



Classroom Observation of Mathematics Teachers' Use of Instructional Materials in Teaching Geometry in Selected Technical Secondary Schools in Muhanga District, Rwanda

Joel Sindikubwabo¹ , Alphonse Uworwabayeho¹  & Onesme Niyibizi^{1,2} 

¹African Centre of Excellence for Innovative Teaching and Learning Mathematics and Science (ACEITLMS), College of Education, University of Rwanda, Rwanda

²Institut Catholique de Kabgayi (ICK), Rwanda

Abstract

This paper reports the classroom-observation component of a broader qualitative study of how mathematics teachers use instructional materials to teach and learn geometry in selected Technical Secondary Schools (TSS) in Muhanga District, Rwanda. While teachers' accounts of practice are useful, self-reports can overstate the consistency and quality of classroom implementation, so this paper focuses on what was directly observed in real geometry lessons. Anchored in an interpretivist paradigm and a qualitative case-study design, the study observed twenty geometry lessons taught by ten mathematics teachers purposively drawn from five TSS representing urban, semi-urban, and rural contexts. A structured observation checklist, informed by constructivism, Vygotsky's Zone of Proximal Development, and Gagné's Nine Events of Instruction, was used to record the presence, type, and quality of instructional-material use at successive stages of each lesson. The researchers analysed the observation data using narrative analysis, reconstructing each lesson as a chronological account and comparing the accounts across lessons. The findings show that traditional geometry tools, particularly rulers, compasses, protractors, and setsquares, dominated observed lessons, while concrete hands-on materials, geometric models, and ICT-based materials were rarely present. Teachers often used materials to demonstrate constructions on the chalkboard, with learners largely copying diagrams rather than handling materials themselves; when practical activities occurred, teachers often worked with shared materials because quantities were insufficient. Across the four instructional events tracked, most lessons were rated as only moderately implemented, and assessment and feedback practices using materials were the weakest and most irregularly observed. These classroom-level findings extend prior interview-based accounts by showing a gap between teachers' stated intentions and what actually occurred during instruction, and they point to insufficient material quantities, limited ICT infrastructure, and time pressure as the principal constraints on effective classroom use.

Keywords: Classroom observation; Competency-Based Training; Instructional materials; Geometry teaching; Technical Secondary Schools; Narrative analysis

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* **Corresponding author:** Joel Sindikubwabo: sinjoel8@gmail.com

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Introduction

Geometry occupies a central place in mathematics education because it develops learners' capacity to interpret shapes, spaces, and their measurement and connection to the physical world (Vimbelo & Bayaga, 2024). It links abstract mathematical reasoning to practical, real-world problem solving in fields such as construction, engineering, and design (Cumino & Zich, 2021), which makes it especially important in Technical Secondary Schools (TSS), where learners are being prepared for technical and vocational careers (Jablonski & Ludwig, 2023). Instructional materials, ranging from traditional tools such as rulers and compasses to digital resources such as dynamic geometry software, are widely regarded as essential for translating abstract geometric ideas into forms that learners can see, touch, and use (Rahiem, 2020).

Technical and vocational education in Rwanda is coordinated by the Rwanda TVET Board (RTB), and TSS follows a Competency-Based Training (CBT) approach. CBT is a structured training and assessment approach in which learners acquire the knowledge, skills, and attitudes needed to perform tasks to a specified standard, and in which theoretical and practical sessions are shaped around agreed competencies (International Labour Organization [ILO], 2020). In such a system, instructional materials are not optional extras. They are the means through which learners practise, apply, and demonstrate competence, for example by measuring, constructing, and checking geometric figures themselves. Rwanda's move toward competence-oriented training therefore places instructional materials at the centre of learner-centred pedagogy and requires teachers to shift from purely verbal explanation toward practical, materials-based instruction (ILO, 2020; Nteziyaremye et al., 2024). However, evidence from Rwandan classrooms suggests that this shift has been partial: teachers continue to rely heavily on textbooks and chalkboards, with limited use of hands-on materials, models, or ICT tools in primary mathematics classrooms (Umuhoza & Uworwabayeho, 2021), while broader regional evidence from Nigeria and Tanzania suggests that learners perform better in mathematics when teachers use materials and locally available resources (Mazana et al., 2020).

