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Beyond Basic ICT Access: Pedagogical Integration of Geospatial Technologies in Geography Teaching in Temeke Municipality, Tanzania

Ally Mohamed J.[1]*, Prospery M. Mwila[2]

[1] Educational Officer, Ilala Municipality
[2] Saint Augustine University of Tanzania

Correspondence e-mail * : allym3255@gmail.com

Abstract : Digital technology is now central to competence-based Geography education, yet access and pedagogical use remain uneven in Tanzanian public schools. This study examined how ICT integration supports Geography teaching and learning in Temeke Municipality. Its main objective was to assess whether available technology was being converted into subject-specific, learner-centred practice. A mixed-methods approach and cross-sectional survey design were used. The sample comprised 120 participants: 100 students, 16 Geography teachers, and four Ward Education Officers. Student and teacher questionnaires and semi-structured officer interviews generated the data. Questionnaires were administered in selected schools; interviews were conducted, recorded in notes, and compared with survey responses. Quantitative data were coded in SPSS and summarized through frequencies and percentages, while qualitative responses were organized thematically and integrated during interpretation. Expert review and piloting supported content validity; internal consistency was assessed against a Cronbach's alpha threshold of .70, although the achieved coefficient was not reported. Participation was voluntary and confidentiality was protected. Findings showed a pronounced access-use gap: computers, laptops, tablets, projectors, internet services, videos, and PowerPoint were available or used in several schools, but digital maps, GIS, satellite imagery, GPS, online inquiry, and collaborative digital tasks were rarely available or enacted. Teachers generally possessed basic operational skills but lacked geospatial pedagogical competence. The study concludes that generic hardware access alone does not transform Geography learning. It recommends curriculum-aligned geospatial resources, reliable connectivity and electricity, school-based coaching, practical professional development focused on inquiry, mapping, field data, and spatial reasoning, and sustained municipal support for technical continuity.

Keywords: ICT integration; Geography education; geospatial technologies; TPACK; GIS; secondary schools; Tanzania

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INTRODUCTION

Geography education increasingly requires learners to interpret spatial data, connect local environmental change with global processes, and evaluate evidence rather than merely reproduce place facts. Spatial thinking combines concepts of space, tools of representation, and processes of reasoning, so learners need repeated opportunities to work with location, distance, distribution, scale, association, and

change (National Research Council, 2006; Jo & Bednarz, 2009). Digital maps, geographic information systems (GIS), satellite imagery, global positioning systems (GPS), simulations, and video can make dynamic or inaccessible phenomena visible and support inquiry across scales. For example, time-series satellite images can help learners examine urban expansion, while digital elevation data can support explanations of drainage and flood exposure. These tools are educationally useful when students use evidence to identify patterns and explain relationships, rather than simply view an image selected by the teacher.

Recent reviews indicate that ICT can widen access to resources, promote collaboration, and strengthen personalized and active learning, but benefits depend on how tools are selected and used rather than on their presence alone (Msafiri et al., 2023; Panjaitan et al., 2023). Research on technology integration also shows that resources, institutional arrangements, subject culture, teacher knowledge, beliefs, and assessment can operate as connected barriers (Hew & Brush, 2007). UNESCO (2023) similarly cautions that technology is educationally valuable only when it is appropriate to context, supported by teachers, equitable, and aligned with learning goals. The relevant question for Geography education is therefore not only whether schools possess digital equipment, but whether that equipment enables learners to investigate spatial questions and communicate evidence-based explanations.

Across Africa, the promise of digital learning coexists with unequal infrastructure, connectivity, technical support, and teacher preparation. These constraints are especially consequential in Geography because subject-specific digital practice demands more than basic computer literacy: teachers must connect technological affordances to spatial concepts, field inquiry, visual interpretation, and learner activity. A Tanzania-focused systematic review found that infrastructure, teacher competence, institutional support, and pedagogical alignment operate as an interdependent system (Msambwa & Daniel, 2024). Tanzania's Education and Training Policy, 2023 edition, and National Digital Education Guidelines and Strategies 2024/25-2029/30 reinforce digital competence and institutional readiness, making evidence about classroom enactment timely (Ministry of Education, Science and Technology [MoEST], 2023, 2024).

