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The Impact of E-Learning, Modular, and Stimulus-Based Learning on Midwifery Education in Africa: A Systematic Review

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ABSTRACT

Midwifery education in Africa faces persistent resource constraints, geographical barriers to access, and quality gaps, which have driven the adoption of e-learning, modular, and stimulus based pedagogical approaches. Although these innovations improve flexibility, support competency development, and align with international standards, evidence on their effectiveness and sustainability remains fragmented across diverse African contexts. To synthesise evidence on application, effectiveness, and implementation challenges of e-learning, modular learning, and stimulus-based strategies in African midwifery education, thereby informing curriculum reform, instructor/lecturers' development, and policy formulation. Systematic review conducted following PRISMA 2020 guidelines. Six databases were searched for studies published January 2015–March 2025. Eligible studies examined e-learning, modular, or stimulus-based learning in African midwifery education and reported outcomes including knowledge, competence, satisfaction, feasibility, or adoption. Thirteen studies meeting inclusion criteria underwent quality appraisal using CASP, JBI, and MMAT tools. Due to methodological and outcome heterogeneity, narrative synthesis was employed. Evidence from qualitative, quantitative, and mixed methods studies across Ghana, Nigeria, Kenya, Uganda, Rwanda, Zambia, Liberia, and multi country settings indicated that e learning improved ICT competence, scheduling flexibility, and academic performance, but faced barriers including high data costs, unreliable connectivity, and limited institutional support. Modular learning strengthened knowledge acquisition, clinical confidence, and competence within structured Continuing Professional Development (CPD) programmes, yet the need for strong governance and sustained resourcing remains. Stimulus based strategies, including quizzes, reminders, conferences, and objective Structured Clinical Examinations (OSCEs), increased engagement and supported competence development, although they did not replace repeated supervised clinical practice. Overall improvements occurred, while infrastructure gaps, instructors' preparedness, and programme sustainability moderated impact in many training contexts. E-learning, modular, and stimulus-based approaches demonstrate potential for strengthening African midwifery education, yet effectiveness remains highly context-dependent. Sustained investment in infrastructure, enabling policy frameworks, and systematic instructors/lecturers' development are critical prerequisites to ensuring that the teaching innovations reduce rather than exacerbate educational inequalities.

Keywords: E learning, modular learning, stimulus-based learning, midwifery education, Africa, continuing professional development, clinical competence, digital pedagogy, systematic review

1.0 INTRODUCTION

The preparation of competent midwives remains central to improving maternal and newborn health outcomes in Africa, where maternal mortality remains unacceptably high (World Health Organization, 2023). Midwifery education has long relied on traditional classroom teaching, but increasing demands for efficiency, access, and relevance have led to experimentation with new approaches. E-learning, modular, and stimulus-based strategies have all been introduced in varying forms to address gaps in resources, faculty capacity, and geographical access. These innovations promise to enhance learning flexibility, standardise competencies, and strengthen critical thinking, yet their outcomes have not been consistently evaluated across contexts.

Several primary studies have examined e-learning in African midwifery education. For example, Gracious et al. (2024) and Mambwe and Tembo (2021) reported that virtual platforms supported flexibility, ICT skill development, and improved grades but were hampered by poor connectivity and cost barriers. Modular learning has also been explored, particularly in competency-based curricula and continuous professional development for educators, where findings suggested improvements in knowledge and confidence (Shikuku et al., 2024; Ladur et al., 2025). Stimulus-based approaches, including quizzes, structured prompts, and clinical assessments such as OSCEs, were found to increase engagement and reinforce learning, though without adequate supervision they risked superficial competence (Adesuyi et al., 2023; Ndayisenga et al., 2022). These studies, while valuable, provide fragmented insights and are limited by differences in design, scope, and focus.

Previous systematic reviews have examined broader themes in health professions education. Barteit et al. (2020) reviewed e-learning in low- and middle-income countries and concluded that while feasible, interventions were often pilot projects with limited sustainability. Hyrkäs and Mowitz (2023) mapped midwifery education in sub-Saharan Africa against ICM standards and found structural gaps in governance, faculty, and resources. However, these reviews were not designed to synthesise evidence across the specific modalities of e-learning, modular, and stimulus-based learning within midwifery education. Similarly, global reviews of simulation and digital learning (ten Hoop-Bender et al., 2014) acknowledged their potential but did not provide a focused African synthesis. As a result, stakeholders are left with scattered evidence and little consolidated guidance on the effectiveness, challenges, and contextual influences of these approaches.

This study therefore responds to the need for an integrated synthesis of findings on e-learning, modular, and stimulus-based learning in African midwifery education. By consolidating the evidence, it provides clarity on what has been achieved, identifies gaps that persist, and offers direction for curriculum reform, faculty development, and policy. The rationale rests on the urgent requirement for educational innovations that are both context-sensitive and aligned with global standards. Unlike previous reviews, this study brings together these three pedagogical strategies, analyses them collectively, and situates them within the realities of African midwifery education, thereby filling a critical knowledge gap.

The aim of this study therefore, was to synthesise and critically analyse existing evidence on the impact of e-learning, modular, and stimulus-based learning approaches on midwifery education in Africa, so as to generate a comprehensive understanding of their effectiveness, challenges, and wider implications for educational policy and practice. To achieve this aim, the study pursued several specific objectives. First, it sought (i) to examine how e-learning approaches have been applied within African midwifery education and to assess both their reported benefits and their limitations. Second, it aimed (ii) to analyse the contribution of modular learning approaches to knowledge, competence, and the strengthening of structured pedagogy among students and educators. Third, the study set out (iii) to evaluate the role of stimulus-based strategies, such as quizzes, prompts, and clinical assessments, in supporting learner engagement and competence. In addition, it intended (iv) to identify the contextual and regional influences, including infrastructural, governance, and institutional factors, that shape the effectiveness of these innovations. Finally, the review sought (v) to synthesise the overall implications of these approaches for curriculum reform, faculty development, and policy direction in midwifery education across Africa.

