Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

# Teacher and Student Perceptions of Active Learning Implementation and Its Challenges in ICT Supported Ethiopian Secondary and Preparatory Schools

**Assefa Kibret Melaku**

assefakibret59@gmail.com

Oda Bultum University

**Mengesha Shumet Dessalegn**

Woldia University

**Research Article**

**Keywords:**

**Posted Date:** November 19th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-11414753/v1

**License:** This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

**Additional Declarations:** No competing interests reported.

# Teacher and Student Perceptions of Active Learning Implementation and Its Challenges in ICT Supported Ethiopian Secondary and Preparatory Schools

## Authors

**Assefa Kibret Melaku**[1] (Corresponding author)

[1] Department of Educational Planning and Management, Oda Bultum University, Chiro, Ethiopia. Email: assefakibret59@gmail.com ORCID ID: https://orcid.org/0009-0009-1327-6894

**Mengesha Shumet Dessalegn**[2] (PhD)

[2] Department of Psychology, Woldia University, Woldia, Ethiopia. Email: menshu44@gmail.com ORCID ID: https://orcid.org/0000-0002-1279-5870

## Abstract

Active learning supported by digital technology is promoted in Ethiopian education policy, yet evidence on how it is implemented and experienced in secondary and preparatory schools remains limited, particularly regarding teacher–student differences in perception and school-level constraints. This convergent mixed-methods study examined reported implementation, perceptions and challenges in five ICT-supported schools in Oromia, Ethiopia. Teachers (n = 78) and students (n = 212) completed a researcher-developed questionnaire; five principals, five supervisors and five ICT technical staff took part in semi-structured interviews. Quantitative analysis used descriptive statistics, Welch's t-tests with effect sizes, Holm-adjusted p-values and school fixed-effects sensitivity checks; interviews were analysed with reflexive thematic analysis. Reported implementation was moderate (teachers: M = 3.42, SD = 0.68; students: M = 3.28, SD = 0.74), with no significant teacher–student difference (p = .131). Teachers reported more favourable overall perceptions than students (M = 3.65 vs. 3.41; unadjusted p = .006), but this difference was not robust to school-level clustering (p = .21) and is reported as exploratory. The most endorsed challenges were heavy workload and large classes, limited ICT infrastructure and insufficient training. Five interview themes were identified, and the informant groups contributing to each are stated explicitly. The findings suggest that ICT provision, teacher capacity, supervision and language support need coordinated attention. Academic resilience and learning analytics were not measured, and no causal claims are made.

**Keywords:** active learning; ICT-supported learning; teacher perceptions; student perceptions; implementation challenges; mixed methods

# 1. Introduction

## 1.1 Background

Preparatory schools in Ethiopia constitute the final stage of general secondary education before the national examinations that shape access to higher education. Examination results are closely tied to students' educational and occupational trajectories and place substantial pressure on students, teachers and schools. Understanding classroom conditions under this pressure is therefore a practical priority.

Ethiopian schools have also expanded their use of digital technology. Government policy, donor programmes and institutional initiatives have promoted the integration of information and communication technologies (ICT) to improve the quality and relevance of education **[1]**. Whether these initiatives have altered classroom practice remains unclear, particularly in upper-secondary and preparatory schools, where examination pressure is most acute.

## 1.2 Active learning and ICT-supported learning environments

Active learning engages students in discussion, problem solving, collaboration and reflection rather than passive reception **[2, 3]**. In the international literature, "smart learning environments" denote technology-rich settings that offer adaptive, context-aware and personalised support **[4–6]**. Most of this evidence derives from well-resourced contexts. Recent Ethiopian studies report that teachers generally view active learning favourably but implement it only partially, with crowded classrooms, limited time, weak student engagement, language difficulties and scarce resources constraining practice **[7–9]**. Research on ICT use in Ethiopian secondary schools similarly finds that positive teacher beliefs often fail to translate into practice because of weak training, low confidence and unreliable systems **[10]**.

*Terminology.* In Ethiopian policy and school discourse, "smart learning environment" refers to classrooms equipped with computers, connectivity and digital resources. This is narrower than the adaptive, context-aware systems described by Hwang **[4]** and Zhu et al. **[6]**. The present study examines this ICT-supported form of the concept as it exists in the sampled schools and does not assess adaptive or context-aware functions. The term "ICT-supported learning environments" is therefore used to describe what was studied.