Temeke Municipality provides a critical urban and peri-urban setting in which nominal access may conceal a deeper pedagogical divide. Previous Tanzanian studies have often assessed general ICT availability or teacher readiness, while fewer have examined whether Geography teachers use discipline-specific tools such as GIS, digital maps, satellite imagery, and GPS to support spatial reasoning. The present study therefore investigated the availability and accessibility of ICT, teachers' competence, classroom use, and ICT-supported pedagogy, with the main objective of determining whether technology access is translated into subject-specific, learner-centred Geography teaching. Its contribution is to distinguish basic digital access from

meaningful geospatial integration and to identify the linked resource, competence, and pedagogical conditions required for change.

Literature Review

1. Theoretical Review

Technological Pedagogical Content Knowledge (TPACK) explains effective technology integration as the intersection of technological knowledge, pedagogical knowledge, and content knowledge (Mishra & Koehler, 2006). For Geography, this intersection is visible when a teacher does more than operate a projector. The teacher must decide whether satellite imagery, GIS layers, a digital elevation model, GPS observations, or a video best represents a particular spatial process and then structure questions and tasks that elicit interpretation. A technically competent teacher may know how to display a map but still need pedagogical content knowledge to select an appropriate scale, sequence observations, address misconceptions, and assess whether students can explain a spatial pattern. TPACK therefore directs attention away from equipment counts toward teachers' capacity to make principled, subject-specific choices.

The framework also predicts that generic ICT training will have limited classroom effects when it is detached from Geography curricula and assessment. Teacher change depends on knowledge and confidence as well as beliefs about learning and the culture of the school and subject department (Ertmer & Ottenbreit-Leftwich, 2010). In this study, those contextual elements matter because a teacher may have basic operational skill but avoid a geospatial task if internet access is unreliable, lesson time is short, technical assistance is absent, or examinations do not reward spatial inquiry. TPACK is thus treated as situated competence: teachers need to coordinate a tool, a Geography concept, a suitable teaching method, and the practical conditions under which the lesson will occur.

Constructivist learning theory adds a learner-centred account of how digital tools may improve learning. Learners construct meaning by connecting new evidence to prior knowledge, testing explanations, collaborating, and reflecting (Vygotsky, 1978). Geospatial technologies can support this process when students compare map layers, collect local coordinates, interpret land-use change, or defend explanations using visual evidence. Spatial thinking is especially relevant because it requires learners to connect representations with concepts and reasoning processes (National Research Council, 2006; Jo & Bednarz, 2009). A map becomes a learning tool when students interrogate what it represents, recognize its scale and limitations, compare it with other evidence, and use it to answer a geographical question.

However, a slide presentation can reproduce teacher-centred transmission even when it uses modern hardware. Constructivism therefore distinguishes interactive knowledge construction from the digitization of lecture notes. GIS-

supported inquiry can promote relational thinking when the task, guidance, and conceptual focus are carefully designed (Favier & van der Schee, 2012, 2014). This qualification is important: learner-centred practice does not mean leaving students to navigate complex software without support. Teachers must provide preparatory tasks, prompts, modelling, feedback, and opportunities to explain findings so that attention remains on Geography rather than on software operation.

Used together, TPACK and constructivism expose a progression from access to transformation: infrastructure enables use; integrated teacher knowledge shapes task design; and learner activity produces educational value. This combined perspective also accommodates the current emphasis on context. Technology that is technically sophisticated but unreliable, unaffordable, linguistically inaccessible, or misaligned with examinations may remain unused. The framework guiding this study thus treats meaningful Geography ICT integration as the joint product of functional resources, teacher competence, curricular fit, and participatory pedagogy rather than as a direct consequence of hardware availability.

2. Empirical Review

International evidence shows consistent potential but uneven implementation. A systematic review of 51 studies in secondary education found benefits for curriculum coverage, shared resources, personalized learning, and teaching processes, alongside recurrent barriers involving infrastructure, skills, and support (Msafiri et al., 2023). A Geography-specific review similarly reported that digital tools can visualize complex processes and increase interaction, but that limited resources and teacher preparation constrain uptake (Panjaitan et al., 2023). Retrospective research on GIS in schools confirms that curriculum inclusion has expanded globally while classroom implementation continues to depend on teacher readiness, accessible data, and institutional support (Kholoshyn et al., 2022). These patterns support the distinction between having a technology and embedding it in routine subject teaching.

Studies of GIS-supported Geography provide a more specific account of the conditions for learning. Favier and van der Schee (2012) found that effective inquiry design requires structured preparation, domain-specific guidance, and evaluation rather than unrestricted software use. Their later quasi-experimental study reported stronger development of geospatial relational thinking in a short technology-supported lesson series than in a conventional series covering the same content (Favier & van der Schee, 2014). Jo and Bednarz (2009), meanwhile, showed that learning materials may use spatial representations while still asking mainly low-level questions. Together, these studies suggest that access to maps or GIS is only the starting point; the cognitive demand of the questions and the quality of instructional scaffolding determine whether students practise spatial reasoning.