2.0 METHODS

2.1 Study Design

This study followed a systematic review design, using the PRISMA 2020 guidelines to ensure rigour and transparency. The focus was on e-learning, modular learning, and stimulus-based learning in midwifery education across Africa. Because of variation in study designs, interventions, and outcome measures, a meta-analysis was not undertaken. Instead, a narrative and thematic synthesis was used to integrate evidence, while preserving study context and methodological specificity. The eligibility criteria, search strategy, screening procedures, and quality appraisal plan were agreed by the authors before database searching commenced.

2.2 Eligibility Criteria

Studies were included if they examined e-learning, modular learning, or stimulus-based learning within midwifery education in Africa. Eligible participants were student midwives, midwifery educators, or other health trainees involved in midwifery-related learning. Both quantitative and qualitative primary studies were considered, including cross-sectional surveys, intervention studies, and descriptive qualitative reports. Studies were required to report at least one relevant outcome such as knowledge, skills, competence, satisfaction, or feasibility. Only peer-reviewed articles published in English between January 2015 and March 2025 were eligible. Reviews, editorials, protocols, and conference abstracts were excluded, as were studies outside Africa or those not addressing midwifery education. These criteria ensured that only studies directly relevant to midwifery education and the interventions of interest were synthesised.

2.3 Search Strategy

A comprehensive search strategy was developed to identify all relevant studies on e-learning, modular learning, and stimulus-based learning in midwifery education across Africa. Six electronic databases were systematically searched: PubMed, Scopus, ProQuest, EBSCOhost, Cochrane Library, and Google Scholar. The search covered publications from January 2015 to March 2025. Controlled vocabulary terms were used where supported, including Medical Subject Headings (MeSH) in PubMed, alongside free-text keywords across all sources. Search terms included “e-learning,” “online learning,” “modular learning,” “competency-based learning,” “stimulus-based learning,” “midwifery,” “nursing education,” and “Africa,” combined with Boolean operators (AND/OR); synonyms and truncations were used to maximise sensitivity and capture variations in terminology. Reference lists of included articles and relevant reviews were also manually searched to identify additional eligible studies not retrieved through database searches. All identified records were imported into Rayyan software for screening and management. The three authors screened records in two stages using Rayyan. Titles and abstracts were screened first, followed by full-text assessment of potentially eligible articles. Each stage was conducted with reviewer cross-checking, and disagreements were resolved through discussion until consensus was achieved.

2.4 Study Selection

The screening process began with a systematic search across six databases, yielding 5,289 records. After de-duplication and initial exclusions, 4,277 records were removed for the following reasons: duplicate entries 622, irrelevant titles 2,204, non-English publications 61, non-peer-reviewed reports 587, unsuitable settings 501, and non-related interventions 302. This left 1,012 records for title and abstract screening. During this stage, 773 studies were excluded for not addressing e-learning, modular learning, or stimulus-based learning in midwifery education, leaving 239 articles for full-text assessment. Of these, 18 full texts could not be retrieved, resulting in 221 articles assessed for eligibility. Following detailed evaluation, 208 studies were excluded for reasons including irrelevance 95, unsuitable design 52, inappropriate population or sample 41, and contextual misalignment 20. At the end of this process, 13 studies met all inclusion criteria and were retained for quality appraisal and synthesis. The selection pathway follows PRISMA guidance and is presented in Figure 1.