The problem that motivated this study is that the role intended for materials in CBT may not match what happens in geometry lessons in TSS. Geometry requires learners to construct, measure, and visualise. If materials are present but used only for teacher demonstration, or are too few for learners to use, learners may not receive the practice that CBT is designed to provide. Little is known about this because much of the existing evidence on how teachers use instructional materials is drawn primarily from teachers' self-reports (Mjenda & Kyaruzi, 2025; Saralar & Bîrgîlî, 2022), which risk overstating actual classroom practice because teachers may describe intended rather than enacted use. Direct classroom observation offers a complementary and more objective window into what materials are actually present in geometry lessons, how they are used at each stage of instruction, and how consistently this occurs (Mokotjo & Mokhele, 2021).

Observation-based studies of teaching do exist in Rwanda, but they address other school levels or subjects. Umuhoza and Uworwabayeho (2021) combined interviews with classroom observation in

primary mathematics classrooms, and Ndiokubwayo et al. (2021) documented classroom-observation data on competence-based physics teaching in secondary schools. Among the studies reviewed for this paper, none reported structured observation of how instructional materials are used at successive stages of geometry lessons in TSS, and none concerned Muhanga District. This paper addresses that gap by reporting findings drawn specifically from structured classroom observation of geometry lessons, examined against the wider literature on instructional-material use in mathematics teaching. The study is intended to show where in a geometry lesson materials help learners practise and where they do not, and so to indicate where RTB, school leaders, and teacher trainers should direct resources and professional development.

Research Objective

This paper is guided by the following research objective: to examine, through structured classroom observation, how mathematics teachers use instructional materials in teaching geometry concepts in selected Technical Secondary Schools in Muhanga District.

Literature Review

Competency-Based Training and Instructional Materials in TSS

According to the ILO (2020), CBT focuses on the tasks an individual performs, the conditions under which they are performed, and the standard to which they must be performed. Training is divided into small units, each dedicated to mastery of a specific competency, and learners move on once they can demonstrate that mastery. The same manual states that theoretical and practical sessions should follow learner-centred principles, and it describes practical sessions in which trainees learn by doing, supported by materials such as job sheets and practical exercise booklets (ILO, 2020). For geometry in TSS, learning by doing implies that learners should themselves measure, draw, construct, and check figures with instruments and models, and that teachers should assess these performances. This provides the standard against which the observed use of materials is read in this study. Studies of competence-oriented reform in Rwandan technical schools similarly point to gaps between policy intent and classroom practice (Nteziyaremye et al., 2024).

Instructional Materials and Classroom Practice in Geometry

Instructional materials are widely credited with turning abstract geometric ideas into concrete, observable classroom actions, because geometry's spatial nature is difficult to convey through verbal explanation alone (Siregar, 2025). Empirical classroom-based studies indicate that the mere presence of materials in a school is not sufficient; what matters for learning is how materials are actually deployed during instruction, including whether they are used to demonstrate concepts, whether learners handle them directly, and whether they are reused during feedback and assessment (Jones & Tzekaki, 2016). Hands-on tools such as rulers, compasses, protractors, and physical models allow learners to construct shapes and directly observe geometric relationships, and observational studies have found that this hands-on engagement is associated with deeper comprehension than passive observation of teacher demonstrations (Byrne et al., 2023).

Teacher Practice: Demonstration versus Learner Engagement

Classroom-based evidence consistently distinguishes between two broad patterns of material use: teacher-centred demonstration, in which materials are used mainly to illustrate concepts on the board while learners copy, and learner-centred engagement, in which learners themselves use materials to construct, test, and verify geometric ideas (Mir, 2025). Observational research shows that many teachers default to the demonstration pattern even when they express a preference for active learning, largely because inquiry-based and cooperative approaches require more preparation time and confidence (Anchunda & Kaewurai, 2025). Where learners are allowed to use materials themselves, studies report improved participation and a stronger sense of ownership over the concepts being taught (Ukobizaba et al., 2019), while lecture-based delivery driven by time pressure and syllabus-coverage demands has been observed to persist even in the presence of adequate materials (Ssemugenyi, 2023).

Materials in Assessment, Feedback, and ICT Integration

Beyond demonstration and practice, instructional materials also play a role in formative assessment, allowing teachers to observe learners' practical work and provide immediate, targeted feedback (Chisunum & Nwadiokwu, 2024). Classroom observation studies in ICT-supported geometry instruction, such as those using GeoGebra and other dynamic geometry software, report that digital tools can make feedback more immediate and exploratory, but their observed use remains limited where infrastructure and teacher training are inadequate (Awaji, 2025; Siregar & Scholar, 2025). Broader research on resource constraints confirms that shortages of instructional materials (Akugizibwe & Ahn, 2020), limited hands-on time for solid geometry activities (Tessema et al., 2024), and insufficient technical training for digital tools (Tyminski, 2017) are recurring, observable barriers to consistent classroom implementation, compounded by heavy teaching workloads that reduce preparation time (Ayeni & Ph, 2018).

