-6499

Supporting Learners with Special Needs in Home Economics Practical Classes through Artificial Intelligence Assistive Technologies

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Article History:
Received: 02/05/2026
Accepted: 30/05/2026
Published: 21/06/2026

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Abstract

Inclusive education seeks to provide equal learning opportunities for all students regardless of physical or cognitive ability. However, practical-based subjects such as Home Economics pose significant challenges for learners with special needs due to limitations in demonstration speed, communication barriers, and safety concerns during practical activities. This study investigates the use of Artificial Intelligence assistive technologies to support inclusive participation in Home Economics practical classes. The research adopts a mixed-method approach involving special education teachers, Home Economics teachers, and students with disabilities. AI assistive tools such as speech-to-text cooking guides, visual recognition safety alerts, adaptive instructional videos, and personalized learning assistants will be implemented during practical lessons. Data will be collected through observation checklists, performance assessment rubrics, and interviews. The expected findings indicate that AI assistive technologies improve participation, independence, and confidence among learners with special needs while reducing instructional burden on teachers. The technology is also anticipated to enhance safety and promote individualized learning pace. The study concludes that AI provides a practical pathway for achieving inclusive vocational education. It recommends provision of assistive technologies, teacher training in inclusive digital pedagogy, and policy support to ensure equitable access to Home Economics education.

Keywords: Artificial Intelligence (AI), Assistive Technologies, Inclusive Education, Special Needs Learners, Home Economics Education, Adaptive Learning, Vocational Education, Educational Technology.

Article Citation: A. Ahmad (2026). Supporting Learners with Special Needs in Home Economics Practical Classes through Artificial Intelligence Assistive Technologies. **IRGS Journal of Arts, Humanities and Social Sciences (IRGSJAHSS),** Vol-1(Iss-1), 9–13.

Introduction

Education is universally recognized as a fundamental human right and an essential instrument for promoting social inclusion, economic development, and national transformation. Inclusive education seeks to ensure that all learners, regardless of disability, gender, ethnicity, or socio-economic background, have equal access to quality learning opportunities within supportive educational environments. The principle of inclusion emphasizes participation, equity, accessibility, and respect for diversity in teaching and learning processes. Globally, educational systems are increasingly adopting inclusive approaches to address the educational needs of learners with disabilities and special learning conditions (UNESCO, 2020).

In Nigeria, the implementation of inclusive education has gained increased attention due to global educational reforms, national policy initiatives, and commitments to Sustainable Development Goal 4, which advocates inclusive and equitable quality education for all. Despite these efforts, learners with special needs continue to face numerous barriers within educational institutions, particularly in vocational and practical-based subjects such as Home Economics. Many schools lack adequate facilities, instructional materials, assistive devices, and trained personnel necessary for supporting learners with disabilities in practical learning environments (Federal Republic of Nigeria, 2013).

Home Economics is an important vocational subject that equips learners with practical skills related to food preparation, nutrition, clothing and textiles, family living, entrepreneurship, and resource management. The subject contributes significantly to self-reliance, vocational competence, and socio-economic development. However, the practical nature of Home Economics presents unique challenges for learners with special needs, especially those with visual impairments, hearing impairments, physical disabilities, learning difficulties, or cognitive limitations. Practical lessons often require fast demonstrations, physical coordination, verbal communication, and safe handling of cooking equipment, all of which may create barriers for students with disabilities if adequate support systems are unavailable (Olaitan & Agusiobo, 2014).

Traditional teaching approaches in Home Economics practical classes are frequently designed for average learners without considering the diverse learning needs and abilities of students with disabilities. Consequently, many learners with special needs experience exclusion, low participation, reduced confidence, and limited opportunities for skill acquisition during practical activities. Teachers also encounter difficulties in managing inclusive classrooms due to insufficient training, large class sizes, inadequate assistive resources, and safety concerns associated with practical instruction (Ajuwon, 2008).

The rapid advancement of Artificial Intelligence (AI) and emerging educational technologies has created new opportunities for enhancing inclusive education and supporting learners with special needs. Artificial Intelligence refers to the simulation of human intelligence by computer systems capable of learning, reasoning, pattern recognition, decision-making, and problem-solving. AI technologies are increasingly being applied in educational settings through intelligent tutoring systems, adaptive learning platforms, speech recognition systems, virtual assistants, educational analytics, and assistive technologies designed to support learners with disabilities (Luckin et al., 2016).

