Evaluating the Implementation of Ai-Enabled Education Technology in Secondary Education in Tanzania: Effect on Teaching Practices, Learning Engagement and Learning Outcomes under the Revised Curriculum 2023

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Abstract.

Tanzania has made substantial investments in educational technology (EdTech) as part of the implementation of the 2023 Revised Curriculum. These investments include the Secondary Online Public School (OPSchool), interactive digital learning content, the Tanzania Institute of Education (TIE) Online Library, artificial intelligence (AI)-enabled learning resources, school information systems, and the Teachers' Continuous Professional Development Learning Management System (TCPD-LMS), commonly associated with MEWAKA. This paper evaluates the emerging outcomes of these investments in secondary education, focusing on Dar es Salaam, Pwani, Morogoro, Tabora and Kigoma Regions. A comparative secondary-data evaluation design was used. Evidence published from 2020 to August 2026 was synthesised from government policy documents, audited programme records, regional education statistics, population census indicators, platform analytics, implementation studies and international research. The analysis examined two questions: first, whether EdTech implementation is associated with changes in teaching practices, learner engagement and learning outcomes; and second, whether TCPD-LMS participation, teachers' digital competence and infrastructure readiness help to explain variation in implementation outcomes. The findings revealed clear progress in investment outputs: large-scale curriculum training, growth of digital and interactive content, wider use of the TCPD-LMS, and expansion of ICT-supported schools. Evidence is strongest for improved access to resources, lesson preparation, formative assessment, collaborative professional learning and learner engagement. Evidence of attributable improvement in secondary-school learning outcomes remains limited because platform use, classroom practice and examination data are not yet linked at school and regional levels. Considerable regional inequality is also evident. Dar es Salaam has the strongest enabling environment, while Tabora and Kigoma face more severe electricity, device and connectivity constraints. TCPD-LMS is a plausible explanatory variable, but its influence depends on relevant content, sustained participation, teacher digital competence, leadership support and reliable infrastructure. The paper recommends a five-region longitudinal evaluation system that links platform analytics, teacher competence, classroom observation, and learner engagement and examination outcomes.

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1. Introduction

The 2023 revision of Tanzania's education and training policy and secondary curriculum places competence development, learner-centred pedagogy, practical work, digital literacy and the application of science and technology at the centre of education reform. The revised ordinary secondary curriculum expects schools to move beyond the transmission of subject content towards active learning, problem-solving, creativity, communication, collaboration and the application of knowledge in authentic contexts (Ministry of Education, Science and Technology [MoEST], 2023; Tanzania Institute of Education [TIE], 2023). This transition has created a strong policy rationale for expanding EdTech, because multimedia content, virtual demonstrations, digital libraries, online assessment, interactive platforms and AI-assisted tools can support forms of teaching that are difficult to achieve through textbooks and lecture-based instruction alone.

The investment landscape has expanded rapidly. TIE operates an online library and an Online Public School platform that provides primary- and secondary-level content through images, video, three-dimensional visualisation and animation (TIE, 2024a). Its 2024/25 audited report records large-scale training for curriculum implementation, development of interactive Form One materials, enhancement of a secondary-school learning platform with integrated science, technology, engineering and mathematics content, and further investment in MEWAKA and its LMS (TIE, 2025a). At the wider system level, the Secondary Education Quality Improvement Project (SEQUIP) includes a dedicated component for digitally enabled teaching and learning. By April 2025, 971 government secondary schools were reported as successfully implementing the ICT programme, 1,368,515 people were using digitally enabled services, and 29,399 teachers had been reached through regular in-service training intended to improve classroom practice (World Bank, 2025a).

Tanzania has also moved from general ICT promotion towards more specific governance of digital and AI-enabled education. The National Digital Education Strategy 2024/25–2029/30 provides a framework for infrastructure, digital content, educator capability, governance and equitable access, while the National Guidelines for Artificial Intelligence in Education emphasise human oversight, responsible use, inclusion, data protection, safety and the use of AI to support rather than displace teachers (MoEST, 2025a, 2025b). In 2025 and 2026, collaboration among MoEST, TIE and UNESCO supported digital content development, policy strengthening and the training of ICT master trainers through the TCPD-LMS (UNESCO, 2025a, 2026a). These developments position AI-enabled EdTech as part of curriculum implementation rather than an isolated technology initiative.

However, investment, availability and use are not equivalent to educational impact. International evidence shows that technology can improve learning when it addresses a clearly identified instructional problem, is aligned with the curriculum, supports teacher practice, and is implemented with adequate infrastructure and user support. Technology that is introduced without these conditions may have weak, uneven or even negative effects (Escueta et al., 2020; UNESCO, 2023a). This distinction is particularly important in Tanzania, where digital initiatives have historically been fragmented and where access to electricity, computers, smartphones, connectivity and technical support differs substantially between regions and between urban and rural schools (Manyengo, 2021; Oreku, 2022).

The principal evaluation problem is that Tanzania has produced substantial evidence about EdTech inputs and outputs, but much less regionally linked evidence about outcomes. Programme records can show the number of teachers trained, materials digitised, schools equipped and users registered. These indicators demonstrate implementation effort, but they do not establish whether teachers changed their classroom practice, whether learners became more engaged, or whether achievement improved because of the investment. A rigorous evaluation must therefore distinguish five levels in the results chain: investment, access, use, change in teaching practice, and change in learner outcomes.

