



Adaptive Literacy Assessment in Education: A Systematic Review of Computerised Testing Models

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Abstract

This systematic review synthesises current evidence on adaptive testing models used in literacy assessment within educational frameworks. The review was motivated by the limitations of traditional fixed-form literacy assessments, which often fail to accommodate differences in learner ability levels and may yield inefficient, less accurate measurement outcomes. The study examined how Computerised Adaptive Testing (CAT) and related adaptive assessment technologies improve the precision, efficiency, personalisation, and scalability of literacy evaluation through psychometric frameworks such as Item Response Theory (IRT) and Artificial Intelligence (AI)-supported adaptive systems. A comprehensive literature search was conducted across five electronic databases: Google Scholar, ERIC, PsycINFO, JSTOR, and PubMed. The search yielded 120 studies, which were screened using predefined inclusion and exclusion criteria in accordance with the PRISMA guidelines. After title, abstract, and full-text screening, 10 eligible studies published between 2018 and 2025 were selected for analysis. Findings revealed that adaptive literacy assessment models significantly reduce testing time while improving measurement accuracy and learner engagement. The reviewed studies also highlighted the importance of robust item calibration, algorithm design, AI integration, and psychometric validity in enhancing adaptive assessment systems. Furthermore, evidence from both developed and developing countries demonstrated the feasibility of implementing adaptive literacy tools across diverse educational settings. Despite these advantages, challenges remain in infrastructure, ethical AI use, item bank development, and user experience. The review concludes that adaptive testing models have substantial potential to transform literacy assessment by supporting fairer, learner-centred, and data-driven evaluation practices.

Keywords: Computerised Adaptive Testing, Adaptive Literacy Assessment, Item Response Theory, Literacy Education, Artificial Intelligence, Educational Assessment.

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INTRODUCTION

Literacy assessment remains a key aspect of education because it provides information about learners' ability to read, comprehend texts, and use language effectively. In Africa, literacy is closely linked to educational attainment, employability, and national development. Although literacy rates have improved in many African countries, challenges persist, particularly among learners at foundational and basic education levels. These challenges have raised concerns about whether existing assessment methods adequately capture the literacy skills required in contemporary and increasingly complex learning environments.

Traditional literacy assessment approaches used in many educational systems, including those in Africa, often rely on fixed-form tests in which all learners respond to the same set of items regardless of their ability levels (Oladele et al., 2022a). Such approaches have been criticised for their inability to account for individual learner differences, thereby limiting accurate measurement of literacy competence. According to Jia and Liu, (2026) One major limitation of fixed-form testing is the lack of individualisation, as learners with varying abilities are assessed using identical test items. Similarly, Padang (2025) observed that conventional testing often produces floor and ceiling effects, as some learners encounter items that are too easy, while others encounter items that are too difficult.

These limitations are particularly evident within African educational contexts, where linguistic diversity, unequal learning opportunities, overcrowding, and shortages of instructional materials characterise classrooms. In South Africa, Chauke and Tabane, (2024) emphasised the need for adaptive assessment procedures in inclusive English First Additional Language classrooms. Their study highlighted the importance of assessment systems that can accommodate differences in learners' language backgrounds, knowledge levels, and learning needs. These findings suggest that conventional assessment models may not adequately support equitable literacy evaluation in diverse African classrooms.

In response to these challenges, adaptive testing has emerged as an innovative approach to educational assessment (Oladele et al., 2022b). Adaptive testing refers to assessment methods in which the difficulty and sequence of test items change according to a learner's responses during the assessment process. The theoretical foundation of adaptive testing is largely based on Item Response Theory (IRT), which explains the relationship between learner ability and item characteristics. Unlike

Classical Test Theory, IRT enables individualised measurement by selecting items that best match the learner's estimated ability level. Liu et al. (2024) explained that Computerised Adaptive Testing (CAT) continuously estimates learner ability and administers items that maximise measurement precision while minimising unnecessary testing time.