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AI assistive technologies can significantly improve accessibility and participation in Home Economics practical classes by providing personalized instruction, communication support, safety monitoring, and adaptive learning experiences. Technologies such as speech-to-text cooking guides, visual recognition safety alerts, adaptive instructional videos, virtual assistants, and personalized learning systems can help learners with disabilities participate more independently and confidently in practical activities. These technologies also provide opportunities for individualized learning and flexible instruction that accommodate different learning styles and abilities (Holmes et al., 2019).

Globally, educational institutions are increasingly integrating AI-supported assistive technologies into inclusive classrooms to enhance learning outcomes and accessibility for students with special needs. However, the adoption of such technologies in Nigerian schools remains limited due to challenges such as poor infrastructure, inadequate funding, insufficient teacher training, and limited policy implementation. There is therefore an urgent need to explore innovative approaches capable of improving inclusive vocational education and supporting learners with disabilities in practical learning environments (UNESCO, 2021).

This conference paper therefore examines the role of Artificial Intelligence assistive technologies in supporting learners with special needs in Home Economics practical classes. The paper explores the concept of inclusive education, discusses applications and benefits of AI assistive technologies, identifies challenges affecting implementation, and proposes strategies for effective integration of intelligent technologies into Home Economics education in Nigeria. The study also highlights the implications of AI-supported inclusive education for sustainable educational development and social inclusion (Holmes et al., 2019).

Conceptual Clarifications

Inclusive Education

Inclusive education refers to an educational approach that ensures all learners, regardless of physical, intellectual, social, emotional, linguistic, or other conditions, participate fully in educational activities within regular learning environments. Inclusive education emphasizes equal opportunities, accessibility, participation, and respect for diversity in schools and educational institutions. The goal of inclusion is to eliminate discrimination and barriers that prevent learners with disabilities from accessing quality education and participating meaningfully in learning processes (UNESCO, 2020).

Inclusive education requires adaptation of teaching methods, curriculum content, instructional materials, classroom environments, and assessment practices to meet learners' diverse needs. Teachers are expected to utilize flexible instructional strategies and supportive technologies that promote participation and academic success for all learners. Effective inclusion also involves collaboration among teachers, parents, administrators, communities, and support professionals in creating supportive learning environments (Ajuwon, 2008).

Artificial Intelligence Assistive Technologies

Artificial Intelligence assistive technologies refer to intelligent digital tools and systems designed to support individuals with disabilities and special learning needs. These technologies utilize machine learning, speech recognition, computer vision, natural language processing, and adaptive algorithms to improve accessibility, communication, learning, and independence among users. AI assistive technologies can provide personalized support based on learners' abilities, preferences, and educational needs (Holmes et al., 2019).

Examples of AI assistive technologies include speech-to-text applications, text-to-speech systems, intelligent tutoring systems, adaptive learning platforms, visual recognition software, virtual assistants, automated captioning systems, and predictive learning tools. In educational settings, these technologies support inclusive instruction, learner engagement, communication, and individualized learning experiences for students with disabilities (Luckin et al., 2016).

Home Economics Education

Home Economics is a vocational and practical-oriented subject concerned with improving family living, resource management, nutrition, clothing, entrepreneurship, and household management. The subject equips learners with practical skills and knowledge necessary for personal development, family welfare, and socio-economic self-reliance. Home Economics combines theoretical knowledge with practical activities that promote creativity, problem-solving, and vocational competence (Olaitan & Agusiobo, 2014).

In practical classes, students engage in cooking, sewing, interior decoration, nutrition analysis, textile production, and other hands-on activities. Such practical experiences are essential for skill acquisition and vocational training. However, learners with special needs may require adaptive instructional approaches and assistive technologies to participate effectively and safely in practical learning environments (Ajuwon, 2008).

Challenges Facing Learners with Special Needs in Home Economics Practical Classes

Learners with special needs often experience numerous challenges in Home Economics practical classes due to the practical and interactive nature of the subject. One major challenge is communication barriers, particularly for students with hearing impairments or speech difficulties. Practical demonstrations and verbal instructions are commonly used during cooking and sewing lessons, making it difficult for some learners to follow activities effectively without communication support systems (UNESCO, 2020).

Another significant challenge is safety concerns during practical activities. Home Economics practical classes involve the use of sharp objects, cooking equipment, electrical appliances, hot surfaces, and chemicals that may pose risks to learners with visual impairments, physical disabilities, or cognitive limitations. Teachers often struggle to provide individualized supervision and safety support in overcrowded classrooms, thereby increasing the risk of accidents and injuries during practical lessons (Olaitan & Agusiobo, 2014).