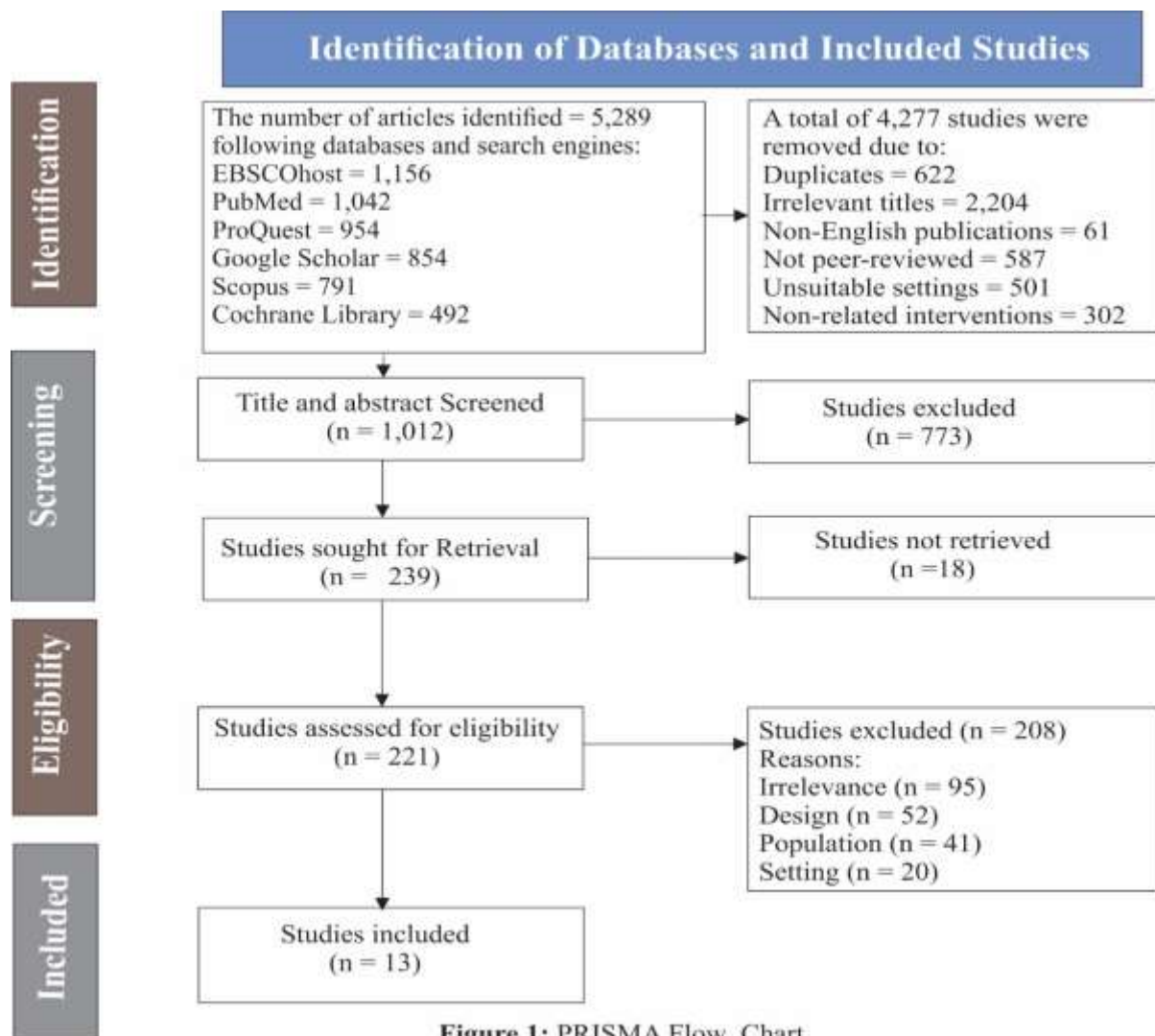


Figure 1: PRISMA Flow Chart

2.5 Quality Assessment

Thirteen included studies underwent appraisal using design-appropriate tools. For qualitative studies, the CASP checklist was applied; Gracious et al. (2024), Akingbade et al. (2024), Ndayisenga et al. (2022), and Uhawenimana et al. (2024) demonstrated clear aims, appropriate designs, adequate data collection, and rigorous analysis, yielding low risk of bias, whilst Riner et al. (2021) and Mambwe and Tembo (2021) showed limitations in reflexivity and researcher–participant relationship reporting (moderate risk). For cross-sectional surveys, the JBI Analytical Cross-Sectional Checklist was employed; Alhassan et al. (2021), Addae et al. (2022), and Adesuyi et al. (2023) addressed confounders effectively and applied valid measures (low risk), whilst Alhassan (2020) was rated moderate risk due to limited confounder control and self-reported outcomes. For mixed-methods studies, MMAT (2018) was used; Shikuku et al. (2024) and Bigirwa et al. (2022) demonstrated clear rationale and adequate integration (low risk), whilst Ladur et al. (2025) had methodological gaps in addressing divergences (moderate risk). Overall, most studies demonstrated low to moderate bias risk; whilst methodological weaknesses existed, particularly reflexivity in qualitative work and confounder control in surveys, the evidence base remains sufficiently robust to support review conclusions (see Appendix II).

2.6 Characteristics of Included Studies

The included studies constitute a methodologically heterogeneous but thematically coherent evidence base, which the review captures most appropriately through narrative synthesis rather than quantitative

pooling. Thirteen studies met the inclusion criteria, spanning January 2015 to March 2025 and conducted across sub-Saharan African settings, including Ghana, Nigeria, Kenya, Uganda, Rwanda, Zambia, Liberia, and one multi country study. The geographical distribution reflects a concentration in West and East Africa, which aligns with the review's emphasis on low- and middle-income training environments where infrastructural constraints intersect with evolving professional education models. Design diversity is pronounced, encompassing cross sectional surveys that were frequently institutional based and focused on student experiences of e learning or modular approaches (Alhassan, 2020; Addae et al., 2022; Adesuyi et al., 2023), alongside qualitative phenomenological studies, focus group discussions, and interview-based inquiries that captured in depth perspectives from students and educators (Ndayisenga et al., 2022; Mambwe & Tembo, 2021). Mixed methods and pre post intervention studies also appeared, particularly where adoption and instructional design were central concerns (Bigirwa et al., 2022; Shikuku et al., 2024).

In terms of intervention typology, the evidence clustered around three broad strands, namely e learning and digital learning modalities, blended or modular continuing professional development programmes, and stimulus based or assessment linked approaches such as conferences, quizzes, reminders, and objective structured clinical examinations. Participant groups ranged from undergraduate and diploma midwifery students to postgraduate learners and clinical educators, while sample sizes varied from small qualitative cohorts of 12 to 48 participants to large cross-sectional samples exceeding 400 respondents, which reinforces the breadth but also the uneven evidential granularity across outcomes. Several studies were conducted during the COVID 19 period, which intensified the focus on digital learning and exposed both scalability opportunities and operational constraints (Riner et al., 2021; Uhawenimana et al., 2024). Outcomes assessed included knowledge acquisition, skills competence, learner engagement, attitudes, feasibility, cost effectiveness, and perceived acceptability; although most studies reported positive directional effects, contextual moderators such as connectivity, device access, digital literacy, institutional support, workload, and clinical integration consistently shaped the strength and durability of observed benefits (See Appendix 1).

3.0 Synthesis of Findings

Evidence from Ghana, Nigeria, Kenya, Uganda, Rwanda, Zambia, and Liberia demonstrates that e-learning, modular, and stimulus-based interventions exert differential impacts mediated by infrastructural capacity, institutional commitment, and pedagogical design quality. E-learning platforms enhanced ICT competence and scheduling flexibility across contexts (Gracious et al., 2024; Mambwe & Tembo, 2021; Alhassan et al., 2021), yet high data costs (86.8% reporting barrier), unreliable connectivity (81.3%), and device inadequacy (76.5%) constrained access and sustained engagement (Alhassan, 2020). Learner-content, learner-instructor, and learner-learner interactions emerged as significant predictors of perceived learning impact, collectively explaining 37.2% of outcome variance (Addae et al., 2022, $p < 0.05$), suggesting that pedagogical design quality, particularly interaction architecture mediates effectiveness more powerfully than technology provision alone.

Modular learning approaches, implemented predominantly through blended and structured CPD programmes, yielded substantial knowledge gains and competence improvements. Shikuku et al. (2024) documented mean knowledge increases from 65% to 74% (absolute gain +10%, relative +27%) alongside OSCE performance improvements of 31% absolute for breastfeeding assessment and 50% absolute for IUD insertion; qualitative data revealed positive attitudinal shifts toward respectful maternity care, indicating that well-structured modular interventions influence both technical competence and professional values. Ladur et al. (2025) demonstrated cost-effectiveness, with blended learning costing USD 624-759 per participant compared to USD 909-1144 for full face-to-face delivery, whilst maintaining feasibility and acceptability despite internet access and time management challenges. These findings suggest that modular approaches offer scalable pathways for competency development when supported by adequate governance frameworks and institutional resourcing.