The integration of Artificial Intelligence (AI), machine learning, and educational data analytics has further expanded the possibilities of adaptive literacy assessment. Adaptive testing is also supported by constructivist learning theory and the Zone of Proximal Development, which emphasise learner-centred instruction and assessment. Their study on computerised adaptive assessment of reading processes demonstrated that graduated prompts and adaptive scaffolding enhanced the predictive validity of literacy assessment. This indicates that adaptive literacy assessment can support both evaluation and instructional intervention by identifying learners' developmental needs.

Globally, adaptive testing has gained considerable attention because of its ability to improve assessment precision, efficiency, and personalisation. Rice et.al.(2022) reported that Computer Adaptive Progress Testing successfully produced stable estimates of learner ability across medical schools in five European countries involving students from more than 40 nationalities. Their findings demonstrated that adaptive testing systems can operate effectively across multilingual and culturally diverse populations while maintaining high reliability and low measurement error. Similarly, Ma et al. (2025) found that adaptive testing significantly reduced test length while maintaining strong reliability and high correlations with oral reading performance measures.

Research has also shown that adaptive assessment systems can improve learner engagement, motivation, and knowledge retention. In a study conducted in Kwara State, Adeoye et.al. (2025) found that adaptive assessment tools significantly enhanced learners' engagement and retention compared with traditional assessment methods. Learners reported receiving clearer feedback on their learning needs and greater active participation during assessment. These findings reinforce the argument that adaptive literacy assessment promotes personalised learning by aligning assessment difficulty with learner competence.

Recent developments in AI-assisted adaptive systems have further strengthened the movement toward intelligent learner-centred assessment environments. Minn and Nkambou (2025) identified domain models, student models, and tutor models as essential components of AI-assisted adaptive

learning systems capable of personalising educational experiences. Likewise, Mohammadi (2024) reported that AI-aided adaptive learning environments improved teachers' assessment literacy and instructional quality. These developments suggest that adaptive assessment is evolving beyond simple testing mechanisms toward intelligent educational systems that provide immediate feedback, predictive analytics, and individualised learning pathways.

Within Africa, interest in adaptive testing technologies has accelerated due to digital transformation and the educational disruptions caused by the COVID-19 pandemic. Ayanwale and Ndlovu (2024) argued that the cancellation of National Benchmark Tests in South Africa during the pandemic exposed the limitations of paper-based assessments and highlighted the need for computer-adaptive alternatives. They emphasised that Fourth Industrial Revolution technologies, including AI and computerised testing systems, present opportunities for more reliable, efficient, and scalable educational assessment across Sub-Saharan Africa. In a subsequent simulation study, the researchers demonstrated the feasibility of implementing CAT for South Africa's National Benchmark Tests using SimulCAT software, revealing that adaptive testing reduced testing time while maintaining high measurement precision.

Furthermore, recent psychometric research in Sub-Saharan Africa has highlighted the importance of advanced adaptive measurement models for improving fairness and equity in educational assessment. Ntumi et. al. (2025) applied Multidimensional Item Response Theory (MIRT) models to high-stakes competency assessments across Ghana, Nigeria, Kenya, South Africa, and Uganda. Their findings indicated that adaptive MIRT models improved reliability, predictive validity, and measurement precision compared with traditional unidimensional IRT models. The study also revealed that adaptive testing reduced test length while maintaining high accuracy, although some assessment items exhibited linguistic and socioeconomic bias across subgroups. These findings underscore the need for culturally responsive and equitable adaptive assessment systems within African educational settings.

Despite these advancements, several barriers continue to hinder the implementation of adaptive literacy assessment in Africa. Researchers have identified inadequate technological infrastructure, unstable electricity supply, poor internet connectivity, limited access to digital devices, and low technological competence among educators as major implementation challenges. In addition, there is limited availability of culturally relevant and linguistically appropriate adaptive literacy assessment tools designed specifically for African learners. Concerns regarding psychometric validation, item

bank development, ethical AI use, algorithm transparency, and data privacy also remain insufficiently addressed in African educational research.