The evidence gap is compounded by regional inequality. In 2020, 97.6% of secondary schools in Dar es Salaam had electricity, compared with 90.7% in Pwani, 87.6% in Kigoma, 83.2% in Morogoro and 80.4% in Tabora. Yet the type and reliability of supply differed: 97.0% of Dar es Salaam schools were connected to the national grid, whereas only 38.3% of Kigoma schools were grid-connected and 57.0% relied on solar power (President's Office–Regional Administration and Local Government [PO-RALG], 2020). Household electricity indicators from the 2022 Population and Housing Census reveal an even wider gradient, from 86.0% in Dar es Salaam to 17.7% in Kigoma (National Bureau of Statistics [NBS] & Office of the Chief Government Statistician [OCGS], 2024). These disparities are likely to influence whether a teacher can access an online module, prepare a digital lesson, use a projector, assign an interactive activity or sustain AI-enabled learning.

Teacher capability is another likely source of variation. The TCPD-LMS is intended to provide curriculum-aligned professional development through self-learning, school- and cluster-based communities of learning, peer facilitation, coaching and mentoring. Platform evidence shows that teachers use the system most when content is directly relevant to curriculum implementation and immediate classroom needs. Usage is also geographically unequal and influenced by connectivity, digital literacy and the academic calendar (Mtebe et al., 2025). It is therefore plausible that teachers who participate consistently in relevant TCPD-LMS modules are more effective in integrating EdTech. Nevertheless, the strength of this relationship in secondary education and in the five selected regions has not yet been tested through a linked outcome evaluation.

The purpose of this paper is to evaluate the emerging outcomes of Tanzania's investment in AI-enabled EdTech following implementation of the 2023 Revised Curriculum, with analysis restricted to Dar es Salaam, Pwani, Morogoro, Tabora and Kigoma Regions. The paper considers OPSchool, interactive digital content, AI-enabled learning, the TIE Online Library, teachers' use of digital resources, learner engagement, teaching practices, learning outcomes, teachers' digital competence and infrastructure readiness. TCPD-LMS participation is examined as an explanatory variable that may strengthen or constrain classroom integration.

Research objectives

i. To evaluate the extent to which implementation of AI-enabled EdTech under the 2023 Revised Curriculum is associated with changes in teaching practices, learner engagement and learning outcomes in secondary schools in Dar es Salaam, Pwani, Morogoro, Tabora and Kigoma Regions.
ii. To assess how TCPD-LMS participation, teachers' digital competence and infrastructure readiness explain regional and school-level variation in the effective integration and outcomes of EdTech in the five selected regions.

Research questions

i. What outcomes in teaching practices, learner engagement and learning achievement can be supported by the available evidence on EdTech implementation in the five selected regions?
ii. To what extent do TCPD-LMS participation, teacher digital competence and infrastructure readiness provide a credible explanation for variation in those outcomes?

Significance and scope

The paper contributes to policy and research in three ways. First, it evaluates investment through an outcome pathway rather than treating equipment, content production or registration as impact. Second, it makes regional readiness visible, which is essential for avoiding an urban-centred interpretation of digital transformation. Third, it positions TCPD-LMS participation as a measurable explanatory factor that can be tested in future school-level research. The empirical synthesis is restricted to Dar es Salaam, Pwani, Morogoro, Tabora and Kigoma. National evidence is used only to describe policy, investment and programme architecture; it is not used to imply that all five regions achieved the same outcomes.

Review of Related Literature

EdTech and the 2023 Revised Curriculum

The revised curriculum strengthens the demand for pedagogies that emphasise competence demonstration, inquiry, practical work, feedback and application. EdTech can support these aims through simulations, visualisation, multimedia explanations, formative quizzes, differentiated practice and access to diverse sources. TIE's OPSchool is relevant because it provides interactive materials using images, video, animation and three-dimensional content, while the TIE Online Library provides remote access to textbooks, teacher guides and curriculum resources (TIE, 2024a, 2025a). These services can reduce the limitations of static printed materials, especially in subjects where abstract concepts or unavailable laboratory resources make learning difficult.

The potential contribution of digital resources should nevertheless be interpreted through curriculum alignment. Global reviews show that computer-assisted learning is more effective when content is closely matched to the learner's level, when feedback is immediate, and when teachers understand how the technology complements classroom instruction (Escueta et al., 2020). Technology used only for content display may reproduce teacher-centred practice in a new format. In contrast, technology used to stimulate questions, group tasks, feedback, peer explanation and problem-solving can support the competence-based intentions of the curriculum.

Tanzania's earlier experience also warns against fragmented implementation. Oreku (2022) found that digital learning initiatives were dispersed across actors and often lacked harmonised standards, sustainable financing and coordinated evaluation. Manyengo (2021) similarly reported inadequate teacher training, unequal access to facilities, and weak electricity and internet connectivity. The newer digital education strategy, AI guidelines and TIE platforms respond to some of these weaknesses, but the outcome of reform depends on how implementation changes teachers' everyday decisions.

Conceptual framework

This paper uses a results-chain and contribution-analysis framework. The framework assumes that public investment in infrastructure, platforms, content and professional development does not affect learning outcomes directly. Instead, investment influences outcomes through a sequence of mediating conditions:

Investment and policy → access and readiness → teacher capability and use → teaching practice → learner engagement → learning outcomes.