Theoretical Framework of the Observation

The observation instrument used in this study draws on constructivist learning theory, which holds that learners construct understanding through active interaction with materials and their environment (Isik, 2018), and on Vygotsky's notion of the Zone of Proximal Development (ZPD; Vygotsky, 1978), in which materials mediate guided interaction between teacher and learner. It is further structured around Gagné's Nine Events of Instruction, which specify a sequence of instructional functions, including gaining attention, presenting content, providing guidance, eliciting practice, and giving feedback, through which materials can support effective teaching (Mulyani et al., 2024; Daniel et al., 2025). This combined framework allows classroom observation to capture not only whether materials are present, but at which stages of the lesson they are used and how effectively (Nkundabakura & Nsengimana, 2023).

The three perspectives were not used side by side. Each answered a different question about the same lesson. Gagné's events answered when in the lesson materials should be used, and so supplied the order of the checklist. Constructivism answered who acts on the materials, and so supplied the criterion that strong use means learners themselves handle, construct, or test ideas with materials rather than only watching the teacher. The ZPD answered how that action is supported, and so supplied the criterion that strong use means guidance, prompts, and peer sharing around materials

that help learners do more than they could do alone. A rating for any event therefore combined the three: for example, a well-done rating for guiding learners during practical activities required that the event occurred at the right stage (Gagné), that learners were acting on materials (constructivism), and that the teacher's support was matched to their needs (ZPD). Table 1 shows which elements of the checklist drew on each perspective.

Table 1. Contribution of each theoretical perspective to the observation checklist

Perspective	What it contributed to the checklist	Events in which it was most visible
Gagné's Nine Events of Instruction (when)	The order of lesson stages in which the presence, type, and quality of material use were recorded	All four events reported: introducing concepts; demonstrating; guiding practical activities; supporting assessment and feedback.
Constructivism (who acts)	The criterion that strong use means learners themselves handle, construct, or test ideas with materials	Demonstrating use of materials; guiding learners during practical activities
Zone of Proximal Development (how supported)	The criterion that strong use means guidance, prompts, and peer sharing around materials that move learners beyond what they can do alone	Guiding learners during practical activities; supporting assessment and feedback
Integration	A single rating per event that combines stage (Gagné), learner action (constructivism), and support (ZPD)	All four events

Summary of the Literature and Research Gap

The literature suggests three points. First, under CBT, the value of materials lies in learners using them to practise and demonstrate competence. Second, teachers tend to use materials for demonstration, and this tendency is reinforced by shortages, limited ICT, and time pressure. Third, much of this evidence rests on self-reports or on other school levels and subjects. What remains unclear is how these patterns appear when geometry lessons in TSS are observed directly, stage by stage, and this is the gap addressed here.

Methodology

Research Paradigm and Approach

The study was located within the interpretivist paradigm, which holds that reality is socially constructed through the meanings people attach to their experiences and is therefore appropriate for investigating teachers' classroom practices in their natural setting (Khatri, 2020; Pervin & Mokhtar, 2022). A qualitative approach was adopted because the aim was to generate rich, descriptive evidence of classroom practice rather than statistical generalisation. This position fits a structured observation checklist for two reasons. First, the checklist was not used to count behaviours in isolation. Each item asked for a judgement of the quality of material use in context (Not Observed, Poorly Done,

Moderately Done, Well Done), and such judgements depend on how teachers and learners use and give meaning to materials within the lesson. Second, every rating was paired with observation notes describing the episode behind it. The checklist therefore structured what to look for, while the interpretivist stance governed how what was seen was understood and reported.

Research Design

A qualitative case-study design was used, focusing on the bounded case of mathematics teachers' use of instructional materials in geometry lessons in selected TSS in Muhanga District. The broader study used classroom observation. This paper uses and analyses classroom-observation data only, namely checklist ratings and observation notes. Classroom observation provided a direct, first-hand record of instructional-material use as it occurred during actual lessons.