African studies show that mobile devices and common presentation tools often diffuse faster than specialist applications. In South African Geography classrooms, smartphones can widen access to maps and information, yet their instructional value depends on school rules, data affordability, and purposeful task design (Gubevu & Mncube, 2024). Research in Tanzanian secondary schools similarly identified insufficient resources, limited skills, and infrequent use (Mwaluko et al., 2023). Across these settings, the recurring pattern is not complete technological absence but selective, low-complexity use: teachers adopt video and presentation software more readily than GIS-supported inquiry.

This selective adoption is consistent with the wider barrier literature. Schools may acquire devices without providing subject-specific digital content, maintenance, scheduling arrangements, technical support, or assessment incentives, while teachers may lack confidence that an unfamiliar activity will succeed within a fixed lesson (Hew & Brush, 2007; Ertmer & Ottenbreit-Leftwich, 2010). Connectivity costs and power interruptions further increase the risk of a failed lesson. Consequently, teachers may reasonably prefer a downloaded video or prepared slide deck even when they recognize the educational potential of interactive tools. An interpretation of low use must therefore consider both teacher competence and the reliability of the system in which teachers work.

Tanzanian scholarship confirms this access-use distinction. Ngeze (2017) identified readiness gaps in secondary schools, while later reviews found persistent interactions among infrastructure, competence, beliefs, leadership, and digital content (Msafiri et al., 2023; Msambwa & Daniel, 2024). The national policy shift toward digital education heightens the need for municipal evidence on classroom practice (MoEST, 2023, 2024). Yet the specific combination of student, teacher, and ward-level perspectives on geospatial tools remains underdeveloped. This study addresses that gap by examining not simply whether ICT exists in Temeke schools, but how far it supports learner-centred Geography pedagogy.

METHODOLOGY

The study used a mixed-methods approach with a predominantly qualitative orientation and a cross-sectional survey design to examine ICT integration at one point in time. It was conducted in public ward secondary schools in Temeke Municipality, Dar es Salaam, an urban and peri-urban setting selected because schools differ in access to technology and supporting services. The study involved 120 respondents: 100 students, 16 Geography teachers, and four Ward Education Officers. Students were selected through simple random sampling from school lists, while Geography teachers and Ward Education Officers were purposively selected because of their direct instructional or supervisory knowledge. Questionnaires containing closed and open questions were administered to students and teachers to examine

resource availability, access, classroom use, teacher skills, training, and pedagogical practices. Semi-structured interviews with Ward Education Officers explored implementation, supervision, professional development, institutional support, and constraints. After permissions were obtained from education authorities and school heads, the researcher explained the study, obtained voluntary participation, administered questionnaires in the schools, and conducted interviews; survey and interview evidence was then compared during interpretation. Quantitative responses were coded and analysed in SPSS using frequencies and percentages, while open responses and interview notes were organized thematically and integrated with the survey patterns. Content validity was strengthened through alignment with the objectives, review by a supervisor and experienced academics, and piloting in schools outside the sample. Questionnaire reliability was assessed using a prespecified Cronbach's alpha criterion of .70 or above; because the achieved coefficient is absent from the source manuscript, no numerical reliability claim is made here. Ethical safeguards included official permission, informed consent, the right to withdraw, confidentiality, respectful engagement, and academic-only use of the data. As a cross-sectional, perception-based study without achievement measures, the findings indicate patterns of access and enactment but do not establish causal effects on learning outcomes.

RESULT AND DISCUSSION

The main finding is that Temeke schools had begun to cross the threshold of basic ICT access, but most had not reached discipline-specific transformation. The evidence converged on a three-part pattern: generic tools were more visible than geospatial tools; teacher competence was stronger for routine operations than for Geography-specific applications; and classroom use remained primarily presentational rather than inquiry-driven. Table 1 integrates the results across respondents and instruments.

This convergence is important because students, teachers, and Ward Education Officers viewed the same problem from different positions. Student reports indicate what learners encountered, teacher responses show perceived competence and classroom choices, and officer interviews add an institutional perspective on support and implementation. Agreement across these sources strengthens the interpretation that the central issue is an access-use gap rather than an isolated complaint about one device or one school. At the same time, the data remain self-reported and cross-sectional. They show a consistent pattern of perceived availability and enactment but cannot establish the condition of every device, the quality of every lesson, or changes over time.