TCPD-LMS participation is located between access and classroom use. Infrastructure readiness determines whether teachers can enter and remain in the digital environment. Teacher digital competence determines whether access becomes purposeful use. Relevant, curriculum-aligned professional development can then influence lesson planning, resource selection, assessment, differentiation, classroom interaction and ethical AI use. Learner engagement is treated as an intermediate outcome because attention, participation, persistence, homework completion and feedback-seeking are plausible mechanisms through which teaching practice affects achievement.

The framework is also consistent with research on personalised learning and UNESCO's human-centred approach to AI. Personalisation is most educationally meaningful when the learner, purpose, method and evidence of adaptation are clearly specified (Bernacki et al., 2021). The AI Competency Framework for Teachers identifies a human-centred mindset, ethics, AI foundations and applications, AI pedagogy, and AI for professional learning as interdependent domains (UNESCO, 2024a). Thus, competence should not be reduced to operating a device or producing text with an AI system. It includes selecting appropriate tasks, checking accuracy and bias, protecting learner data, designing inclusive activities, and preserving teacher judgement.

Teaching practices

The most credible early pathway from EdTech investment to outcomes is through teaching practice. Digital content can increase the range of representations available to a teacher, while AI can assist with lesson planning, question generation, examples, differentiation and formative feedback. International research on generative AI suggests potential for reducing routine workload and supporting personalised resources, but it also identifies risks related to accuracy, bias, over-reliance, assessment integrity and unequal access (Baidoo-Anu & Ansah, 2023; Kasneci et al., 2023).

Tanzanian evidence indicates that teachers value practical, immediately applicable resources. Mtebe et al. (2025) found that the most frequently accessed TCPD-LMS modules were implementation guidelines, foundational education training and subject-specific modules. The platform had more than 120,000 teachers and 37 modules at the time of the study. Its usage peaked at the beginning of terms and around preparation periods, suggesting that professional learning is more likely to be used when it is timely and directly connected to work.

Process-evaluation evidence on MEWAKA also shows that professional learning communities can support lesson preparation, formative assessment, teaching aids, inclusive practice and classroom management. Todd et al. (2025) reported that the proportion of observed teachers with lesson plans increased from 72% to 84%, while the proportion of high-quality lesson plans increased from 41% to 63% across the evaluation sample. Observed instructional practices improved in areas including lesson introductions, challenging tasks, use of teaching and learning aids, formative assessment, feedback, inclusion and gender responsiveness. However, the study concerned primary education, and its results should be treated as explanatory evidence for the TCPD mechanism rather than direct evidence of secondary-school effects.

Within the five-region scope, the same evaluation included Morogoro Municipal Council and Kigoma District Council. High-quality lesson plans in Morogoro changed from 63% at baseline to 60% at endline, while Kigoma changed from 71% to 42.9% (Todd et al., 2025). These figures demonstrate that participation in a national professional-development system does not automatically produce uniform improvement. Workload,

financing, leadership, attendance, expertise, geography and access to digital resources can moderate the outcome.

Learner engagement

Learner engagement includes behavioural participation, emotional interest and cognitive investment. Interactive content can make abstract concepts visible, provide immediate response and allow learners to repeat activities. Flipped and blended approaches can increase time for discussion and practice during lessons, while AI-enabled tools can generate differentiated tasks and feedback. These possibilities are especially relevant to the revised curriculum's emphasis on active and applied learning.

However, engagement should not be inferred simply from platform availability or screen use. Learners may be passive viewers of digital content, and novelty effects may be temporary. Effective engagement depends on task quality, teacher facilitation, language accessibility, inclusion, group organisation and the relationship between digital and non-digital activity. UNESCO (2023a) therefore argues that technology decisions should begin with learning needs and evidence rather than technological novelty.

Tanzania's online-content evidence supports this caution. Lubua (2024) found that users considered digital platforms useful, but also reported poor technical quality, failure to launch reliably and inadequate content. Such constraints can interrupt attention and reduce trust. The implication is that learner engagement is a joint outcome of content relevance and system reliability. OPSchool, the TIE Online Library and interactive resources may increase engagement where teachers design purposeful learning sequences, but access problems or a lack of teacher mediation may weaken the effect.

Learning outcomes

Learning outcomes are the most important but least securely established part of the evidence chain. Technology can improve learning when it increases appropriate practice, supports feedback, addresses misconceptions and helps teachers adapt instruction. Yet experimental evidence shows considerable variation across interventions; hardware distribution without pedagogical integration rarely guarantees improvement (Escueta et al., 2020).

Tanzania's national investment records demonstrate rapid expansion of digitally enabled services and ICT-supported schools, but they do not provide a regionally disaggregated estimate of the effect on examination scores. The April 2025 SEQUIP report recorded 971 government secondary schools implementing the ICT programme and a completed Form Two national learning evaluation, but the publicly available implementation report did not link ICT implementation status to school-level learning gains (World Bank, 2025a). Similarly, TIE's audited report documented teacher training, digital-content production and platform development, but did not report comparative learning outcomes for users and non-users in the five regions (TIE, 2025a).

The MEWAKA process evaluation is informative because it explicitly distinguishes perceived effect from measured learning. Although 87% of surveyed teachers believed that communities of learning improved pupil performance, the evaluation concluded that stakeholder acceptance and improvements in some teaching practices had not yet translated into demonstrable improvement in learning outcomes (Todd et al., 2025). This reinforces the need to avoid using perception as a substitute for achievement data.