Although the international literature provides substantial evidence on the effectiveness of adaptive testing models, research on adaptive literacy assessment in African contexts remains fragmented and limited. Existing African studies have focused primarily on feasibility, usability, and high-stakes testing applications. At the same time, relatively few systematic reviews have synthesised evidence relating to adaptive literacy assessment practices, psychometric foundations, implementation challenges, and learner outcomes across the continent. Consequently, there remains a significant gap in understanding how adaptive testing models can effectively support literacy assessment in diverse African educational environments.

Therefore, this systematic review seeks to synthesise current evidence on adaptive testing models used in literacy assessment, with particular attention to African educational contexts. The review aims to examine prevailing trends, theoretical foundations, psychometric approaches, implementation practices, challenges, and emerging innovations associated with adaptive literacy assessment. By consolidating existing evidence, the study aims to provide educators, researchers, policymakers, and assessment developers with insights to support the design and implementation of fair, efficient, valid, and learner-centred literacy assessment systems across Africa.

Statement of the Problem

Accurate literacy assessment remains a cornerstone of educational quality and learner development, as it informs instructional decisions, identifies learning gaps, and guides interventions. However, traditional literacy assessments, which often employ fixed-form testing, have been criticised for their limited ability to capture the full range of learners' literacy skills across diverse ability levels (Ntumi et al. 2025). Such static assessments can lead to measurement inefficiencies, including ceiling and floor effects, in which high-performing students find tests too easy, and low-performing students find them too difficult. Consequently, these assessments may fail to represent learners' true literacy competence, undermining both the validity and fairness of educational decisions based on their results.

The growing diversity of learners in classrooms, characterised by differences in linguistic backgrounds, learning pace, and cognitive development, further complicates the effectiveness of

one-size-fits-all testing formats. This misalignment between test difficulty and learner ability contributes to disengagement, test anxiety, and inaccurate diagnosis of literacy proficiency (Dunaway, 2025). Moreover, fixed assessments often require longer administration times without necessarily increasing measurement precision, posing logistical and psychological challenges for both learners and educators.

In response to these limitations, adaptive testing models have emerged as a promising alternative, offering dynamic item selection based on individual performance in real time (Huang et al., 2025). By leveraging psychometric frameworks such as Item Response Theory (IRT), these models can provide more precise, efficient, and personalised literacy assessments. However, the application of adaptive testing in literacy contexts is still evolving, with variations in model design, algorithmic approaches, item bank construction, and interpretation of adaptive scores (Bulut, 2024). Despite its theoretical advantages, empirical evidence on the effectiveness, fairness, and scalability of adaptive testing models for literacy assessment remains fragmented.

This gap underscores the need for a systematic review that synthesises existing research on adaptive testing models for literacy assessment in educational contexts. Such a review is essential for identifying prevailing methodologies, assessing their psychometric soundness, evaluating implementation outcomes, and highlighting best practices to guide future applications. Without a clear understanding of these aspects, educators and policymakers may struggle to adopt adaptive testing models effectively, thereby limiting their potential to enhance literacy evaluation and learning outcomes.

Research Objectives

This systematic review aims to synthesise current evidence on adaptive testing models used in literacy assessment within educational contexts. It will evaluate the effectiveness, technical frameworks, and practical implications of these models to inform educators, researchers, and policymakers seeking to implement adaptive literacy assessments that support enhanced learning outcomes. The specific objectives of the study are to;

- a) Review published papers on Adaptive Testing for Literacy Assessment in Education in Africa.
- b) present the current trends of Adaptive Testing for Literacy Assessment in Education in Africa.

MATERIAL AND METHOD

This study adopted a systematic review design to synthesise existing literature on adaptive testing models used in literacy assessment within educational contexts. The systematic review approach was considered appropriate because it provides a structured and comprehensive method for identifying, evaluating, and synthesising empirical and theoretical evidence relating to adaptive literacy assessment and Computerised Adaptive Testing (CAT). The review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency, rigour, and replicability throughout the identification, screening, eligibility assessment, and inclusion stages.