## 1.3 Research gap and contribution

Existing Ethiopian research documents implementation barriers in active learning and in ICT integration separately **[7–10]**. What remains underdeveloped is an integrated account that (a) compares teacher and student perceptions of ICT-supported active learning, (b) situates those perceptions alongside the institutional perspectives of principals, supervisors and ICT staff, and (c) does so with explicit attention to the limitations of clustered sampling and researcher-developed measures. The contribution of this study lies in this combined descriptive examination, not in identifying barriers that are already documented. The Discussion distinguishes corroborated findings from complementary explanations and unresolved tensions.

Academic resilience **[11–14]** and learning analytics **[15–18]** are active research areas, but neither is measured here. They are noted only as future research directions to which descriptive evidence of this kind may contribute.

### 1.4 Purpose and research questions

The purpose of the study is to describe the reported implementation of active learning in ICT-supported learning environments in selected Ethiopian secondary and preparatory schools, to examine teacher and student perceptions, and to identify the challenges reported by classroom actors and school-level informants. Four research questions guided the study:

**RQ1.** To what extent is active learning reported as implemented in ICT-supported learning environments in the sampled schools, as reported by teachers and students?

**RQ2.** How do teachers and students perceive active learning and ICT-supported learning environments, and do their perceptions differ?

**RQ3.** What challenges do teachers, students, principals, supervisors and ICT technical staff identify?

**RQ4.** How do the perspectives of school leaders and technical staff complement or qualify the questionnaire findings?

## 2. Theoretical and conceptual framework

### 2.1 Social cognitive theory

The study draws on Bandura's social cognitive theory **[19]**, which holds that personal, behavioural and environmental factors influence one another reciprocally. Self-efficacy, the belief that one can organise and execute the actions needed to reach a goal **[20]**, is central: teachers who believe they can use active methods and technology are more likely to attempt them **[21]**, and students who plan, monitor and evaluate their learning are more likely to persist when work is difficult **[22]**. The theory also directs attention to environmental conditions, such as class size, equipment, supervision and institutional support, as factors that enable or limit what individuals do.

### 2.2 Technology acceptance and facilitating conditions

The technology acceptance model proposes that perceived usefulness and perceived ease of use are the primary determinants of technology adoption **[23]**. Facilitating conditions, defined as the degree to which an individual believes that organisational and technical infrastructure exists to support system use, originate in the Unified Theory of Acceptance and Use of Technology (UTAUT) **[24]** rather than in the TAM2 extension **[25]**, which does not conceptualise them as a core construct. They are attributed to UTAUT in this study.

The perception measures are organised accordingly. Perceived usefulness and perceived ease of use derive from the technology acceptance model; perceived competence reflects self-efficacy from social cognitive theory; and perceived support from the school and woreda corresponds to facilitating conditions as conceptualised in UTAUT. Part C of the questionnaire asked about

"active learning and ICT-supported learning environments" together, so the referent of the usefulness and ease-of-use items is the *combined pedagogical–technological arrangement* rather than technology alone. The perception scores are therefore treated as a descriptive measure of the perceived usefulness and ease of use of ICT-supported active learning, not as a pure measure of technology acceptance.

### 2.3 Active learning and barriers to technology integration

Two further frameworks inform the interpretation of RQ1 and RQ3. The ICAP framework distinguishes passive, active, constructive and interactive engagement **[26]** and provides a basis for interpreting the implementation practices. Ertmer's distinction between first-order barriers (external: equipment, time, training) and second-order barriers (internal: beliefs, confidence, pedagogy) **[27]** organises the challenge findings. Only one of the five implementation practices concerns ICT directly; the other four concern pedagogy, which is why a pedagogical framework is relevant alongside technology-acceptance constructs.

### 2.4 Organising framework

Figure 1 presents the organising framework. It is descriptive: it identifies the domains examined and the research question that addresses each, and it does not posit causal paths. The comparison of teacher and student responses is the only inferential analysis.