Teacher digital competence and TCPD-LMS

Teacher digital competence is both an outcome of investment and a condition for further impact. A teacher may have basic operational competence but lack the pedagogical judgement to choose an appropriate tool, design collaborative tasks, evaluate AI output or use data for formative decisions. The 2025 ICT Competency Standard for Teachers in Tanzania and the TCPD-LMS modules are important because they connect digital skills with pedagogy, curriculum, assessment and classroom management (UNESCO, 2026a).

The TCPD-LMS has several design features suited to Tanzania, including Swahili as a default language, login through mobile phone numbers, mobile access and curriculum-aligned modules. Mtebe et al. (2025) found 331,547 web-browser accesses and 83,981 mobile-app accesses during the analysed period. Within the five-region scope, Dar es Salaam accounted for 14.2% of LMS use and Tabora for 9.4%. The high share recorded in Tabora is notable because the region has comparatively low household grid electricity and low school computer density. It suggests that access may be supported through shared devices, mobile connectivity, scheduled training or institutional facilities, but this interpretation requires school-level verification.

Participation quality matters more than registration. Login frequency, module completion, assessment performance, forum activity, repeated access and application in lesson planning are stronger indicators than

the existence of an account. This is consistent with recent MEWAKA research that emphasises equity, teacher agency and adaptation during scale-up (Swai et al., 2024). Future evaluation should therefore distinguish exposure, completion, competence gain and classroom transfer.

Infrastructure readiness and regional inequality

Infrastructure readiness includes electricity, connectivity, devices, technical support, security, maintenance and appropriate learning spaces. The five regions present contrasting conditions. Dar es Salaam combines high household electricity, high school grid connection and the highest computer ownership in the country. Pwani benefits from proximity to the commercial centre but includes dispersed rural districts. Morogoro contains both urban centres and large rural areas. Tabora and Kigoma have lower household grid access and lower computer density, although solar energy supports many schools.

The regional device figures from 2020 show that Dar es Salaam had approximately 8.95 desktop computers and 3.32 laptops per secondary school. The corresponding figures were approximately 8.25 and 1.78 in Pwani, 5.39 and 1.58 in Morogoro, 2.52 and 1.45 in Tabora, and 2.77 and 0.65 in Kigoma (calculated from PO-RALG, 2020). These are averages across government and non-government schools and do not describe functionality, age, location within schools or learner-to-device ratios. Nevertheless, they reveal a large difference in the capacity to run digital lessons.

Literature gap

The literature supports a plausible pathway from EdTech and TCPD to improved teaching and engagement, but four gaps remain. First, most programme data are national and not disaggregated for the five regions. Second, much TCPD research has focused on primary education. Third, there is limited linkage between platform analytics, teacher competence, classroom observation and learner achievement. Fourth, AI-enabled learning is emerging more quickly than the evidence needed to evaluate safety, equity and effectiveness. These gaps justify a cautious secondary-data evaluation and a recommendation for a prospective five-region study.

3. Methodology

Research design

The study used a comparative, theory-based secondary-data evaluation. It combined descriptive regional comparison with contribution analysis to determine what outcomes could reasonably be associated with EdTech investment and where the evidence remained insufficient. The review period was January 2020 to 8 August 2026. The 2020 data provided a pre-reform infrastructure baseline, while 2023–2026 sources documented curriculum implementation, platform development and emerging outcomes.

Study area

The study covered Dar es Salaam, Pwani, Morogoro, Tabora and Kigoma Regions only. These regions were selected because they provide a useful urban–rural and connectivity gradient. Dar es Salaam represents a highly urbanised and comparatively connected context. Pwani and Morogoro include urbanising corridors and rural districts. Tabora and Kigoma represent large, geographically dispersed regions with lower household grid access and more constrained device environments.

Data sources

The evaluation used five categories of evidence:

1. Policy and curriculum documents, including the Education and Training Policy 2014, 2023 Edition; the Curriculum for Ordinary Secondary Education, Forms I–IV; the National Digital Education Strategy; and the National Guidelines for Artificial Intelligence in Education.
2. Government and programme records, including PO-RALG regional education statistics, the 2022 Population and Housing Census, TIE's 2024/25 audited report, and the 2025 SEQUIP Implementation Status and Results Report.
3. Platform and professional-development studies, particularly TCPD-LMS analytics and the MEWAKA process evaluation.
4. Tanzania-focused research on digitalisation, online content and implementation constraints.
5. International evidence and competency frameworks used to interpret the likely mechanisms and standards for effective EdTech and AI use.

All cited sources were published between 2020 and 2026. Empirical comparisons were limited to the five regions. National sources were used to describe policy, investment and system-wide implementation, not to assign unobserved regional effects.

Variables and indicators

Table 1

Evaluation constructs and indicators

Construct	Operational indicators
EdTech implementation	Availability and use of OPSchool, interactive content, TIE Online Library, AI-enabled tools, school ICT programmes and digital resources
TCPD-LMS participation	Logins, module enrolment and completion, downloads, repeated use, forum or community participation, and curriculum-related module use
Teacher digital competence	Operational, pedagogical, ethical and evaluative competence; ability to design, facilitate and assess technology-supported learning
Infrastructure readiness	Electricity source and reliability, internet connectivity, computers, mobile access, projectors, maintenance and technical support
Teaching practices	Lesson planning, learner-centred methods, use of multiple representations, formative assessment, feedback, inclusion and differentiation
Learner engagement	Attendance, participation, task completion, persistence, interaction, interest and use of feedback
Learning outcomes	Subject assessments, Form Two learning evaluation, CSEE performance, competence demonstration and progression

Data analysis

Regional statistics were extracted and compared descriptively. Desktop and laptop counts were divided by the number of secondary schools to create approximate device-density indicators. Qualitative evidence was coded against the results chain: access, use, teaching practice, engagement and achievement. Evidence strength was classified as: (a) strong, where measured outcomes and a relevant comparison were available; (b) moderate, where consistent measured process changes were available but causal attribution was limited; or (c) emerging, where conclusions depended on programme outputs, perception or indirect evidence.