Relevant literature was retrieved from five major electronic databases: Google Scholar, ERIC (Education Resources Information Centre), PsycINFO, JSTOR, and PubMed. These databases were selected for their extensive coverage of educational, psychological, psychometric, and technology-related research. The search yielded 120 studies, comprising 35 from Google Scholar, 25 from ERIC, 20 from PsycINFO, 20 from JSTOR, and 20 from PubMed.

The search strategy employed combinations of keywords and Boolean operators such as AND and OR to refine the search and retrieve studies relevant to the review objectives. The major search terms included “Computerised Adaptive Testing (CAT),” “Adaptive Literacy Assessment,” “Item Response Theory and Adaptive Testing,” “AI-Assisted Adaptive Learning Systems,” “Psychometrics and Computerised Testing,” “Adaptive Reading Assessment,” and “Feasibility of CAT in Developing Countries.” The search was limited to peer-reviewed studies published between 2018 and 2025 to capture recent developments in adaptive testing technologies and literacy assessment practices.

Studies were included if they focused on adaptive testing or Computerised Adaptive Testing (CAT), literacy or educational assessment, and educational contexts. Both empirical and theoretical studies published in English-language journals, conference proceedings, dissertations, and academic reports were considered eligible. Studies were excluded if they did not focus on adaptive testing or literacy assessment, were unrelated to education, were published outside the specified period, were not written in English, or lacked sufficient methodological or empirical information.

Following the identification stage, duplicate and unrelated studies were removed. The titles and abstracts of the remaining studies were screened to determine their relevance to the objectives of the review. Studies that met the preliminary screening criteria underwent full-text assessment to establish eligibility. After screening and eligibility, 10 studies met all inclusion criteria and were selected for final analysis.

RESULTS

Study Selection

A systematic search of Google Scholar, ERIC, PsycINFO, JSTOR, and PubMed yielded 120 records relevant to adaptive testing and literacy assessment. After removing duplicate records and studies not relevant to the review objectives, 78 studies remained for title and abstract screening. After screening, 22 articles were deemed potentially eligible and underwent full-text review. Full-text assessment excluded 12 studies that did not meet the inclusion criteria. Consequently, 10 studies met all eligibility requirements and were included in the final qualitative synthesis.

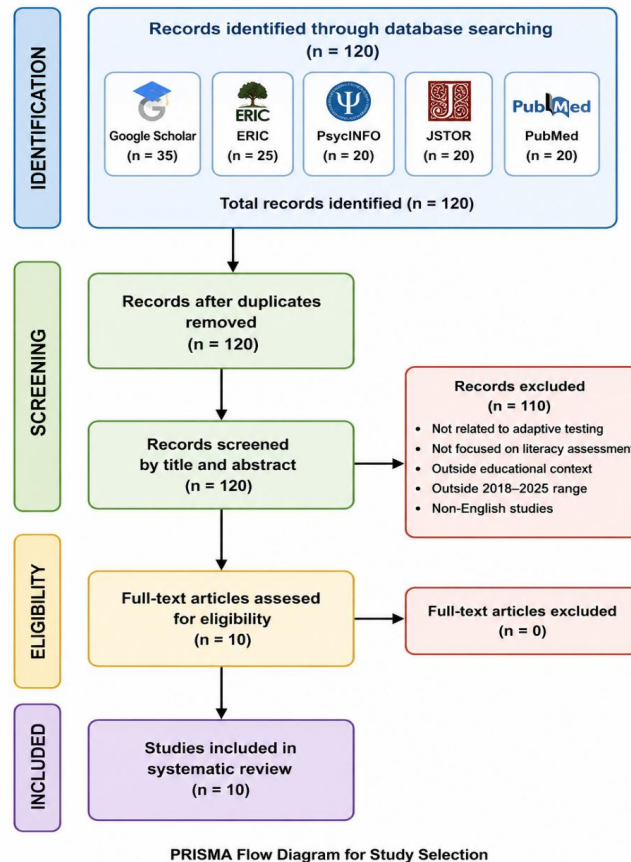


Figure 1: PRISMA Flow Diagram

Characteristics of Included Studies

The selected studies were conducted across diverse educational settings, including primary schools, secondary schools, universities, and large-scale educational assessment systems. The studies originated from different geographical locations, including Nigeria, South Africa, Germany, Spain, Italy, and multinational European educational environments. Methodologically, the studies employed simulation, experimental, mixed-methods, correlational, validation, and survey designs.