Stimulus-based strategies including formative quizzes, structured reminders, professional conferences, and OSCEs elevated learner engagement and reinforced knowledge retention. Adesuyi et al. (2023) found conference attendance associated with higher knowledge levels (AOR 2.14, $p = 0.024$), whilst quizzes and

reminders increased engagement across diverse learner populations. However, Ndayisenga et al. (2022) revealed that OSCEs, whilst improving competence assessment and identifying skill gaps, risked producing superficial competence when not integrated with repeated supervised clinical practice, highlighting the necessity for stimulus-based interventions to complement rather than substitute clinical apprenticeship models. Uhawenimana et al. (2024) corroborated this finding, with participants preferring face-to-face instruction for practical skill development whilst valuing blended approaches for cost-effectiveness and knowledge updates, suggesting that optimal pedagogical models combine stimulus-based engagement with sustained clinical supervision.

Cross-cutting themes emerged regarding contextual moderators shaping intervention effectiveness. Infrastructure deficits, particularly unstable electricity, limited device access, and prohibitive data costs constrained e-learning adoption across all contexts, with severity varying between urban tertiary institutions and rural training sites (Riner et al., 2021). Faculty preparedness constituted a critical mediating factor; institutions with systematic faculty development in digital pedagogy achieved superior learner outcomes compared to those implementing technology without corresponding pedagogical capacity building (Bigirwa et al., 2022). Institutional support mechanisms including technical assistance, dedicated learning platforms, and integration of innovations into formal curricula distinguished sustainable interventions from short-term pilot projects (Alhassan et al., 2021). These findings underscore that pedagogical innovation effectiveness depends less on intervention type per se than on the quality of implementation infrastructure, faculty preparation, and institutional commitment supporting adoption.

4.0 DISCUSSION

This systematic review synthesised evidence across 13 studies examining e-learning, modular, and stimulus-based pedagogical approaches in African midwifery education, revealing that whilst these innovations demonstrate potential for addressing resource constraints and expanding access, their effectiveness remains highly contingent upon infrastructure quality, institutional commitment, and faculty preparedness. The evidence challenges simplistic technology-deterministic assumptions by demonstrating that pedagogical design quality, interaction architecture, and implementation infrastructure exert greater influence on learning outcomes than technology provision alone, with infrastructural deficits, cost barriers, and faculty capacity gaps constraining impact across diverse contexts.

E-learning platforms enhanced ICT competence, scheduling flexibility, and academic performance across Ghana, Nigeria, Zambia, and Liberia (Gracious et al., 2024; Mambwe & Tembo, 2021; Alhassan et al., 2021); however, prohibitive data costs affecting 86.8% of learners, unreliable connectivity constraining 81.3%, and device inadequacy impacting 76.5% created substantial access barriers that disproportionately affected students in resource-limited settings (Alhassan, 2020). These findings align with Barteit et al. (2020), who documented that whilst e-learning demonstrates feasibility in low- and middle-income countries, sustainability remains constrained by infrastructure deficits and limited institutional integration. The present review extends this understanding by identifying interaction quality, specifically learner–content, learner–instructor, and learner–learner engagement as explaining 37.2% of perceived impact variance (Addae et al., 2022), suggesting that pedagogical design with emphasis on multi-modal interaction offers pathways for maximising effectiveness within infrastructure constraints. This finding carries important implications for curriculum developers, indicating that resource allocation should prioritise pedagogical design expertise and interaction scaffolding over technology acquisition alone.

Modular learning approaches, particularly within structured CPD and blended delivery models, yielded substantial knowledge gains (mean +10% absolute, +27% relative) and competence improvements (OSCE scores increasing 31–50% absolute) whilst demonstrating cost-effectiveness relative to traditional face-to-face instruction (Shikuku et al., 2024; Ladur et al., 2025). These findings suggest that well-structured modular curricula offer scalable mechanisms for competency development, addressing both access constraints and quality imperatives confronting African midwifery education. However, sustainability contingencies emerged; programmes requiring robust governance frameworks, sustained institutional resourcing, and systematic faculty development achieved superior outcomes compared to those implemented without corresponding infrastructure (Bigirwa et al., 2022). This pattern aligns with

Hyrkäs and Mowitz (2023), who identified governance gaps and faculty deficits as persistent constraints in sub-Saharan African midwifery education. The present review advances understanding by demonstrating that modular approaches can partially compensate for these constraints when designed with adequate implementation infrastructure, yet cannot substitute for broader systemic strengthening.

Stimulus-based strategies including formative quizzes, structured reminders, professional conferences, and OSCEs elevated engagement and reinforced learning (Adesuyi et al., 2023); nevertheless, these interventions risked producing superficial competence when divorced from repeated supervised clinical practice (Ndayisenga et al., 2022). This finding carries critical implications for competency-based curriculum design, suggesting that whilst stimulus-based approaches enhance knowledge retention and engagement, they must complement rather than substitute clinical apprenticeship models emphasising repeated supervised practice. The preference expressed by Rwandan participants for face-to-face instruction for practical skills whilst valuing blended approaches for knowledge updates (Uhawenimana et al., 2024) underscores learners' sophisticated understanding of pedagogical fit, recognising that different content domains require differentiated instructional modalities. This nuanced perspective challenges one-size-fits-all innovation narratives, suggesting that optimal pedagogical models strategically deploy e-learning, modular, and stimulus-based approaches according to learning outcome requirements rather than blanket adoption.

Cross-cutting infrastructural, faculty capacity, and institutional support themes emerged as critical moderators shaping intervention effectiveness. Unstable electricity, limited device access, and prohibitive data costs constrained e-learning adoption, with severity varying between well-resourced urban institutions and resource-limited rural training sites (Riner et al., 2021). Faculty preparedness constituted a mediating factor determining implementation quality; institutions investing in systematic digital pedagogy development achieved superior learner outcomes compared to those implementing technology without corresponding faculty capacity building (Bigirwa et al., 2022). Institutional support mechanisms, including technical assistance, dedicated platforms, curricular integration, distinguished sustainable interventions from short-term pilots (Alhassan et al., 2021). These patterns suggest that pedagogical innovation effectiveness depends less on intervention type than on implementation infrastructure quality, revealing that technology provision absent supporting systems risks exacerbating rather than reducing educational inequalities.