TCPD-LMS was assessed as an explanatory variable through three questions: whether participation was present, whether content was relevant to curriculum and pedagogy, and whether classroom transfer was plausible under the observed infrastructure and competence conditions.

Ethical and validity considerations

The paper used publicly available documents and did not collect personal data. Source triangulation was used to reduce reliance on single reports. Audited records were preferred for investment outputs, government statistics for regional indicators, and peer-reviewed or institutional studies for implementation mechanisms.

No respondent quotations are included. No primary interview transcripts or five-region respondent dataset were supplied for this paper, and inventing quotations such as “Teacher 1, Dar es Salaam, October 2025”

would be unethical and methodologically invalid. The paper therefore reports only verifiable secondary evidence. If primary data are later added, quotations should be drawn only from genuine respondents in Dar es Salaam, Pwani, Morogoro, Tabora and Kigoma, with anonymised identifiers, role, region and interview date.

Limitations

The design cannot estimate a causal treatment effect. Current public data do not consistently link school-level EdTech exposure, TCPD-LMS records, teacher competence, classroom observation, learner engagement and examination results. Some of the strongest TCPD process evidence concerns primary schools and is used only to explain mechanisms. The 2020 infrastructure baseline may not capture all improvements made after the revised curriculum. Device counts also do not show functionality, maintenance or actual pedagogical use. These limitations are incorporated into the interpretation of findings.

4. Findings

Investment and implementation outputs

The first finding is that Tanzania has moved beyond isolated pilots towards a more coherent national EdTech architecture. The architecture now includes policy and AI guidance, curriculum-linked digital content, OPSchool, the TIE Online Library, the TCPD-LMS, school ICT programmes and digitally enabled assessment and information systems. The presence of these complementary components is important because infrastructure, content and professional development are more likely to produce outcomes when implemented as a system.

TIE's 2024/25 audited report provides concrete evidence of scale. The institute trained 53,000 secondary-school teachers on implementation of the revised 2023 curriculum against a target of 45,000. It also trained 11,037 advanced-secondary teachers and 1,958 newly employed Business Studies teachers. For digital content, TIE reported development or digitisation of 1,277 Form One curriculum items in Physics, Chemistry, Mathematics, Biology and Geography; launch of interactive digital materials; and enhancement of a secondary-school LMS platform with integrated STEM content. Expenditure associated with the interactive content and platform line was TZS 786,500,200, while TZS 76,700,000 was reported for enabling digital technology in MEWAKA and uploading primary- and secondary-school content (TIE, 2025a).

The audited report also states that TZS 1,041,912,461 was spent on related curricula-development and distribution activities, an increase of 129% over the previous year, driven partly by development of the LMS supporting MEWAKA. These are substantial implementation outputs. They confirm public investment and institutional delivery, but the records do not disaggregate use or educational outcomes for the five regions.

SEQUIP provides additional system-level evidence. Its digitally enabled teaching and learning component had a reported cost allocation of US$115 million. By April 2025, the project reported 971 government secondary schools successfully implementing the ICT programme, 1,368,515 users of digitally enabled services, and 29,399 teachers reached through regular in-service training. However, the target of 1,500 ICT-implementing schools had not yet been achieved, and the teaching-and-learning-material indicator was off track (World Bank, 2025a). The finding is therefore one of major expansion with incomplete coverage and uneven implementation.

Regional infrastructure readiness

Table 2

Selected readiness indicators for the five regions

Region	Secondary schools with electricity, 2020 (%)	Schools on national grid, 2020 (%)	Approx. desktops per secondary school, 2020	Approx. laptops per secondary school, 2020	Households using grid electricity for lighting, 2022 (%)	Adult literacy, 2022 (%)
Dar es Salaam	97.6	97.0	8.95	3.32	86.0	97.5
Pwani	90.7	77.2	8.25	1.78	41.9	86.4

Region	Secondary schools with electricity, 2020 (%)	Schools on national grid, 2020 (%)	Approx. desktops per secondary school, 2020	Approx. laptops per secondary school, 2020	Households using grid electricity for lighting, 2022 (%)	Adult literacy, 2022 (%)
Morogoro	83.2	67.6	5.39	1.58	33.4	82.1
Tabora	80.4	59.8	2.52	1.45	20.2	68.0
Kigoma	87.6	38.3	2.77	0.65	17.7	76.7

Note. School indicators were calculated from PO-RALG (2020). Household electricity and adult literacy are from NBS and OCGS (2024). Device values are regional averages across government and non-government secondary schools and do not indicate functionality or learner-to-device ratios.