Table 1: Characteristics of Included Studies

Author(s) and Year	Educational Context	Methodology	Adaptive Model
Wokoma & Opara (2018)	Nigerian Secondary Schools	Evaluation Design	CAT
Gökçe & Glas (2018)	TIMSS Assessment	Simulation Study	IRT-Based CAT
Navarro & Mourgues-Codern (2018)	Reading Assessment	Experimental Design	Dynamic CAT
Angelone et al. (2022)	University Courses	Comparative Study	CAT
Rice et al. (2022)	European Medical Education	Adaptive Progress Testing	CAT
Mohammadi (2024)	Adaptive Learning Environments	Mixed Methods	AI-Assisted Adaptive Systems
Ayanwale & Ndlovu (2024)	National Benchmark Tests	Simulation Study	CAT
Ma et al. (2025)	Online Reading Assessment	Validation Study	ROAR-CAT
Yumus et al. (2025)	Early Literacy Assessment	IRT-Based CAT	EuLeApp©
Adeoye et al. (2025)	Nigerian Educational Setting	Survey Design	Adaptive Assessment

Current Trends in Adaptive Literacy Assessment

Analysis of the reviewed studies revealed several emerging trends in adaptive literacy assessment. First, there is increasing adoption of Computerized Adaptive Testing systems supported by Item Response Theory. Most studies reported using psychometric calibration procedures to improve measurement precision and reliability. Second, adaptive literacy assessment is becoming increasingly

integrated with Artificial Intelligence, machine learning, and educational data analytics to support personalised learning and assessment decision-making.

Third, there is growing interest in adaptive assessment applications within developing countries, particularly in Africa. Studies conducted in Nigeria and South Africa demonstrated the feasibility of implementing adaptive testing within educational systems despite infrastructural constraints. Fourth, adaptive literacy assessment tools are increasingly being developed for early literacy screening, reading diagnosis, and online educational environments.

Effectiveness of Adaptive Testing Models

The reviewed studies consistently reported positive outcomes associated with adaptive testing models. Several studies found that adaptive assessments reduced testing time while maintaining or improving measurement precision. Gökçe and Glas (2018), Ma et al. (2025), and Ayanwale and Ndlovu (2024) reported that adaptive testing achieved reliability levels comparable to or higher than those of traditional fixed-form assessments, using fewer test items.

Furthermore, adaptive literacy assessment systems demonstrated strong capabilities in identifying learner strengths and weaknesses. Navarro and Mourgues-Codern (2018) reported that dynamic adaptive assessment provided additional information regarding reading competence beyond conventional assessment approaches. Similarly, Yumus et al. (2025) found that adaptive literacy screening tools offered precise measurement of early literacy skills.

Benefits of Adaptive Literacy Assessment

The synthesis of findings revealed several benefits associated with adaptive literacy assessment systems. These include improved measurement accuracy, shorter testing duration, enhanced learner engagement, personalised assessment experiences, and more efficient use of assessment resources. Adeoye et al. (2025) reported that adaptive assessments increased learner motivation, engagement, and knowledge retention compared with traditional assessment approaches.

Table 2: Major Benefits Reported Across Reviewed Studies

Benefit	Frequency Across Studies
Improved measurement precision	9
Reduced testing time	8
Enhanced learner engagement	6
Personalized assessment	7
Improved reliability and validity	8
Early identification of literacy difficulties	4

Implementation Challenges

Despite the reported benefits, several challenges were identified across the reviewed studies. Commonly reported barriers included inadequate technological infrastructure, limited access to computers and internet connectivity, insufficient teacher training, challenges associated with item bank development, and concerns regarding psychometric fairness. Studies focusing on AI-assisted adaptive systems also highlighted issues relating to algorithm transparency, data privacy, and ethical use of learner information.