Several limitations merit acknowledgement. Methodological heterogeneity across included studies precluded meta-analysis, limiting capacity for precise effect size estimation. Publication bias may have excluded negative or null findings, potentially inflating apparent effectiveness. Some of the studies employed convenience sampling and lacked sufficient randomised control groups, thus constraining strong causal inference. Nevertheless, the convergence of findings across diverse contexts regarding infrastructure constraints, faculty capacity imperatives, and pedagogical design quality suggests robust patterns warranting attention despite methodological limitations.

Implications for policy and practice emerge clearly from synthesised evidence. First, infrastructure investment constitutes a prerequisite for equitable e-learning adoption; policy interventions should address connectivity deficits, subsidise learner data costs, and ensure device access particularly for students in resource-limited settings. Second, faculty development programmes emphasising digital pedagogy, interaction design, and blended learning facilitation require prioritisation and sustained resourcing. Third, curriculum developers should adopt strategic rather than blanket innovation deployment, matching pedagogical modalities to learning outcome requirements rather than pursuing technology for its own sake. Fourth, institutional support systems, including technical assistance, dedicated platforms, curricular integration require establishment to transition innovations from pilot status to sustainable practice. Fifth, quality assurance mechanisms should evaluate not merely technology adoption but learning outcome achievement, ensuring innovations strengthen rather than merely diversify pedagogical approaches.

Future research should address persistent evidence gaps through methodologically rigorous investigation. Randomised controlled trials comparing e-learning, modular, and stimulus-based approaches against traditional instruction would strengthen causal inference regarding effectiveness. Longitudinal studies

tracking learner outcomes beyond immediate post-intervention periods would clarify sustained impact on clinical competence and professional practice. Cost-effectiveness analyses comparing different pedagogical modalities across diverse contexts would inform resource allocation decisions. Implementation science research examining factors facilitating or constraining innovation adoption would generate actionable guidance for educational leaders. Research investigating how innovations affect educational equity, particularly comparing outcomes for learners in well-resourced versus resource-limited settings would clarify whether these approaches reduce or exacerbate existing disparities.

5.0 CONCLUSION

E-learning, modular, and stimulus-based pedagogical approaches demonstrate potential for addressing resource constraints, expanding access, and enhancing competency development within African midwifery education; nevertheless, effectiveness remains highly context-dependent, mediated by infrastructure quality, faculty preparedness, and institutional commitment. Evidence synthesised from the 13 studies reveals that, whilst the teaching innovations enhance ICT competence, scheduling flexibility, knowledge acquisition, and learner engagement, substantial barriers including prohibitive costs, connectivity deficits, faculty capacity gaps, and inadequate institutional support constrain impact. Pedagogical design quality, particularly interaction architecture in e-learning contexts exerts greater influence on outcomes than technology provision alone, suggesting that resource allocation should prioritise pedagogical expertise development over technology acquisition. Modular approaches offer cost-effective scalable pathways for competency development when supported by robust governance and sustained resourcing; stimulus-based strategies elevate engagement yet require integration with supervised clinical practice to achieve meaningful competence. Sustained investment in infrastructure, enabling policy frameworks, systematic faculty development, and strategic rather than blanket innovation deployment constitute critical prerequisites to ensure that these pedagogical approaches reduce rather than exacerbate educational inequalities confronting African midwifery education.

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Appendix I: Study Characteristics and Key Findings

Author(s), Year	Country / Setting	Aim / Purpose	Study Design	Population / Participants	Sample Size	Type of Intervention	Comparison	Outcomes Measured	Main Findings / Results
Gracious et al. (2024)	Ghana, Kwame Nkrumah University of Science and Technology	To explore the expectations, experiences, and challenges of nursing and midwifery students using virtual learning during COVID-19.	Descriptive phenomenological design (qualitative)	Undergraduate and postgraduate nursing and midwifery students	12	E-learning (virtual/online learning)	Traditional face-to-face (pre-pandemic)	Expectations, experiences, challenges, ICT skills, academic performance, satisfaction	Students reported mixed feelings, initial optimism, and anticipated support. Benefits included flexibility, cost-effectiveness, multitasking, ICT skill acquisition, and improved grades. Challenges included high data cost, poor connectivity, distractions, academic misconduct, and transition difficulties. Students partly met their expectations and recommended institutional/government support to sustain virtual learning.
Alhassan et al. (2021)	Ghana, University of Health and Allied Sciences	To evaluate experiences of healthcare trainees with the SMART	Mixed methods, cross-sectional descriptive	Undergraduate nursing, midwifery, public	363 (out of 446 invited, 81%)	E-learning (SMART e-Learning project using Moodle)	Traditional classroom teaching	Mobile phone ownership and usage, access and utilization of e-learning	High mobile ownership (96%) but limited academic use; most common e-learning use was writing interim assessments (82%), downloading materials