The table demonstrates that regional readiness is multidimensional. Dar es Salaam has a clear advantage in school electricity, grid connection, device density, household electricity and adult literacy. Pwani has relatively high school electricity and desktop density, but household electricity is less than half that of Dar es Salaam. Morogoro occupies a middle position. Tabora has the lowest adult literacy rate and low household electricity, while Kigoma has the lowest household grid electricity and laptop density.

Kigoma illustrates why a single readiness indicator is insufficient. A relatively high proportion of schools had some electricity, but only 38.3% were connected to the national grid and 57.0% used solar power. Solar can support digital learning, but outcomes depend on system capacity, battery condition, maintenance and the energy demands of devices. Thus, "electrified" should not be treated as equivalent to "ready for sustained online and AI-enabled learning".

TCPD-LMS participation and teacher capability

Platform analytics demonstrate meaningful but uneven use. The TCPD-LMS served more than 120,000 teachers and offered 37 modules. During July 2023–June 2024, the highest monthly login count was 24,527 in January 2024. The most enrolled module, the MEWAKA implementation guideline, had 17,914 enrolments; the foundational education training module had 10,798; Physics had 2,003; and Chemistry had 1,660 (Mtebe et al., 2025). The pattern indicates demand for content that is directly connected to curriculum implementation and subject teaching.

Regional distribution supports the argument that infrastructure and institutional activity shape participation. Dar es Salaam accounted for 14.2% of LMS use and Tabora 9.4% (Mtebe et al., 2025). Dar es Salaam's high share is consistent with its strong infrastructure. Tabora's high share, despite lower device and household-electricity indicators, suggests that digital participation can be enabled through mobile access, shared institutional facilities or scheduled professional-development activity. However, without school-level linkage, the precise mechanism cannot be confirmed.

The LMS access pattern also shows that mobile availability is necessary but not sufficient. Web-browser access reached 331,547, compared with 83,981 mobile-app accesses. Increasing mobile access may improve equity, but data costs, screen size, network quality and the suitability of learning activities for phones remain constraints. The implication is that a low-bandwidth, downloadable and mobile-first design should complement—not replace—school connectivity and devices.

Evidence from Morogoro and Kigoma shows that participation does not guarantee improvement in the same way across settings. In the MEWAKA process evaluation, high-quality lesson plans declined slightly in Morogoro Municipal Council from 63% to 60%, and more sharply in Kigoma District Council from 71% to 42.9% (Todd et al., 2025). The evaluation linked implementation constraints to workload, staff shortages, finance, transport, attendance, internet costs and limited resources. This supports Objective 2: TCPD-LMS is a plausible explanatory variable, but its effect is moderated by participation quality and enabling conditions.

Effects on teaching practices

The available evidence supports a moderate conclusion that EdTech investment and technology-supported professional development are improving some teaching processes. TIE's training scale and content production increase the probability that teachers have access to curriculum-aligned materials. TCPD evidence shows

improvement in lesson planning and observed practices across the wider evaluation sample. The LMS usage pattern shows that teachers actively seek implementation guidance and subject resources.

The strongest supported changes are:

- greater access to curriculum and syllabus materials;
- improved lesson planning and use of schemes of work;
- increased use of teaching aids and multiple representations;
- greater use of formative assessment and timely feedback;
- improved opportunities for collaborative reflection through communities of learning;
- increased potential for differentiated and inclusive instruction; and
- greater exposure to digital and AI-related professional learning.

However, the evidence does not establish that all trained teachers used digital resources in lessons or that the observed teaching changes were caused by AI-enabled tools. Training attendance can overstate competence, and downloads can overstate use. A teacher may complete an online module without access to a functioning projector, reliable internet or learner devices. Therefore, the result is best described as increased capability and opportunity, with uneven classroom transfer.

Effects on learner engagement

Evidence of learner engagement is emerging rather than conclusive. Interactive images, video, animation, three-dimensional content and digital quizzes are well aligned with attention, participation and feedback. The revised curriculum also creates more opportunities for project work and learner-centred activity. Teachers in the MEWAKA evaluation reported that professional learning helped them use new methodologies and teaching aids, while observations recorded greater use of challenging tasks, assessment and inclusive practices (Todd et al., 2025). These changes are likely to support engagement.

Nevertheless, public regional datasets do not yet provide comparable learner-engagement indicators for the five regions. Attendance, homework completion, classroom participation, time-on-task and platform activity are not linked to school EdTech exposure. The evidence therefore supports a plausible positive contribution, not a measured regional effect.

Effects on learning outcomes

The available evidence is insufficient to conclude that AI-enabled EdTech has caused improved secondary-school learning outcomes in the five regions. National reports show increased access to ICT-supported services and completion of learning assessments, but they do not publish a matched comparison between EdTech-using and non-using schools. TIE's records show training and content outputs rather than student achievement. TCPD research shows improvements in some teaching practices, but the process evaluation did not find demonstrable improvement in pupil learning outcomes during the study period (Todd et al., 2025).

This does not mean that the investment has no effect. It means that the effect has not been measured with an adequate design. Learning outcomes may require more time, repeated teacher use, reliable infrastructure and alignment across curriculum, assessment and professional support. They may also differ by subject. Interactive content could produce stronger effects in Physics, Chemistry, Mathematics, Biology and Geography than in subjects where the content is less developed.

Regional profiles

Dar es Salaam. The region has the strongest readiness profile and the highest documented TCPD-LMS share. It is the most favourable environment for blended learning, OPSchool use, online library access and experimentation with AI-assisted lesson preparation. The central risk is that positive urban experience may be generalised to regions with substantially different conditions.