Population, Sample, and Setting

The population comprised mathematics teachers in twenty-four TSS in Muhanga District. Using purposive sampling, five schools were selected to reflect urban (Padri Vjeko Centre TSS and Muhanga Technical Center TSS), semi-urban (Iter Rutobwe TSS), and rural (Nyabikenke TSS and Kiyumba TSS) contexts, so that variation in resource availability across settings could be captured. Ten mathematics teachers, two per school, teaching geometry at Levels 3 and 4 under the Competency-Based Training (CBT) curriculum were purposively selected. Levels 3 and 4 were chosen because Level 5 teachers were excluded because of their examination-preparation workload during the data-collection period.

Gagné's Nine Events of Instruction

Gagné's (1985) Nine Events of Instruction describe a sequence of conditions that support learning within a lesson: (1) gaining attention; (2) informing learners of the objective; (3) stimulating recall of prior learning; (4) presenting the content; (5) providing learning guidance; (6) eliciting performance, or practice; (7) providing feedback; (8) assessing performance; and (9) enhancing retention and transfer. The events are not a rigid script. They offer a lesson-long sequence against which the use of any resource can be located. In this study, the sequence was used to ask, for each stage of a geometry lesson, whether and how instructional materials were used (Mulyani et al., 2024; Daniel et al., 2025).

Observation Instrument: Development, Validation, and Use

A structured classroom observation checklist was developed around Gagné's Nine Events of Instruction, capturing the presence, type, and quality of instructional-material use at each stage of a geometry lesson: gaining attention, presenting content, providing guidance, eliciting practice, providing feedback, and enhancing retention. Each item was rated on a four-point scale (Not Observed, Poorly Done, Moderately Done, Well Done).

Development. The checklist was built in three steps. First, Gagné's events were used to fix the lesson stages. Second, items under each stage were written to reflect constructivist expectations (whether learners themselves handled, constructed, or tested with materials) and ZPD-based expectations (whether teacher guidance, prompts, and peer sharing helped learners move beyond what they could do alone). Third, items were grouped into the four instructional events.

Each of the ten teachers was observed teaching two geometry lessons of approximately forty minutes each, yielding twenty classroom observations in total. In each lesson, the observer completed the

checklist and wrote observation notes on which materials were present, who used them, at which stage, and how. The observer's position in the classroom, whether lessons were audio or video recorded, and when ratings were assigned. The instrument was piloted in two TSS that were not part of the main sample, after which minor refinements were made to improve clarity and coverage.

Data Collection Procedure

Classroom observation took place from April to June 2026, a total of 9 weeks. Each teacher was observed twice, for about forty minutes per lesson, giving about 80 minutes of observation per teacher and about 800 minutes (roughly 13 hours) across the ten teachers. Authorisation was secured before any observation, and each observation was arranged with the teacher in advance.

Data Analysis

The observation data were analysed using narrative analysis. Narrative analysis treats accounts of events as stories with a sequence, a setting, actors, and a plot, and it aims to understand how events connect over time rather than to break them into separate categories (Clandinin & Connelly, 2000; Polkinghorne, 1995; Riessman, 2008). It suits lesson observation because a lesson is a time-ordered episode in which what happens at one stage shapes what can happen at the next. The analysis followed five steps.

First, the observation notes and completed checklist for each lesson were read repeatedly for familiarisation. Second, each lesson was divided into episodes according to the Gagné-based stage in which materials appeared, or should have appeared. Third, each lesson was re-told as a short chronological account: the setting and materials at the start, what the teacher and learners did with them, and how the lesson ended. Fourth, the twenty accounts were compared to identify recurring plots, that is, similar sequences of action across lessons and schools, and these were written up as storylines. Fifth, the checklist ratings were used to show how widespread each storyline was, so that the narrative and the ratings each checked the other. The storylines are not themes: they keep the order of events, which is the information that a list of themes would remove.

Trustworthiness and Ethical Considerations

Trustworthiness. The credibility of the narrative accounts was supported by keeping each account tied to the observation notes and checklist for the same lesson, by pairing narrative with ratings, by the inter-rater check above, and by describing the schools and their contexts so that readers can judge transferability (Lincoln & Guba, 1985).

Ethical clearance was obtained from the University of Rwanda, College of Education, and authorisation was subsequently secured from Muhanga District education authorities and the participating schools. Informed consent was obtained from all observed teachers; participation was voluntary, teachers had the right to withdraw from the study at any time without any consequences, and confidentiality and anonymity were maintained throughout data collection and reporting (Abay et al., 2016).

Results

This section presents the findings as narrative accounts built from the twenty observed lessons. It begins with a composite account of a typical lesson, then follows the four instructional events in the order in which they occur in a lesson, and ends with the constraints that shaped the accounts.