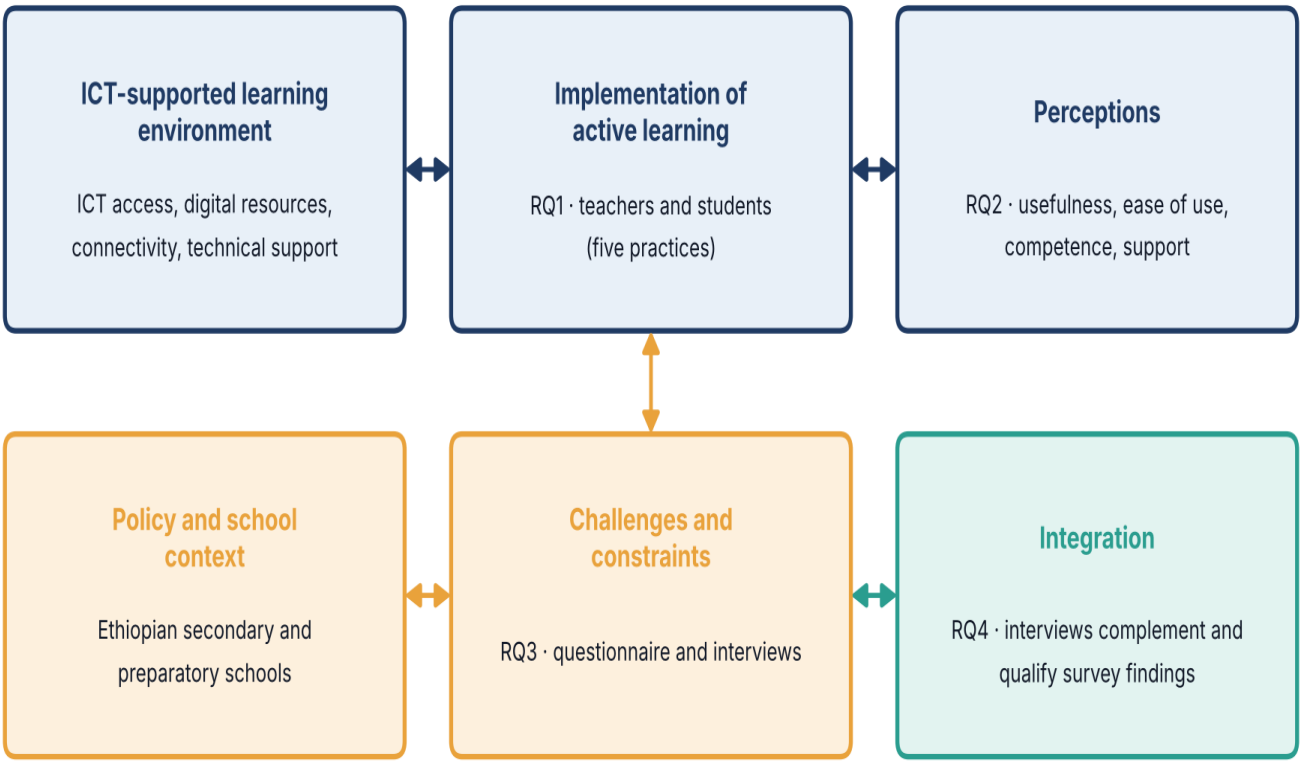



**Fig. 1** Organising framework of the study. Double-headed arrows indicate domains described in relation to each other; no directional or causal relationships were tested

# 3. Methods

## 3.1 Research approach and design

The study used a convergent parallel mixed-methods design **[28]**: quantitative and qualitative data were collected in the same period, analysed separately and integrated at the interpretation stage through a joint display. The quantitative strand was a descriptive, cross-sectional survey of teachers and students on implementation, perceptions and challenges. The qualitative strand used semi-structured interviews with principals, supervisors and ICT technical staff. The design was selected because the two strands address different participant groups whose perspectives cannot be obtained from a single instrument; convergence and divergence between strands were examined at the interpretation stage.

The study involved no experimental manipulation, and data were collected once. The findings therefore describe reported experiences and group differences, not causal effects. The paradigmatic stance was pragmatism, which orients the study toward answering each research question with the method best suited to it. Table 1 summarises the methodological components.

**Table 1.** Summary of the study design, sampling and analysis

| Component | Description |
|---|---|
| Design | Convergent parallel mixed methods (pragmatist orientation, no experimental manipulation): a descriptive cross-sectional survey of teachers and students and semi-structured interviews with school leaders and technical staff, integrated through a joint display |
| Sampling | Multi-stage: 20 woredas → 5 by lottery; one eligible school randomly selected per woreda; teachers (n = 78) and students (n = 212) by simple random sampling; principals, supervisors and ICT staff (n = 5 each) purposively (all post-holders) |
| Analysis | SPSS v26: descriptives, Cronbach's α, Welch's t-tests with Cohen's d, Holm correction and school fixed-effects check; reflexive thematic analysis of interviews (Braun and Clarke); joint display for integration |

## 3.2 Study setting and sampling

The study area contains 20 woredas in Oromia. Sampling followed three stages (Figure 2, Table 2). In Stage 1, five woredas (25%) were selected by lottery: Chiro City Administration, Tulo, Bedesa City Administration, Habro and Daro Lebu. *Eligible schools* were defined as secondary or preparatory schools with at least a functioning computer laboratory and internet connectivity, as confirmed by woreda education office records; the number of eligible schools per woreda ranged from one to three. In Stage 2, one eligible school was randomly selected per woreda: Charcher, Hirna, Bedesa, Gelemso and Mechara Secondary Schools. In Stage 3, teachers and students in Grades 9–12 were selected by simple random sampling (lottery) from school lists. Principals, supervisors and ICT technical staff were selected purposively, and every post-holder in the five schools took part.