Table 3: Common Challenges Identified in the Reviewed Studies

Challenge	Number of Studies Reporting
Technological infrastructure limitations	7
Limited teacher preparedness	5
Item bank development difficulties	6
Psychometric validation concerns	5
Data privacy and ethical concerns	4
Limited digital literacy among users	4

Summary of Findings

Overall, the findings indicate that adaptive testing models are increasingly being adopted for literacy assessment due to their ability to provide accurate, efficient, and learner-centred evaluation. The

reviewed evidence demonstrates strong support for the use of Computerised Adaptive Testing, Item Response Theory, and Artificial Intelligence-assisted adaptive systems in literacy assessment. However, successful implementation requires adequate technological infrastructure, robust psychometric design, and sustained capacity development among educational stakeholders.

DISCUSSION

The findings from this systematic review indicate that adaptive testing models have considerable potential to transform literacy assessment through improved precision, efficiency, personalisation, and learner engagement. Across the reviewed studies, there was consistent evidence that Computerised Adaptive Testing (CAT) and adaptive assessment systems outperform traditional fixed-form assessments in measuring learner abilities more accurately while reducing testing duration. However, beyond these reported advantages, the reviewed literature also reveals important methodological, contextual, and implementation concerns that require critical examination, particularly within African educational settings.

One of the most consistent findings across the studies was that adaptive testing improves measurement precision by aligning assessment difficulty with learner ability. Studies by Gökçe and Glas (2018), Kalender and Berberoglu (2017)), and Ma et al.(2025) demonstrated that CAT systems can maintain high reliability while significantly reducing test length. These findings support existing psychometric literature, which argues that Item Response Theory-based adaptive assessments provide more efficient measurement because items are selected according to estimated learner competence rather than administered uniformly to all test takers. The implication is particularly important for literacy assessment, where learners often possess widely varying reading abilities. Nevertheless, while the reviewed studies strongly support the psychometric efficiency of CAT, many relied heavily on simulations or controlled digital environments, which may not fully reflect the realities of low-resource educational systems common in many African countries.

The review also revealed that adaptive literacy assessments contribute positively to learner engagement and personalised learning. Adeoye et al.(2025) found that students exposed to adaptive assessments reported higher engagement, motivation, and knowledge retention than those using traditional testing approaches. Similarly, (Yumus et.al.(2025) showed that adaptive literacy tools such as EuLeApp© enabled individualised literacy support and early identification of reading difficulties. These findings align with constructivist theories and Vygotsky's Zone of Proximal

Development, which emphasise the importance of matching instructional and assessment tasks to learner developmental levels. However, although the reviewed studies emphasised personalisation benefits, relatively few critically examined whether adaptive systems may unintentionally disadvantage learners with low digital literacy skills or limited familiarity with computer-based environments. This represents an important gap because technological inequities remain substantial across many African educational systems.

Another important finding concerns the integration of dynamic and AI-assisted assessment features into adaptive literacy systems. Navarro and Mourgues-Codern (2018) demonstrated that dynamic adaptive assessments incorporating graduated prompts provided stronger predictive validity for reading competence than static assessments alone. Likewise, Mohammadi (2024) found that AI-aided adaptive learning environments enhanced teachers' assessment literacy and instructional quality. These findings suggest that adaptive literacy assessment is gradually evolving beyond simple test administration toward intelligent assessment ecosystems capable of diagnosing learner difficulties and supporting intervention. Nevertheless, most reviewed studies focused primarily on technological effectiveness while paying limited attention to ethical concerns such as algorithmic bias, transparency, and data privacy. Given increasing global concerns about the ethical use of AI in education, future adaptive literacy systems must balance technological innovation with fairness and accountability.