Pwani. Pwani has relatively high school electrification and desktop density, but much lower household electricity than Dar es Salaam. Its proximity to Dar es Salaam may facilitate connectivity and technical support in some districts, while remote schools may remain underserved. Public evidence on platform use and outcome change is not sufficiently disaggregated.

Morogoro. Morogoro has moderate infrastructure and a mixed urban–rural profile. MEWAKA evidence from Morogoro Municipal Council shows that professional-development participation alone did not increase the proportion of high-quality lesson plans during the observed period. This indicates a need to examine participation intensity, leadership, workload and access at school level.

Tabora. Tabora combines low household electricity, low desktop density and the lowest adult literacy among the five regions, yet it recorded 9.4% of TCPD-LMS access. The region may demonstrate the value of mobile and institution-mediated access. It is a priority setting for testing low-bandwidth, offline and shared-device models.

Kigoma. Kigoma has substantial school electrification through solar power but limited grid connection and the lowest laptop density. The decline in high-quality lesson plans in the primary MEWAKA evaluation suggests that access to professional development must be accompanied by sustained coaching, finance, workload management and technical support.

Summary against the objectives

For Objective 1, the evidence shows positive implementation outcomes and probable improvements in teaching practices and learner engagement, but insufficient evidence of attributable improvement in secondary learning outcomes. For Objective 2, regional readiness, teacher digital competence and TCPD participation provide a credible explanation for variation, but they need to be measured together. No single variable is adequate: infrastructure without competence produces underuse, competence without infrastructure prevents application, and participation without relevant content or follow-up may not change practice.

Discussion

From investment outputs to educational outcomes

The findings reveal a common challenge in large-scale EdTech evaluation: the tendency to count what is easiest to measure. Teachers trained, modules uploaded, devices distributed, users registered and schools connected are important indicators of implementation, but they are not final outcomes. Tanzania's investment has created a stronger foundation for digital curriculum implementation than existed in 2020. Yet the next phase of evaluation must determine whether these resources are used repeatedly, appropriately and equitably. The results-chain perspective shows that the evidence becomes weaker as it moves towards learning outcomes. Investment and content production are strongly documented. Access and platform use are moderately documented. Teaching-practice change is supported by process evaluation, although much of the evidence comes from primary education. Learner engagement is plausible but poorly measured. Learning-outcome attribution is weak. This pattern is not unusual; UNESCO (2023a) notes that impartial evidence on EdTech impact remains limited globally.

TCPD-LMS as an explanatory variable

TCPD-LMS should be retained as a central explanatory variable in a future empirical study, but it should be operationalised carefully. A binary measure—trained or not trained—would be inadequate. Teachers vary in module exposure, completion, assessment performance, repeated use, participation in communities of learning, coaching support and classroom application. A stronger TCPD-LMS index would include:

6. number and relevance of completed modules;
7. frequency and recency of access;
8. scores on module assessments;
9. contribution to online or face-to-face communities of learning;
10. coaching or peer-facilitation exposure; and
11. evidence of application in lesson plans and classroom observation.

The Morogoro and Kigoma evidence demonstrates why this detail matters. Both councils were part of a national system, but their lesson-plan trends differed from the aggregate improvement. Implementation conditions can dilute training effects. A teacher may understand an approach but lack time, devices, internet, materials or leadership support. Therefore, TCPD-LMS is best understood as part of an implementation package rather than a stand-alone treatment.

Regional inequality and equitable design

The regional readiness table shows that equal provision will not produce equal opportunity. A digital platform that works effectively in Dar es Salaam may be difficult to use in Kigoma or Tabora. Equity therefore requires differentiated implementation. For highly connected schools, policy can support blended learning, AI-assisted planning and real-time analytics. For low-connectivity schools, downloadable modules, local servers, offline content, solar-compatible equipment, printed backup and cluster-based access may be more effective.

Tabora's relatively high LMS share is important. It suggests that constrained regions are not necessarily low-demand regions. Teachers may participate when content is relevant and access is organised. This supports

investment in Teacher Resource Centres, hub schools and zero-rated or subsidised professional-development access. It also cautions against interpreting low household connectivity as low teacher motivation.

AI-enabled learning

AI adds opportunities and risks beyond conventional digital content. It can help teachers generate examples, adapt reading levels, create quizzes, translate or simplify explanations, and provide rapid feedback. It may be particularly useful in large classes and where teachers have limited preparation time. Emerging Tanzanian research suggests interest in using generative AI as a teaching partner, but evidence remains early and requires stronger regional and subject-specific validation (Kamaghe, 2026).

AI effectiveness depends on teacher judgement. Generated material may contain factual errors, inappropriate cultural assumptions, weak Kiswahili, curriculum misalignment or unsafe data practices. Teachers therefore need competence in prompt design, verification, bias detection, privacy, copyright, assessment integrity and inclusive adaptation. Tanzania's AI guidelines and the UNESCO competency framework offer a basis for developing these capabilities (MoEST, 2025b; UNESCO, 2024a).

AI should not become a new source of inequality. Learners in well-connected urban schools could receive frequent personalised support while learners in remote schools depend on occasional shared access. The appropriate policy response is not to delay all AI use, but to test low-bandwidth and teacher-mediated models while investing in foundational infrastructure.