Learners with special needs also experience difficulties related to demonstration speed and instructional pace. Traditional practical demonstrations are often conducted quickly without sufficient repetition or adaptation for learners who require additional processing time or individualized explanations. Students with learning disabilities, cognitive impairments, or developmental challenges may therefore struggle to understand practical procedures and instructions effectively (Ajuwon, 2008).

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Inadequate assistive resources and instructional materials further limit participation among learners with disabilities. Many schools in Nigeria lack specialized equipment, adaptive tools, accessible learning materials, and assistive technologies necessary for supporting inclusive practical education. Consequently, learners with special needs may feel excluded, dependent, and less confident during practical activities (Federal Republic of Nigeria, 2013).

Another challenge is insufficient teacher preparation in inclusive education and digital pedagogy. Many Home Economics teachers lack adequate training in special needs education, classroom adaptation, and assistive technology integration. Teachers may therefore experience difficulties in addressing diverse learning needs and managing inclusive practical classrooms effectively (Darling-Hammond et al., 2017).

Negative societal attitudes and stigma toward disability also affect participation and confidence among learners with special needs. Some students experience discrimination, social exclusion, and low expectations from peers and educators, which may negatively influence their self-esteem, motivation, and academic performance. Inclusive educational environments must therefore promote respect, acceptance, and equal opportunities for all learners (UNESCO, 2021).

Applications of AI Assistive Technologies in Home Economics Practical Classes

Speech-to-Text and Text-to-Speech Systems

Speech-to-text and text-to-speech technologies represent important AI assistive tools for supporting communication and accessibility in Home Economics practical classes. Speech-to-text systems convert spoken instructions into written text, enabling learners with hearing impairments to follow demonstrations and classroom discussions effectively. Text-to-speech applications also assist learners with visual impairments or reading difficulties by converting written instructions into audio outputs (Holmes et al., 2019).

In practical cooking and sewing lessons, speech-to-text technologies can display step-by-step instructions on digital devices, thereby improving learners' understanding and participation. Such systems reduce communication barriers and enhance independence among learners with disabilities. Teachers can also utilize these technologies to provide individualized instructional support and improve classroom interaction (Luckin et al., 2016).

Visual Recognition Safety Systems

Visual recognition technologies utilize Artificial Intelligence and computer vision to identify objects, monitor environments, and provide safety alerts during practical activities. In Home Economics practical classes, visual recognition systems can detect dangerous situations such as unattended cooking appliances, sharp objects, spills, or fire hazards and provide instant warnings to learners and teachers (Holmes et al., 2019).

These technologies are particularly beneficial for learners with visual impairments, cognitive difficulties, or limited physical coordination. AI-powered safety systems improve practical learning environments by reducing accidents and enhancing confidence during cooking and sewing activities. Teachers also benefit from reduced supervision burden and improved classroom safety management (UNESCO, 2021).

Adaptive Instructional Videos

Adaptive instructional videos provide personalized and flexible learning experiences for students with diverse educational needs. AI-driven video platforms can adjust speed, subtitles, audio descriptions, language, and instructional content according to individual learners' abilities and preferences. Learners can pause, replay, or review practical demonstrations repeatedly until concepts and procedures are fully understood (Luckin et al., 2016).

In Home Economics practical classes, adaptive videos can demonstrate cooking techniques, sewing procedures, food preparation methods, and safety practices in accessible formats suitable for learners with disabilities. Such technologies support self-paced learning, improve conceptual understanding, and promote learner confidence and independence during practical activities (Holmes et al., 2019).

Intelligent Learning Assistants

Intelligent learning assistants are AI-powered virtual systems designed to provide personalized learning support, reminders, feedback, and instructional guidance. These systems can answer learners' questions, provide task instructions, monitor progress, and recommend appropriate learning activities based on individual performance levels and needs (Russell & Norvig, 2021).

In Home Economics practical lessons, intelligent assistants can guide students through cooking recipes, sewing patterns, nutrition calculations, and household management tasks step by step. Learners receive instant feedback and support throughout practical activities, thereby improving engagement, skill acquisition, and confidence. Such technologies also reduce instructional pressure on teachers managing inclusive classrooms (Holmes et al., 2019).