A Composite Narrative of a Typical Lesson

The following account is a composite built from the twenty lesson narratives. It describes the most common sequence of events and does not describe any single lesson.

The teacher introduced the geometric concept through examples from the mathematics textbook and figures drawn on the board. Rulers, compasses, protractors, and setsquares were present, but it was usually the teacher who used them: the construction was drawn on the chalkboard step by step while the concept was explained. Learners watched and copied the diagram into their notebooks. In the lessons where learners were given instruments to try the construction themselves, there were too few to go round. Learners shared the instruments, and some waited for a turn, while in some classrooms textbooks were shared in the same way. The teacher's guidance during this practical work was step-by-step in some lessons and thinner in most. As the lesson drew to its end, time ran out. Several lessons closed before learners had finished the hands-on activity or received feedback on their work. Table 2 shows how widely each storyline below was observed. Each row corresponds to one section that follows.

Table 2. Observation ratings across four instructional events (20 lessons)

Instructional Event Observed			Well Done	Moderately Done	Poorly Done	Not Observed
Introducing geometry concepts using materials			4 (20%)	12 (60%)	3 (15%)	1 (5%)
Demonstrating use of geometry materials			5 (25%)	12 (60%)	2 (10%)	1 (5%)
Guiding learners during practical activities			4 (20%)	12 (60%)	3 (15%)	1 (5%)
Supporting assessment and feedback			4 (20%)	11 (55%)	3 (15%)	2 (10%)

Source: Classroom observation data, 2026.

Storyline 1: Opening the Lesson with Traditional Tools and Textbooks

This storyline concerns introducing geometry concepts using materials. Across the observed lessons, traditional geometry tools- rulers, compasses, protractors, and setsquares- were the materials most consistently present, and teachers were regularly seen using them to demonstrate constructions on the chalkboard. In several classrooms, however, learners were observed sharing these instruments because there were not enough for individual use, and in most lessons no three-dimensional models or hands-on materials were present. Mathematics textbooks were also visible in most lessons and were used to introduce examples and set exercises, although in a number of classrooms learners shared copies because of insufficient supply. Visual materials such as charts and geometric shapes drawn on the board appeared in some lessons, but computers, projectors, and other ICT tools were observed in only a small minority of lessons. Materials were used to introduce concepts at a well-done

or moderately done level in 16 of the 20 lessons (4 and 12 respectively). The introduction was poorly done in three lessons and not observed in one.

Storyline 2: The Teacher Draws and Learners Copy

This storyline concerns demonstrating the use of geometry materials. Materials were most consistently used to introduce and demonstrate geometry concepts: in most lessons, teachers drew constructions using rulers, compasses, or setsquares while explaining the underlying concept. Demonstration was well done in 5 lessons (25%) and moderately done in 12 (60%); it was poorly done in 2 and not observed in 1. However, the dominant observed pattern of use was teacher-led demonstration on the chalkboard rather than learner use of materials. In a majority of lessons, learners were seen mainly copying diagrams rather than constructing shapes themselves.

Storyline 3: Sharing and Waiting During Practical Work

This storyline concerns guiding learners during practical activities. Where learners were given instruments to use directly, guidance was provided step-by-step in about one-fifth of lessons at a well-done level (4 lessons), but in most others (12 lessons) learner engagement with materials was only moderately supported. Guidance was poorly done in 3 lessons and not observed in 1. Because instruments were few, learners shared rulers, compasses, and protractors, and in several classrooms they waited for a turn instead of working at the same time.

Storyline 4: The Lesson Ends Before the Feedback

This storyline concerns supporting assessment and feedback with materials. Materials-based assessment and feedback was the weakest of the four events: it was well done in only 20% of lessons (4), moderately done in 55% (11), poorly done in 15% (3), and not observed at all in 10% (2). Several observed lessons ended before learners had enough time to complete the hands-on activity or to receive feedback on their work, so the storyline closed without the stage in which materials would have been used to check learning.

Constraints Visible in the Narratives

Three constraints on the use of materials were directly visible during the observations. First, insufficient quantities of instructional materials were evident in most lessons, with learners sharing rulers, compasses, and protractors and, in several classrooms, waiting for a turn rather than working at the same time. Second, ICT and visual materials were rarely present, so teachers relied almost entirely on chalkboard demonstration with traditional instruments. Third, several observed lessons ended before learners had sufficient time to complete hands-on activities or receive feedback on their work.