Table 1.
ICT Access and Pedagogical Integration in Geography

Dimension	Evidence from the Study	Integrated Interpretation
Basic access	Computers, laptops, tablets, projectors, internet services, videos, and PowerPoint were reported as available or used in many schools.	Temeke has an enabling digital base, but access varies and does not demonstrate sustained classroom use.
Geography-specific access	Digital maps, GIS, satellite imagery, and GPS devices were unavailable in many schools.	The resource mix supports presentation more readily than spatial analysis, field data collection, or map-based inquiry.
Teacher competence	Most teachers reported basic ICT skills; some developed skills through ICT training and MEWAKA. Advanced geospatial skills remained limited.	Professional learning has supported operational literacy but has not consistently produced integrated technological-pedagogical-content knowledge.
Classroom enactment	Videos, computers, projectors, and PowerPoint were the most common tools; online materials, GIS, satellite imagery, and interactive digital tasks were rare.	Technology was used mainly to transmit or illustrate information, not to reorganize learning around investigation and evidence.
Enabling conditions	Inadequate equipment, weak infrastructure, limited digital resources, and insufficient training constrained use.	Barriers are mutually reinforcing; isolated equipment provision is unlikely to produce durable change.

The first part of this pattern is an infrastructure paradox. Computers and projectors make digital lessons possible, yet the scarcity of GIS, digital maps, satellite imagery, and GPS restricts the disciplinary work that makes Geography distinctive. The finding aligns with Msambwa and Daniel's (2024) argument that effective integration depends on interacting technical, human, and organizational conditions and with Mwaluko et al.'s (2023) evidence of limited resources and teacher skills. It also reflects UNESCO's (2023) warning that technology should be judged by educational fit, equity, and sustainability rather than novelty or procurement. In practical terms, a projector may make a landform visible, but it does not automatically enable students to compare layers, identify change, or produce a spatial explanation.

The composition of the available resource base matters as much as its size. Generic equipment supports several school subjects and is therefore a rational first

investment, but Geography gains its distinctive educational value from representations and operations tied to place, scale, distribution, movement, and human-environment relations. A computer without relevant data, suitable software, or a planned inquiry can function mainly as a presentation device. By contrast, even modest geospatial resources can support richer work when learners compare neighbourhood land uses, map service access, record field locations, or interpret environmental risk. The National Research Council (2006) describes GIS as a support system for spatial thinking, but also stresses that its educational potential depends on curriculum, standards, instructional tools, and systematic implementation.

Availability should also be interpreted as functional and equitable access. A device reported as present may be shared across many classes, unavailable during a scheduled lesson, disconnected from power or the internet, or unusable because software and data are outdated. These conditions can convert nominal access into occasional access. They also affect students differently: a lesson that assumes personal smartphones or paid data may exclude learners who cannot participate on equal terms. The findings therefore support a broader definition of access that includes functionality, scheduling, maintenance, offline content, teacher authorization, and fair opportunities for students to handle the technology (Gubevu & Mncube, 2024; UNESCO, 2023).

For Temeke, this interpretation suggests that procurement should begin with curriculum tasks rather than a list of devices. Schools can identify the Geography topics for which technology offers a clear advantage, specify the data and tools needed, and plan a low-connectivity alternative. Urban growth, coastal processes, drainage, waste management, transport, population distribution, and local environmental hazards provide possible contexts for map comparison and field-to-classroom inquiry. These examples are proposed applications, not activities observed in the study. Their value lies in showing how the reported generic digital base could be connected to local Geography content without assuming continuous high-bandwidth access.

The second part concerns frequency and depth of use. Teachers commonly used PowerPoint and video, whereas interactive online resources and geospatial applications were rare. This hierarchy mirrors the international literature: low-complexity tools are often adopted first because they fit existing routines, while GIS requires data, devices, time, subject-specific confidence, and revised lesson design (Kholoshyn et al., 2022; Panjaitan et al., 2023). Presentation tools therefore represent a meaningful entry point, especially when they improve the visibility of maps, landscapes, processes, and field sites that cannot be visited. The limitation is that frequency of display does not reveal the depth of student thinking.