Benefits of AI Assistive Technologies in Inclusive Home Economics Education

The integration of AI assistive technologies into Home Economics practical classes offers numerous benefits for learners, teachers, and educational institutions. One major benefit is improved participation and inclusion among learners with special needs. AI technologies provide adaptive support systems that enable students with disabilities to engage actively in practical activities and classroom interactions. Learners become more involved in instructional processes and experience greater educational accessibility and social inclusion (UNESCO, 2021).

AI assistive technologies also enhance learner independence and confidence. Personalized instructional support enables learners to complete practical tasks with reduced dependence on teachers or peers. Students gain confidence in their abilities and become more motivated to participate in vocational learning activities. Increased independence contributes positively to self-esteem, skill acquisition, and future employability opportunities (Luckin et al., 2016).

Another important benefit is improved safety during practical activities. Visual recognition systems, automated alerts, and adaptive instructional tools help minimize accidents and ensure safe learning environments for students with disabilities. Teachers can monitor practical activities more effectively while learners

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receive timely guidance and warnings regarding potential hazards (Holmes et al., 2019).

AI-supported learning environments also promote individualized learning and flexible instruction. Students can learn at their own pace, revisit demonstrations, and receive personalized feedback based on their learning needs and abilities. Such adaptive learning experiences improve comprehension, retention, and practical skill development among learners with special needs (Darling-Hammond et al., 2017).

Furthermore, assistive technologies reduce instructional burden on teachers by automating certain support functions and providing additional learning assistance for students. Teachers can therefore focus more on facilitating inclusive learning and managing classroom interactions effectively. AI technologies also support data collection and assessment processes, enabling teachers to monitor learners' progress and identify areas requiring additional support (Holmes et al., 2019).

Challenges Affecting the Integration of AI Assistive Technologies in Nigeria

Despite the numerous benefits associated with AI assistive technologies, several challenges hinder effective integration into Home Economics education in Nigeria. One major challenge is inadequate technological infrastructure. Many schools lack reliable electricity supply, internet connectivity, computers, tablets, and digital learning devices necessary for implementing AI-supported inclusive learning environments (Aduwa-Ogiegbaen & Iyamu, 2005).

Poor funding of education also limits access to assistive technologies and inclusive instructional resources. Educational institutions often lack sufficient financial resources to purchase AI software, adaptive equipment, and digital learning tools required for supporting learners with disabilities. Inadequate funding also affects maintenance, technical support, and sustainability of technology integration initiatives (Federal Republic of Nigeria, 2013).

Another major challenge is insufficient teacher training in inclusive education and digital pedagogy. Many teachers are unfamiliar with AI technologies and lack competencies required for integrating assistive systems into classroom instruction. Without adequate professional development and technical support, teachers may struggle to utilize intelligent technologies effectively in inclusive practical classes (Darling-Hammond et al., 2017).

The issue of digital divide also affects equitable access to AI technologies among learners with special needs. Students from rural communities and low-income backgrounds may have limited access to digital devices, internet services, and technological resources necessary for technology-enhanced learning. Such inequalities may further widen educational disparities if not properly addressed (UNESCO, 2021).

Another challenge is inadequate policy implementation and institutional support for inclusive technology integration. Although Nigeria has introduced policies promoting inclusive education and ICT integration, implementation remains weak due to poor coordination, inadequate monitoring, and limited stakeholder involvement. Effective adoption of AI assistive technologies requires strong policy frameworks and institutional commitment (Federal Republic of Nigeria, 2013).

Strategies for Effective Integration of AI Assistive Technologies

Investment in Assistive Technologies and Infrastructure

Government and educational stakeholders should prioritize investment in assistive technologies and digital infrastructure for inclusive education. Schools should be equipped with reliable electricity, internet connectivity, adaptive devices, and AI-supported learning systems necessary for supporting learners with special needs. Expansion of technological infrastructure is essential for promoting accessibility and inclusion within vocational education programs (OECD, 2021).

Teacher Professional Development

Continuous professional development programs should be organized to equip Home Economics teachers with competencies in inclusive digital pedagogy, special needs education, and AI technology integration. Teachers should receive training on adaptive instructional methods, assistive technologies, classroom management, and inclusive assessment practices. Such training will improve teachers' confidence and effectiveness in managing inclusive practical classrooms (Darling-Hammond et al., 2017).

Teacher education institutions should also integrate inclusive technology education and AI-related courses into teacher preparation programs to ensure that future educators possess necessary competencies for inclusive digital instruction (UNESCO, 2021).