Discussion of the Findings

Materials Present in the Lessons

This pattern is consistent with earlier Rwandan evidence that traditional geometric instruments and textbooks dominate classroom practice while digital tools remain marginal (Umuhoza &

Uworwabayeho, 2021), and it echoes the broader observation that hands-on tools such as rulers, compasses, and protractors are among the most consistently used tools for practical geometry tasks (Byrne et al., 2023). The limited observed presence of ICT materials corroborates findings that infrastructure gaps constrain the use of dynamic geometry software and other digital resources even where teachers recognise their value (Awaji, 2025; Siregar & Scholar, 2025). Under CBT, this matters because competence is shown by learners performing tasks, not by watching them (ILO, 2020).

Demonstration versus Learner Engagement

This gap between the frequent presence of demonstration and the less frequent observation of learner-centred use aligns with prior classroom-based findings that teachers often rely on instructional materials primarily to demonstrate rather than to enable inquiry-based or cooperative learner engagement (Anchunda & Kaewurai, 2025). It also fits the constructivist view that learners understand more when they handle materials themselves (Isik, 2018; Ukobizaba et al., 2019). Gagné's framing points the same way: materials should support every stage of a lesson, not only the presentation stage (Mulyani et al., 2024; Nkundabakura & Nsengimana, 2023). Read through the three perspectives, the storylines show materials well supplied at the presentation stage and thinly supplied at later stages. In ZPD terms, materials seldom became a shared tool between teacher and learner, because the teacher alone used them in most lessons, and step-by-step guidance during learner practice was well done in only about a fifth of lessons.

Assessment and Feedback

The comparatively weaker observed performance in assessment and feedback echoes findings that formative use of materials, though valuable for identifying misconceptions, is often the first practice to be curtailed under time pressure (Chisunum & Nwadiokwu, 2024; Ssemugenyi, 2023).

Constraints on Classroom Use

These directly observed constraints corroborate the broader literature. Material shortages are a persistent barrier to hands-on geometry instruction (Akugizibwe & Ahn, 2020; Tessema et al., 2024). Limited ICT infrastructure and technical training inhibit digital-tool integration (Tyminski, 2017; Rahiem, 2020). Heavy teaching workloads reduce the time available for preparation and practice (Ayeni & Ph, 2018). Because these patterns were observed directly rather than only reported by teachers, they provide independent, classroom-level confirmation that the gap between the intentions of Rwanda's Competency-Based Training (CBT) approach in TSS and enacted classroom practice (Nteziyaremye et al., 2024) is visible not only in what teachers say but in what actually happens in geometry lessons.

Conclusion and Recommendations

Concluding remark

Direct classroom observation of twenty geometry lessons shows that mathematics teachers in the selected Technical Secondary Schools in Muhanga District rely predominantly on traditional geometry tools and textbooks, use them mainly for teacher-led demonstration rather than sustained learner use, and apply them most inconsistently at the assessment and feedback stage of instruction. Materials-

based teaching was moderately, rather than strongly, implemented across the observed lessons, and insufficient material quantities, limited ICT resources, and time constraints were directly visible obstacles to more consistent, learner-centred use. Narrative analysis showed a recurring storyline: lessons opened with traditional tools and textbooks, moved to teacher demonstration while learners copied, shared scarce instruments during practice, and closed before feedback. These observation-based findings confirm and extend earlier interview-based evidence by showing that the gap between the availability of instructional materials and their effective classroom use is evident in real-time teaching, not only in teachers' self-reports. The study adds classroom-level evidence from TSS geometry lessons, a setting that received little observational attention in the studies reviewed, and shows that following a lesson from start to end can reveal where the use of materials thins out.

Limitations and Further Research

The findings come from twenty lessons in five purposively selected schools and are not statistically generalisable. Two lessons per teacher give a limited view of practice, and the presence of an observer may have influenced what teachers did. Narrative accounts are interpretive reconstructions; the checklist ratings and the inter-rater check were used to limit subjectivity. Further research could combine observation with learner outcomes and with the interview data of the broader study, and could extend the work to Level 5 and to other districts.

Recommendations

Based on these findings, school leaders and district education authorities should prioritise increasing the quantity of basic geometry instruments so that individual learners, rather than shared groups, can engage directly with materials during practical activities. Continuous professional development should specifically target the learner-centred and formative-assessment uses of instructional materials. Investment in ICT infrastructure, paired with technical training, is needed to close the visible gap between the potential of digital tools and their classroom use. Finally, RTB and schools should provide dedicated time for materials-based practical activities, so that hands-on geometry instruction is not curtailed before learners can complete construction tasks and receive feedback.

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