	(UHAS), Volta Region	e-Learning pilot project and provide evidence for policy reforms in health sciences education.	Survey with quantitative focus	health nursing, radiology, and postgraduate allied health trainees	response rate)	platform, intranet/WLAN)	(pre-existing approach)	facilities, satisfaction with ICT labs, internet/intranet, content, staff support, academic performance.	(38%), uploading assignments (32%); live chats rarely used (5–17%). Perceived benefits included grades improvement, access to materials, transparency in assessment. Challenges included limited lab space (33%), poor internet speed (29%), insufficient ICT/faculty capacity (25–28%). Satisfaction higher among nursing students, older students, and males. Recommendations included improved ICT infrastructure, faculty training, dedicated bandwidth, and formal e-learning policy guidelines.
Shikuku et al. (2024)	Kenya and Nigeria, 81 pre-service midwifery training institutions	To evaluate the feasibility of a blended continuous professional development (CPD) programme for midwifery educators in Kenya and Nigeria, focusing on knowledge, confidence, skills, and satisfaction.	Mixed methods intervention study, concurrent nested design (quasi-experimental pre-post with qualitative interviews)	Midwifery educators from mid-level training colleges and universities	120 invited; 116 completed online component; 108 completed practical component	Blended CPD: four self-directed online modules (20 hours via WCEA platform) and 3-day face-to-face practical training (teaching pedagogy, EmONC skills, digital innovations)	No direct comparator; pre-post evaluation	Knowledge (MCQ pre- and post-tests), teaching plan and microteaching competence, confidence in pedagogy skills, satisfaction, qualitative feedback from educators, regulators, and managers.	Knowledge scores improved significantly from 52.4% to 80.4% (p < 0.001). Confidence improved from mean 2.7 to 3.7/4 across teaching pedagogy skills. Teaching plan scores rose from 63.6% to 81.8%, microteaching scores median 76.5%. Over half of educators achieved ≥75% competence in teaching plan (51.4%) and microteaching (57.9%). Satisfaction and relevance median = 4/4 for both online and practical modules. Qualitative findings: modules were educative, flexible, interactive, but challenges included poor internet, power outages, technology gaps, and time constraints. Stakeholders highlighted the need for policy support, sustainability, and incentives.
Riner et al. (2021)	Liberia, Mother Patern College of Health Sciences (MPCHS), Monrovia	To describe the use of e-learning in a graduate nursing and midwifery education program in Liberia, and capture the experiences of nurse and midwife instructors as learners and beginning educators using technology.	Case study, qualitative reflective from graduate nurse/midwife instructors	Graduate students who were also nurse and midwife instructors (fourth cohort of MSc Nursing Education)	11 reflections (out of 19 enrolled students)	E-learning integrated into graduate curriculum: internet access, Hinari, PubMed, Cochrane, YouTube, Coggle mapping, TED Talks, and use of technology for lesson planning and teaching practicum.	Traditional instruction (baseline practices before technology adoption)	Technology skills, engagement with global nurse/midwife educator competencies, application of learning theories, critical thinking, problem-based learning, teaching aids, accessing current health information, reflection on student response.	Graduate instructors reported enhanced knowledge, self-efficacy, critical thinking, and creativity in lesson planning, and improved teaching strategies through use of technology. Pre-service students responded positively to visual aids, videos, and interactive approaches. Barriers included limited electricity, internet access, and institutional resources. E-learning was seen as ethically important, globally connecting, and essential for modernising midwifery education in Liberia.
Alhassan (2020)	Ghana, Public	To assess preparedness	Cross-sectional	Undergraduate	233 student	E-learning feasibility	Traditional	Preparedness proxies: mobile	Nearly 100% owned smartphones, used mainly for

	University in Volta Region (School of Nursing and Midwifery)	and feasibility of an e-learning pilot project for nursing and midwifery trainees, focusing on mobile phone ownership, use of applications, internet access, and readiness of faculty/ICT staff.	descriptive survey	nursing, midwifery, and public health nursing students (Years 1–4)	sample rate 78% from 300 questionnaires)	using mobile phones, internet, WhatsApp, Facebook, YouTube, social networking, ICT labs, and structured questionnaire assessment of preparedness.	classroom and limited ICT infrastructure (baseline condition)	ownership, application use, ICT infrastructure satisfaction, faculty/ICT readiness, student suggestions. Usage patterns (social media, search, academic info exchange).	academic info and social media (70%+). 74% rated phones good for learning, 88% used WhatsApp daily, 86% accessed internet daily. Constraints: low bandwidth, poor internet connectivity, high cost of mobile services, limited institutional integration. Students demonstrated high preparedness and adaptability for e-learning. Policy recommendations: statutory e-learning policies, public-private partnerships with telecoms, faculty/student training, and ring-fenced budgets for ICT infrastructure.
Ladur et al. (2025)	Nigeria, Kenya, Tanzania (LMICs)	To assess the feasibility, acceptability, knowledge change, and cost of a blended learning training package for healthcare providers in integrated HIV, TB, and malaria services during ANC and PNC.	Mixed methods feasibility study (quantitative assessments, FGDs, KIIs)	Healthcare providers including nurse-midwives, doctors, clinical officers, and community health workers from rural and urban facilities	89 healthcare providers (74 completed self-directed, 80 completed virtual, 89 completed face-to-face)	Blended learning: 16h self-directed (WCEA platform), 7.5h virtual facilitated Zoom sessions, 2-day face-to-face practical component with OSCEs and skills training.	Traditional 4-day face-to-face ANC-PNC CPD training package (baseline comparator)	Knowledge (MCQ pre/post), skills (OSCEs for breastfeeding, IUD insertion), feasibility (access, participation, costs), acceptability (learner satisfaction, qualitative themes).	Knowledge improved from mean 65% to 74% (absolute +10%, relative +27%). Breastfeeding OSCE improved by 31% absolute (+62% relative); IUD insertion improved by 50% absolute (+72% relative). Cost per participant for BL ranged from USD 624 (Nigeria) to USD 759 (Kenya), lower than full F2F (USD 909–1144). Qualitative themes: inclusive and flexible learning, valuable content, multidisciplinary teamwork, positive shift in respectful maternity care, but challenges with internet, logins, and time constraints. Conclusion: BL was feasible, cost-saving, effective, and acceptable for ANC-PNC in LMICs.
Akingbade et al. (2024)	Nigeria, nine universities across federal, state and private institutions	To explore the experiences and needs of postgraduate nursing students in Nigeria and identify ways to improve postgraduate education during and after COVID-19.	Descriptive phenomenological qualitative study	Postgraduate nursing students enrolled during COVID-19 from diverse universities	22 participants (semi-structured interviews; data saturation achieved)	E-learning and virtual learning adoption in postgraduate nursing education (experiences and needs)	Pre-pandemic face-to-face teaching (contextual comparator)	Experiences and needs related to online learning, mentorship, infrastructure, funding; themes on disruptions, prolonged academic calendars, supervisor communication and innovations for postgraduate nursing education.	Three themes with 14 subthemes: pre-pandemic challenges (paucity of funds, inadequate power, poor internet, lack of infrastructure, shortage of human resources, poor mentorship); pandemic impact (abrupt disruption, prolonged academic calendar, supervisor communication gaps); and innovations to improve postgraduate education (adoption and sustainability of e-learning and blended delivery, proper structuring, upgrading post-basic to postgraduate programmes, expanding programmes in more universities, and financial aid). Primary cross-cutting issues were funding, mentorship and infrastructure.
Ndayisenga et al. (2022)	Rwanda, public and private Higher	To explore perceptions and experiences	Qualitative descriptive	Nursing and midwifery students	29 students (three FGDs,	Blended learning approach combining	Traditional face-to-face teaching	Themes: BL as effective and flexible (time/cost	Students perceived BL as new but effective, flexible, and cost-saving. They valued offline Moodle and encouragement from