Curriculum Adaptation and Inclusive Policy Support

Home Economics curricula should be adapted to accommodate diverse learning needs and integrate assistive technologies into practical instruction. Curriculum reforms should emphasize accessibility, flexibility, individualized learning, and inclusive vocational training. Educational policymakers should also develop comprehensive guidelines and frameworks for implementing AI-supported inclusive education within schools and higher institutions (Federal Republic of Nigeria, 2013).

Strong monitoring and evaluation systems should be established to assess effectiveness of technology integration initiatives and ensure accountability in implementation processes. Government agencies should collaborate with special education professionals, technology experts, and educational institutions in developing inclusive educational policies and standards (OECD, 2021).

Partnerships and Stakeholder Collaboration

Partnerships between government, educational institutions, private organizations, and international agencies can significantly support inclusive technology integration in Nigerian schools. Technology companies can provide adaptive software solutions, technical expertise, and assistive devices, while international organizations can support funding, research, and capacity-building initiatives. Collaborative partnerships promote innovation, sustainability, and knowledge exchange in inclusive education (UNESCO, 2021).

Implications for Inclusive and Sustainable Educational Development

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The integration of AI assistive technologies into Home Economics practical classes has significant implications for inclusive and sustainable educational development in Nigeria. Technology-enhanced inclusive education promotes equal learning opportunities, social participation, and vocational skill acquisition for learners with disabilities. Students equipped with practical competencies and digital literacy skills are better prepared for independent living, entrepreneurship, and employment opportunities within society (Trilling & Fadel, 2009).

AI-supported inclusive learning environments also contribute to social inclusion and reduction of educational inequality. Learners with special needs gain greater access to educational opportunities, classroom participation, and vocational training regardless of physical or cognitive limitations. Such inclusion supports human rights, dignity, and social justice principles within educational systems (UNESCO, 2020).

Furthermore, integration of assistive technologies aligns with Sustainable Development Goal 4, which advocates inclusive and equitable quality education for all learners. By harnessing AI technologies effectively, Nigeria can improve educational accessibility, strengthen vocational education, and promote sustainable human capital development (United Nations, 2015).

Conclusion

Artificial Intelligence assistive technologies provide innovative and practical solutions for supporting learners with special needs in Home Economics practical classes. Inclusive vocational education remains essential for promoting equal opportunities, social inclusion, and skill acquisition among learners with disabilities. However, traditional teaching approaches and inadequate instructional resources continue to limit participation and achievement for many students with special needs within Nigerian educational institutions.

This paper examined the applications, benefits, challenges, and strategies associated with integrating AI assistive technologies into Home Economics practical education. Findings revealed that technologies such as speech-to-text systems, visual recognition safety alerts, adaptive instructional videos, and intelligent learning assistants significantly improve participation, confidence, safety, independence, and individualized learning experiences among learners with disabilities. AI-supported learning environments also reduce instructional burden on teachers and enhance inclusive classroom management.

Despite these benefits, challenges such as inadequate infrastructure, poor funding, insufficient teacher training, and weak policy implementation continue to hinder effective integration of assistive technologies in Nigeria. Addressing these challenges requires strategic investment in digital infrastructure, teacher professional development, curriculum adaptation, and institutional support for inclusive educational innovation.

Ultimately, Artificial Intelligence provides sustainable pathways for achieving inclusive vocational education and supporting equitable access to Home Economics learning opportunities for all learners. Government, educational institutions, private organizations, and international partners must collaborate to promote inclusive technology integration and strengthen educational opportunities for learners with special needs in Nigeria (UNESCO, 2021; Holmes et al., 2019).

Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. Government should increase funding for assistive technologies and inclusive digital infrastructure in schools.
2. Home Economics practical laboratories should be equipped with AI-supported assistive learning devices and safety systems.
3. Continuous teacher training programs should be organized on inclusive digital pedagogy and assistive technology integration.
4. Educational institutions should improve accessibility and support services for learners with special needs.
5. Home Economics curricula should incorporate adaptive instructional approaches and technology-supported learning activities.
6. Policies promoting inclusive education and assistive technology integration should be effectively implemented and monitored.
7. Partnerships between government, private organizations, and international agencies should be strengthened to support inclusive educational innovation.
8. Further research should be conducted on effectiveness of AI assistive technologies in vocational and practical education within Nigerian contexts.

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