The review further showed that adaptive testing is increasingly being explored within African educational contexts, particularly in relation to high-stakes examinations and educational modernisation. Ayanwale and Ndlovu (2022) argued that the disruptions caused by the COVID-19 pandemic accelerated interest in adaptive testing and Fourth Industrial Revolution technologies within South Africa's educational assessment sector. Their later simulation study, Ayanwale and Ndlovu (2024), further demonstrated the feasibility of implementing CAT for National Benchmark Tests with high levels of measurement precision. Similarly, Wokoma and Opara (2018) found that item calibration, scoring mechanisms, and item selection algorithms significantly influenced CAT usability within Nigerian secondary schools. These findings suggest that African educational systems are increasingly recognising the potential of adaptive assessment technologies. However, the literature also indicates that adaptive testing implementation across Africa remains uneven and largely experimental. Most African studies focused on feasibility, usability, or simulation rather than

large-scale operational literacy assessment systems. This limits the extent to which conclusions regarding effectiveness can be generalised across African educational contexts.

A particularly significant contribution of the reviewed literature relates to psychometric equity and fairness. The study by Ntumi et.al. (2025) demonstrated that Multidimensional Item Response Theory (MIRT) models significantly improved predictive validity, reliability, and measurement precision compared with traditional unidimensional models across multiple Sub-Saharan African countries. However, the study also identified Differential Item Functioning (DIF) across linguistic and socioeconomic groups, suggesting that some assessment items favoured particular learner populations. This finding is critically important because it challenges assumptions that adaptive testing systems are automatically fair simply because they are technologically advanced. In multilingual African contexts where literacy development is closely tied to language background and socioeconomic inequality, adaptive literacy assessments must be carefully validated to avoid reinforcing existing educational disparities.

The methodological quality of the reviewed studies also presents both strengths and limitations. Many studies employed robust psychometric designs, including IRT calibration, simulation studies, validation experiments, and mixed-method approaches. Studies such as Ma et al. (2025) and Yumus et al. (2025) demonstrated rigorous validation procedures and large sample sizes, thereby strengthening confidence in their findings. Nevertheless, several studies relied on simulation models, self-reported data, or localised samples, limiting external validity and long-term applicability. Additionally, most reviewed studies were conducted in Europe or technologically advanced educational settings, while African-focused evidence remained relatively scarce. This imbalance suggests that adaptive literacy assessment research in Africa is still developing and requires broader empirical investigation across different educational systems, languages, and learner populations.

Overall, the reviewed literature strongly supports the potential of adaptive testing models to improve literacy assessment through greater precision, efficiency, and personalisation. However, the evidence also indicates that successful implementation depends not only on technological sophistication but also on psychometric quality, infrastructural readiness, contextual relevance, ethical safeguards, and teacher capacity development. While adaptive literacy assessment represents a promising direction for educational measurement in Africa, more context-sensitive, large-scale empirical research is needed to ensure that these systems are equitable, culturally responsive, and practically sustainable across diverse African educational environments.

CONCLUSION

This systematic review examined current evidence on adaptive testing models for literacy assessment in educational contexts, with particular attention to emerging developments within Africa. The review revealed that Computerised Adaptive Testing (CAT) and related adaptive assessment systems provide significant advantages over traditional fixed-form assessments in terms of measurement precision, efficiency, personalisation, and learner engagement. The reviewed studies demonstrated that adaptive assessments can accurately estimate learner ability while reducing testing duration and minimising learner fatigue. In literacy education, adaptive systems also showed strong potential for identifying reading difficulties early, supporting individualised interventions, and improving instructional decision-making.

The findings further indicate that adaptive literacy assessment is increasingly supported by advances in Item Response Theory (IRT), Artificial Intelligence (AI), machine learning, and educational data analytics. These technologies enable more responsive, learner-centred assessment systems that provide immediate feedback and dynamic item selection. Studies conducted in African contexts also suggest that adaptive testing is gradually gaining attention within the continent, particularly in relation to high-stakes examinations, educational modernisation, and digital transformation initiatives.