	Learning Institutions (HLIs)	of nursing and midwifery students using blended learning in public and private HLIs in Rwanda during and after COVID-19 pandemic adaptations.	design using online focus group discussions (FGDs)	from public and private HLIs, across diploma, bachelor, masters, PhD levels	10–12 participants each)	online delivery (Moodle, eLearning, offline modules, Zoom) with face-to-face components; emphasis during COVID-19	(baseline pre-COVID)	saving, improved academic performance, engaging, supported by Moodle and staff); challenges (poor ICT skills, internet access, financial constraints, difficulty with practical/clinical courses, lack of training, limited interaction); recommendations (training for staff/students, improved internet coverage, sustain BL post-COVID).	teaching staff. Reported improved grades and engagement. Barriers included infrastructure gaps, affordability, and difficulties delivering clinical content. Students strongly recommended sustaining BL beyond COVID-19 with better internet access and systematic training.
Addae et al. (2022)	Ghana, five Northern regions (Nursing and Midwifery Training Colleges)	To assess online learning experiences among nursing and midwifery students during the COVID-19 outbreak, including predictors of satisfaction and challenges faced.	Descriptive cross-sectional quantitative study	Second- and third-year nursing and midwifery students, and 2020 graduates from training colleges	318 students (response rate 97.8%)	Synchronous online learning (Zoom, WhatsApp, Google Meet, college websites) during COVID-19 lockdown	Traditional face-to-face instruction (pre-pandemic)	Satisfaction with online learning (pleasant/unpleasant), predictors (age, residence, internet reliability, program type), challenges (cost of data, home distractions, unreliable internet), device use, previous online experience.	Only 42.8% of students reported pleasant experiences, while 57.2% reported unpleasant ones. Predictors of pleasant experience included reliable college internet (AOR 6.39), older age, residence in southern Ghana (AOR 2.30), completion of studies in 2020 program type), (AOR 2.10), and owning devices personally (AOR 3.11). Major challenges: high cost of data (25.1%) and home distractions (22.6%). Findings underscored the importance of reliable ICT infrastructure, affordable internet, and targeted support for students to improve online learning experiences in resource-constrained settings.
Adesuyi et al. (2023)	Nigeria, national context (virtual nursing research conference)	To assess satisfaction and perceived impact of virtual learning during COVID-19 lockdown, using an online nursing research conference as a case study.	Descriptive cross-sectional quantitative survey	Nurses and nursing students attending an online national nursing research conference	236 participants (response rate 98.3%)	Virtual learning platform: 7-day online nursing research conference delivered via Zoom and WhatsApp, covering research topics, publication, SDGs, clinical research,	Traditional face-to-face conferences (pre-pandemic norm)	Satisfaction with virtual learning, perceived impact of programme, learner-content interaction, learner-instructor interaction, learner-learner interaction.	Results: 75.4% reported high satisfaction, 24.2% moderate, 0.4% low. Perceived impact was high in 89.8%, moderate in 7.6%, low in 2.5%. Learner-content (91.1% high), learner-instructor (55.1% high, 43.6% moderate), learner-learner (51.7% high, 44.1% moderate) were all significant predictors of impact (p<0.05). Regression model explained 37.2% variance in perceived impact. Conclusion: Effective virtual learning is determined by interaction across all domains; recommendation for nursing training institutions to

						and data analysis.			embrace virtual platforms as adjuncts or main modes of delivery.
Bigirwa et al. (2022)	Uganda, 10 midwifery institutions	To determine whether technology leadership practices of end users influence the adoption of e-learning in midwifery institutions and to identify salient practices for enhancing adoption.	Explanatory sequential mixed methods design (survey, FGDs, KIIs)	Midwifery students, tutors, administrators, clinical instructors in participating institutions	167 participants (from 224 questionnaires distributed; 91 students, 53 tutors, 15 clinical instructors, 8 administrators)	E-learning in midwifery institutions supported by government and partners since 2010, using LMS, CD-ROM, and online/web platforms; examined through leadership practices lens.	Traditional face-to-face teaching and low ICT use (baseline)	E-learning adoption (measured via student enrolment, LMS/CD-ROM use, faculty online support); technology leadership practices (commitment, supportive environment, recognition, champions, institutionalisation).	Adoption level was moderate at 61%. Correlation showed strong relationship ($r = 0.691, p = 0.000$) between technology leadership and e-learning adoption; regression showed leadership practices explained 47.5% of variance. Six salient practices identified: commitment to provide facilities, encouragement to use facilities, recognition of users, grooming champions, supportive environment, institutionalisation of technology. Barriers: lack of recognition culture, inconsistent commitment, inadequate policies. Recommendations: stronger leadership commitment, collaborative vision, incentive schemes, grooming champions, institutionalisation of e-learning into all teaching and communication.
Mambwe & Tembo (2021)	Zambia, Rusangu University (School of Health Sciences)	To explore nursing students' experiences of e-learning in a midwifery course during the COVID-19 pandemic, with emphasis on access, participation, and perceived effectiveness.	Cross-sectional qualitative study (Focus Group Discussions)	Third- and fourth-year nursing students taking midwifery course	60 students (6 FGDs, 10 per group)	E-learning using Moodle, Google Meet, Zoom, WhatsApp, Facebook classroom, and video/audio uploads; shifted from face-to-face to digital delivery during pandemic.	Traditional face-to-face teaching before COVID-19 closure	Students' experiences of access, connectivity, electricity, device ownership, practical learning needs, and academic engagement in home environments.	Students appreciated flexibility of e-learning (study anytime, anywhere) but faced challenges: poor internet connectivity, high data costs, electricity outages (load shedding), lack of personal computers/smartphones, and unsuitable home study environments. Rural students reported extreme barriers, including climbing molehills for internet access. Midwifery's practical nature made online demonstrations inadequate, raising fears about licensure exam readiness. Students valued demonstrations with return practice over videos. Recommendations: investment in reliable internet and electricity, better support for practical components, and sustainable integration of e-learning as future mainstay of education.
Uhawenimana et al. (2024)	Rwanda, 40 remote public health facilities across 5 provinces	To explore nurses' and midwives' perspectives on using technology to deliver on-the-job CPD trainings for Emergency Obstetric and	Qualitative descriptive design (FGDs and KIIs)	Nurses and midwives working in maternity services and EmONC mentors	54 participants (2 FGDs with mentors, 2 FGDs with nurses/midwives)	Technology-enhanced remote training approaches: smartphone app prototype, IVR (Interactive Voice	Traditional face-to-face CPD trainings (Helping Mothers Survive, Helping Babies Breathe,	Perceptions of face-to-face vs. online CPDs; moderators of technology-enhanced learning (IT skills, internet, CPD credits, workload);	Findings: Face-to-face preferred for practical skills, but online training seen as cost-effective and timely for knowledge updates. Barriers included poor IT skills, weak internet, limited devices, workload, and insufficient CPD credits. Smartphone app for EmONC was acceptable, valued for CPD credits, ease of use, and relevance, but required offline