From a constructivist perspective, the critical issue is not whether a lesson is digital but whether students manipulate information, pose questions, collaborate, and

justify interpretations. A video can be used passively, or it can be paused so students predict a process, record evidence, compare explanations, and revise a diagram. A projected map can serve as an illustration, or groups can examine patterns, propose causes, and defend conclusions. The findings suggest that much current use enhances illustration but leaves the underlying teacher-centred pedagogy largely intact. This is the distinction between digitizing an established routine and redesigning a task around evidence and inquiry.

The rarity of GIS and interactive tasks has direct implications for spatial thinking. Jo and Bednarz (2009) distinguish spatial concepts, representations, and reasoning processes; students develop stronger spatial competence when tasks require all three. Favier and van der Schee (2014) found that a guided geospatial lesson sequence could strengthen relational thinking, but their results should not be generalized as proof that any GIS lesson improves learning. The benefit arose from a designed sequence with defined content and reasoning demands. Temeke schools would therefore need lesson materials that ask students to interpret relationships, compare scales, evaluate patterns, and explain change, rather than merely locate features or copy map labels.

Interactive practice need not begin with technically demanding desktop GIS. A progression can start with annotated offline maps and teacher-led comparison, move to small-group interpretation of downloaded satellite images, and then introduce GPS-enabled field observations or simple layer operations when resources permit. This graduated approach reduces the operational burden while increasing the cognitive demand of the task. It also recognizes that reliable offline resources may be more instructionally valuable than an ambitious internet-dependent platform that fails during lessons. The reported use of videos and PowerPoint can thus serve as a foundation if teachers gradually shift responsibility from display and explanation to student observation, analysis, and argument.

The third part is a competence gap. Teachers' ability to operate familiar tools and their exposure to MEWAKA are important foundations, but basic literacy is not equivalent to TPACK. Geography teachers need opportunities to rehearse curriculum-linked tasks, such as tracing urban expansion from time-series imagery, mapping flood exposure, or collecting field coordinates, and to receive feedback on lesson design. TPACK requires them to coordinate subject content, teaching method, representation, student difficulty, and technology within a particular classroom (Mishra & Koehler, 2006). A short course on software commands cannot by itself build this integrated judgement.

The findings also indicate why professional development should address confidence and working conditions. Teachers are more likely to use unfamiliar tools when they can anticipate common technical problems, observe a credible classroom example, practise with colleagues, and obtain help after training. Knowledge, self-

efficacy, pedagogical beliefs, and school culture interact in technology-related teacher change (Ertmer & Ottenbreit-Leftwich, 2010). In Temeke, a teacher who values inquiry may still return to presentation if devices are difficult to book, digital files are unavailable, or examination preparation rewards factual coverage. Conversely, reliable support and shared lesson materials can reduce the personal risk of trying a new approach.

MEWAKA and school-based professional learning offer a practical route for narrowing this gap because they can connect training with teachers' actual syllabi, devices, class sizes, and time constraints. Sessions could centre on one teachable sequence: define a Geography question, select a local dataset or image, plan student prompts, anticipate misconceptions, decide how groups will share devices, and design an assessment of spatial reasoning. Teachers could then teach the lesson, review student work, and revise it with peers. This cycle is more likely to change practice than a one-off demonstration because it combines technological knowledge with lesson planning, enactment, evidence, and feedback (Favier & van der Schee, 2012; Msafiri et al., 2023).

Table 2 translates the integrated evidence into a developmental continuum. This is an analytical synthesis of the reported findings, not a new statistical scale.

Table 2.
Observed Stage of ICT Integration and the Next Instructional Step

Integration Stage	Status Indicated by the Findings	Priority for Progression
Access	Emerging: generic devices and connectivity exist in many schools.	Ensure functionality, equitable scheduling, electricity, connectivity, maintenance, and offline alternatives.
Adoption	Partial: video, PowerPoint, computers, and projectors are used.	Link each tool to explicit Geography learning objectives rather than occasional demonstration.
Adaptation	Limited: teachers have basic skills but use a narrow repertoire.	Provide school-based coaching in digital mapping, satellite-image interpretation, GPS, and formative assessment.
Transformation	Rare: student-led geospatial inquiry and collaborative digital production are uncommon.	Develop local-data projects, map investigations, field-to-classroom workflows, and assessment rubrics for spatial reasoning.

This continuum reframes the study's contribution. The policy problem is not simply a digital divide between schools with and without equipment; it is also a pedagogical divide between access and meaningful use. The four stages in Table 2 should not be treated as a rigid or irreversible sequence. A school may have connectivity yet lack dependable projection, or one teacher may conduct an advanced inquiry while general practice remains presentational. The continuum is useful because it identifies the next instructional and organizational step rather than classifying a school as either digitally included or excluded.