Interpreting the absence of demonstrated learning effects

The absence of a demonstrated causal effect should not be confused with evidence of no effect. Several explanations are possible. First, implementation may be too recent for stable achievement change. Second, teachers may be trained but not yet using tools consistently. Third, assessment instruments may not measure the competencies targeted by digital learning. Fourth, infrastructure interruptions may reduce treatment intensity. Fifth, positive effects in some schools may be offset by non-use elsewhere.

A strong evaluation must therefore measure implementation fidelity and duration. It should also analyse subject-specific outcomes and distinguish between conventional digital resources and AI-enabled applications. Without such design, national pass-rate changes cannot be attributed to EdTech because they may reflect teacher deployment, textbooks, school construction, selection, assessment changes or other reforms.

Recommendations

1. Establish a five-region longitudinal EdTech outcome evaluation

MoEST, TIE, PO-RALG and NECTA should establish a common school identifier linking EdTech provision, OPSchool and TIE Library use, TCPD-LMS analytics, teacher competence assessments, classroom observations, learner-engagement indicators and examination results. A baseline and at least two follow-up rounds should be conducted in Dar es Salaam, Pwani, Morogoro, Tabora and Kigoma. Schools should be sampled by urban–rural location, ownership, connectivity and implementation intensity.

2. Measure use and competence, not only access and training

Monitoring should report active users, module completion, repeated use, assessment scores, classroom transfer and learner reach. Teacher digital competence should be assessed through practical tasks aligned with the national ICT competency standard and UNESCO's AI framework. Completion certificates should require demonstrated application, such as a curriculum-aligned digital lesson, an assessment activity and a reflection on learner response.

3. Make TCPD-LMS participation a structured implementation package

Online modules should be combined with school-based communities of learning, coaching, peer observation and leadership support. Each school should develop a termly digital-integration plan. Head teachers and peer facilitators should monitor whether professional learning is applied in lessons. Workload and participation time should be formally protected.

4. Adopt differentiated regional infrastructure strategies

Dar es Salaam should be used for advanced pilots involving AI-supported planning, formative analytics and blended learning. Pwani and Morogoro should combine school connectivity with mobile and offline access for rural districts. Tabora and Kigoma should receive priority for solar-system maintenance, low-power

devices, offline servers, downloadable content and cluster-based support. Infrastructure indicators should measure reliability and functionality, not simply presence.

5. Strengthen OPSchool and TIE Online Library analytics

The platforms should collect privacy-preserving data on region, school type, subject, resource accessed, time spent, completion and return use. Dashboards should distinguish teachers from learners and show the relationship between access and curriculum periods. Content should remain downloadable and mobile-responsive, with low-resolution alternatives for video and interactive material.

6. Introduce controlled AI pilots before system-wide expansion

AI-enabled learning should be piloted in selected subjects and schools in all five regions. Pilots should compare teacher-supported AI use with conventional digital content and non-digital instruction. Evaluation should include accuracy, curriculum alignment, engagement, teacher workload, achievement, equity, data protection and cost-effectiveness. No learner-identifiable data should be entered into public AI systems without approved safeguards.

7. Develop regionally responsive teacher support

Professional development should reflect local constraints. Teachers in lower-connectivity settings need skills in offline content, shared-device pedagogy and contingency planning. Teachers in connected settings need stronger competence in AI verification, data literacy, formative analytics and academic integrity. Materials should be available in clear English and Kiswahili, with accessibility features for teachers and learners with disabilities.

8. Align assessment with the revised curriculum

If EdTech is intended to improve problem-solving, practical application, collaboration and digital literacy, assessment must measure these competencies. NECTA and TIE should ensure that formative and national assessments capture curriculum outcomes that technology-supported pedagogy is designed to influence. Otherwise, genuine changes in competence may remain invisible.

9. Publish annual region-disaggregated outcome reports

Annual reports should present investment, access, use, teaching-practice and learner-outcome indicators separately. Results should be disaggregated by region, district, rurality, gender, disability, school ownership and subject. Reporting should explicitly distinguish outputs from outcomes and correlation from causation.

Conclusion

Tanzania has made significant and increasingly coherent investments in EdTech following the 2023 Revised Curriculum. The combination of OPSchool, interactive digital materials, the TIE Online Library, school ICT programmes, AI guidance and the TCPD-LMS creates a credible foundation for changing secondary teaching and learning. Audited and programme evidence confirms large-scale teacher training, digital-content production, platform development and expansion of digitally enabled services.

The outcomes are nevertheless uneven and the evidence is strongest at the early stages of the results chain. Access to resources, professional learning, lesson preparation, formative assessment and opportunities for learner engagement have improved or become more feasible. It is not yet possible to conclude that AI-enabled EdTech has caused higher secondary-school learning outcomes in Dar es Salaam, Pwani, Morogoro, Tabora and Kigoma. The required school-level linkage between investment, platform use, teacher competence, classroom practice, engagement and achievement is not publicly available.

TCPD-LMS is an important explanatory variable because it can connect national investment to teacher capability and classroom application. Its effect, however, depends on participation quality, relevant content, coaching, school leadership and infrastructure readiness. The five regions show a marked readiness gradient, and uniform implementation is unlikely to produce equitable results. The next stage of Tanzania's EdTech reform should therefore prioritise rigorous longitudinal evaluation, differentiated regional support, practical teacher competence and responsible AI integration. The central policy question is no longer whether technology has been provided, but whether it is being used well enough, often enough and equitably enough to improve learning.

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