	Neonatal Care (EmONC), and to identify factors influencing feasibility and acceptability.			es, 12 KIIs)	Response), USSD system, and e-learning methods for EmONC CPD delivery.	etc.)	acceptability of EmONC smartphone app prototype; needs for offline versions, mentorship, and monitoring.	options, financial support for bundles, and mentorship. Conclusion: Blended learning recommended for EmONC CPDs; policy support needed to integrate technology-based training sustainably.
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Appendix II

Quality and Risk of Bias Assessment

Tools used were matched to study design. Qualitative studies were appraised with CASP, quantitative cross-sectional surveys with the JBI Analytical Cross-Sectional Checklist, and mixed methods or programme evaluation studies with the Mixed Methods Appraisal Tool, MMAT 2018.

Judgements are based on full-text reads. Ratings: Yes, No, or Unclear, with an overall risk judgement (Low, Moderate, High) reflecting internal validity and reporting sufficiency.

CASP Qualitative Studies

Study	Design	Q1 Clear aims	Q2 Methodol ogy appropriat e	Q3 Design appropri ate	Q4 Recruitm ent appropri ate	Q5 Data collecti on adequat e	Q6 Research er- participan t relationsh ip considered	Q7 Ethical issues considered	Q8 Rigoro us analysi s	Q9 Clear findin gs	Q10 Value of resear ch	Overall Risk
Gracious et al. (2024)	Descriptive phenomenology	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Low
Riner et al. (2021)	Case study, qualitative reflections	Yes	Yes	Yes	Unclear	Yes	Unclear	Unclear	Unclear	Yes	Yes	Moderate
Akingbade et al. (2024)	Descriptive phenomenology	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Low
Ndayisenga et al. (2022)	Qualitative descriptive, FGDs	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Low
Mambwe & Tembo (2021)	Qualitative, FGDs	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	Yes	Moderate
Uhawenimana et al. (2024)	Qualitative, FGDs and KIIs	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Low

Legend: CASP qualitative checklist Q1 to Q10 correspond to the ten appraisal questions. Overall risk reflects the balance of methodological rigour and reporting.

Interpretation: Most qualitative studies demonstrated clear aims, appropriate designs and rigorous analysis. Reflexivity was often insufficiently reported, hence several “Unclear” ratings on researcher–participant relationships. Overall risk was low for four studies and moderate for two.

JBI Analytical Cross-Sectional Studies

Study	Design	Q1 Inclusion criteria	Q2 Subjects and setting	Q3 Exposure measured validly	Q4 Condition measured objectively	Q5 Confounders identified	Q6 Confounders addressed	Q7 Outcomes measured validly	Q8 Appropriate statistics	Overall Risk
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Alhassan (2020)	Cross-sectional survey	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Moderate
Alhassan et al. (2021)	Cross-sectional survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
Addae et al. (2022)	Cross-sectional survey with regression	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low
Adesuyi et al. (2023)	Cross-sectional survey with regression	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low

Legend: JBI analytical cross-sectional checklist Q1 to Q8 correspond to the eight appraisal items. Overall risk integrates identification and management of confounding, and statistical appropriateness.

Interpretation: Later surveys employed multivariable analyses and clearer confounder handling, hence low risk ratings. Earlier feasibility work showed weaker confounder control, hence moderate risk.

MMAT 2018, Mixed Methods and Programme Evaluation Studies

Study	MMAT Category	Q1 Rationale for mixed methods	Q2 Integration relevant and adequate	Q3 Interpretation of integration coherent	Q4 Divergences addressed	Q5 Qual and quant components meet quality criteria	Overall Risk
Shikuku et al. (2024)	Mixed methods, pre and post evaluation	Yes	Yes	Yes	Unclear	Yes	Low
Ladur et al. (2025)	Mixed methods, feasibility and cost evaluation	Yes	Yes	Yes	Unclear	Yes	Moderate
Bigirwa et al. (2022)	Mixed methods, explanatory sequential	Yes	Yes	Yes	Unclear	Yes	Low

Legend: MMAT items reflect core criteria for mixed methods studies. For the quantitative descriptive programme evaluation, integration items are marked as Unclear and overall risk reflects limited generalisability.

Interpretation: Mixed methods CPD and blended learning studies demonstrated clear rationale and adequate integration of methods. Limited reporting on how divergent qualitative and quantitative findings were handled led to some unclear integration judgements. Where control groups were absent, this was treated as a design limitation affecting internal validity and causal inference, not as a basis for an unclear integration rating.