Despite these promising developments, the review identified several challenges affecting the implementation of adaptive literacy assessment, especially within African educational systems. These include inadequate technological infrastructure, limited digital literacy, insufficient teacher training, concerns regarding psychometric fairness, and the limited availability of culturally responsive assessment tools. Additionally, much of the existing literature remains concentrated in developed countries, with relatively few large-scale empirical studies focusing specifically on adaptive literacy assessment in Africa.

Overall, the review concludes that adaptive testing models represent a promising direction for improving literacy assessment through greater accuracy, flexibility, and learner-centeredness. However, successful implementation requires strong psychometric design, contextual adaptation, technological readiness, ethical safeguards, and sustained policy support. Further African-centred

research is necessary to ensure that adaptive literacy assessment systems are equitable, valid, culturally appropriate, and sustainable within diverse educational environments.

Implications of the Study

The findings of this review have important implications for educational assessment, literacy instruction, policy development, and future research. First, the review demonstrates that adaptive literacy assessment can significantly improve the accuracy and efficiency of learner evaluation. This suggests that educators and assessment practitioners may need to reconsider their continued reliance on traditional, fixed-form literacy assessments, which often fail to capture differences in learner ability levels. Adaptive assessment systems provide opportunities for more individualised evaluation, thereby supporting differentiated instruction and targeted literacy intervention.

Second, the review highlights the growing importance of psychometric and technological competence within educational systems. Since adaptive testing relies heavily on Item Response Theory, item calibration, algorithm design, and digital platforms, educational institutions and examination bodies may need to invest in capacity building for assessment specialists, teachers, and educational technologists. Strengthening assessment literacy among educators will be essential for the successful implementation and interpretation of adaptive literacy assessments.

Third, the findings have policy implications for educational reform within Africa. Policymakers may need to prioritise investments in digital infrastructure, internet accessibility, and educational technology to support the large-scale implementation of adaptive assessment systems. The review also suggests the need for policies that promote fairness, inclusivity, and ethical AI use in educational assessment, particularly in multilingual, socioeconomically diverse African contexts.

Furthermore, the review highlights important implications for equity in educational assessment. While adaptive testing has the potential to reduce measurement error and improve fairness, poorly designed systems may unintentionally reinforce linguistic, cultural, or socioeconomic biases. Therefore, adaptive literacy assessments must be carefully validated to ensure cultural responsiveness and fairness for diverse learner populations.

Finally, the review contributes to the growing body of knowledge on adaptive literacy assessment by synthesising evidence across different educational contexts. The findings provide researchers with a clearer understanding of existing trends, methodological approaches, implementation challenges, and

research gaps. This may guide future empirical investigations aimed at developing contextually relevant adaptive literacy assessment systems within African educational environments.

Recommendations

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

- a) Educational institutions and examination bodies should gradually integrate adaptive testing models into literacy assessment practices to improve measurement precision, learner engagement, and assessment efficiency.
- b) Governments and policymakers in African countries should invest in digital infrastructure, including stable internet connectivity, electricity supply, and access to technological devices, to support the implementation of adaptive assessment systems.
- c) Teacher education institutions and professional development agencies should provide training on adaptive assessment, Item Response Theory (IRT), assessment literacy, and AI-supported educational technologies to strengthen educators' competence in adaptive testing practices.
- d) Researchers and psychometricians should develop culturally responsive and linguistically appropriate adaptive literacy assessment tools that reflect the educational realities of African learners and multilingual classrooms.
- e) Educational stakeholders should establish ethical guidelines and quality assurance frameworks for the use of Artificial Intelligence and adaptive algorithms in educational assessment to ensure transparency, fairness, data privacy, and accountability.
- f) Future studies should focus on large-scale empirical investigations of adaptive literacy assessment within African educational contexts, particularly at foundational and basic education levels where literacy development is most critical.
- g) Further research should also examine learners' perceptions, digital readiness, and accessibility challenges associated with adaptive literacy assessment in low-resource educational environments.
- h) Collaboration between educational researchers, software developers, psychometric experts, and policymakers should be strengthened to support the sustainable design and implementation of adaptive literacy assessment systems across Africa.

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