Tanzania's recent policy and digital education guidance create a supportive direction, but implementation should be evaluated through student learning activity and subject-specific capability (MoEST, 2023, 2024). Monitoring only the number of devices or trained teachers would miss whether learners use spatial evidence. Municipal and school indicators could therefore include device functionality, access by subject and student group, availability of offline geospatial content, frequency of curriculum-linked tasks, teacher participation in coached lesson cycles, and the quality of student maps or explanations. Such evidence would connect investment decisions to classroom practice while avoiding the assumption that every use of technology is equally valuable.

The results further suggest that infrastructure, competence, and pedagogy should be developed as one implementation package. Equipment without maintenance becomes unreliable; training without suitable resources cannot be enacted; and digital content without pedagogical guidance may remain unused. This interdependence is consistent with Tanzanian and international reviews that identify multiple, mutually reinforcing barriers (Hew & Brush, 2007; Msafiri et al., 2023; Msambwa & Daniel, 2024). A coordinated package would assign responsibility for maintenance and scheduling, provide curriculum-relevant files and offline backups, support teachers through peer planning and coaching, and align assessment with spatial reasoning. The emphasis is continuity: teachers need a system that works often enough for a new practice to become routine.

Equity requires attention throughout this progression. Shared-device activities should allocate meaningful roles so that one confident student does not control the tool while others watch. Offline resources and school-provided devices can reduce dependence on household income. UNESCO (2023) identifies inclusion, quality, and sustainability as tests of educational technology; in Temeke, equitable participation is therefore part of pedagogical quality.

Because the study is cross-sectional and reports no achievement test, the claim must remain bounded: participants perceived that ICT can enrich Geography teaching, but the study cannot demonstrate that it caused higher achievement. The sample was limited to selected public ward secondary schools in one municipality, and self-reports may reflect recall or social-desirability bias. The absence of the

achieved reliability coefficient also prevents readers from evaluating internal consistency numerically, even though a threshold was prespecified. These limitations do not erase the repeated access-use pattern, but they restrict estimates of prevalence and causal effect.

Future evaluation should combine classroom observation, device and connectivity audits, teacher knowledge measures, student work, and spatial-reasoning tasks. Longitudinal research could examine whether coached, curriculum-linked professional development changes practice after initial training, while quasi-experimental studies could compare specific lesson sequences without assuming that technology itself is the treatment. Research should also examine differences by school location, gender, disability, prior digital experience, and access to devices outside school. Such designs would test whether the developmental steps proposed in Table 2 improve both participation and geographical reasoning in diverse Tanzanian settings (Favier & van der Schee, 2014; National Research Council, 2006).

CONCLUSION

The study concludes that ICT integration in Temeke's ward secondary schools is best described as basic access with shallow pedagogical use. Generic devices and presentation tools have created a platform for digital instruction, and many teachers possess foundational skills. Nevertheless, the limited availability of geospatial resources and the narrow use of technology mean that students seldom experience the inquiry, visualization, field-data, and spatial-analysis practices that distinguish contemporary Geography. The central implication is that access is necessary but insufficient: transformation occurs only when functional infrastructure, disciplinary content, teacher knowledge, assessment, and learner-centred task design are developed together. The study adds local evidence that the digital divide includes a qualitative difference between seeing information on a screen and using digital representations to reason geographically.

The Ministry of Education, Science and Technology, municipal education authorities, and school leaders should therefore move from undifferentiated hardware provision to a curriculum-aligned geospatial package. This package should include offline and online maps, accessible GIS software, satellite imagery, GPS-enabled field activities, projection, connectivity, power continuity, maintenance, and clear arrangements for equitable access. Schools should first map these resources to priority syllabus topics and prepare offline alternatives so that a connectivity failure does not end the lesson. Municipal monitoring should track functionality and curriculum use, not only inventory.

Professional development should be practical, sustained, and school-based, using MEWAKA and peer coaching to help teachers design and assess actual Geography lessons rather than attend one-off generic ICT sessions. Teachers should

plan a task, teach it, examine student evidence, and revise it with colleagues. School leaders should protect time for collaborative planning, support shared-device routines, and monitor whether students interpret, create, and explain spatial representations. Further research should test how specific geospatial pedagogies affect spatial reasoning, engagement, and achievement across diverse Tanzanian regions using larger samples, classroom observations, student work, and longitudinal or quasi-experimental designs.

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