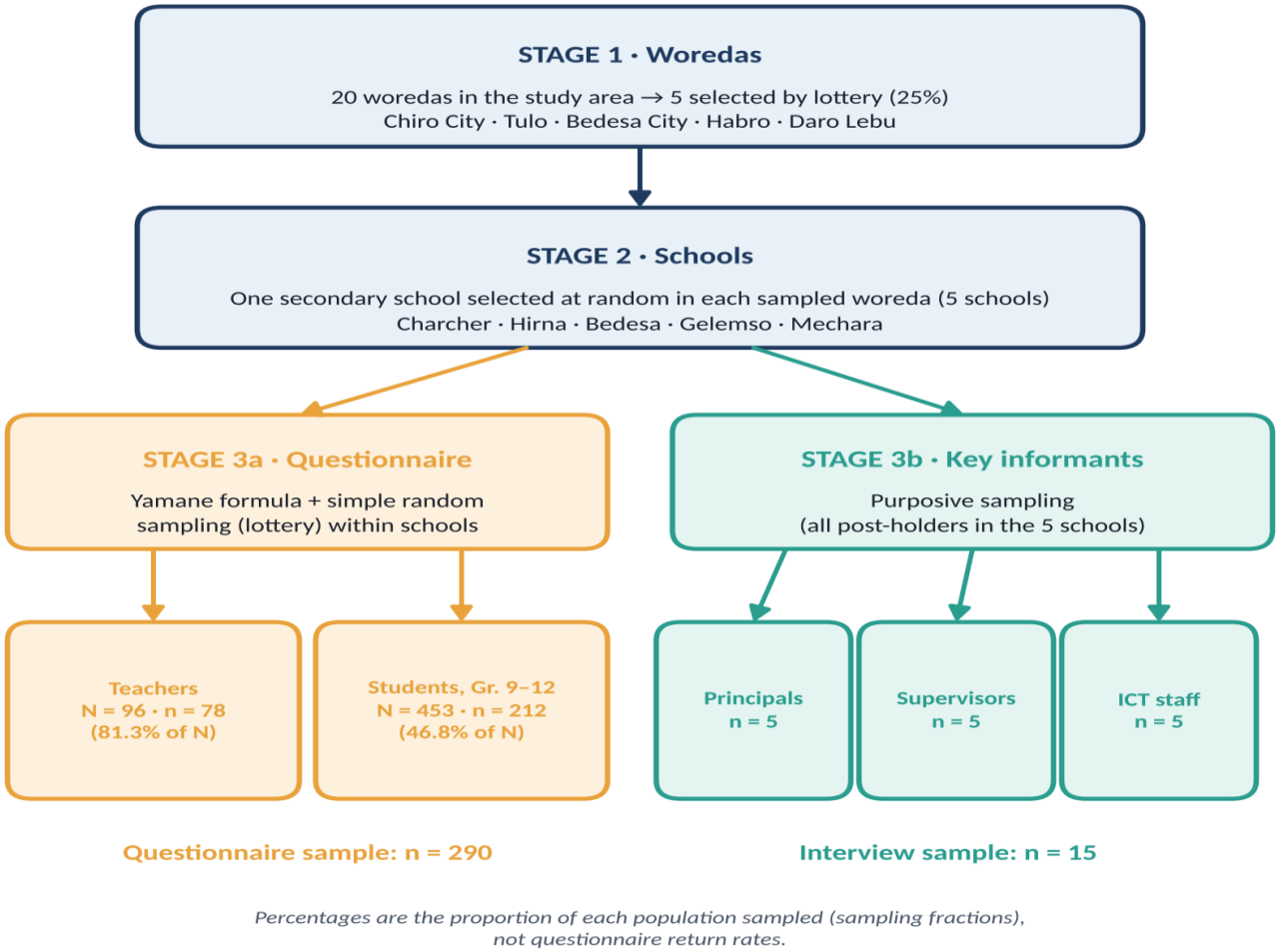



**Fig. 2** Multi-stage sampling procedure and sample allocation. Percentages are sampling fractions (the proportion of each population selected), not questionnaire return rates

*Study population.* The student population (N = 453) comprises students enrolled in Grades 9–12 in the five sampled schools who were present on the data-collection days and whose parents or guardians had not opted out. It does not refer to total school enrolment, which exceeded 400 at one school alone. The teacher population (N = 96) comprises teachers assigned to Grades 9–12 in the five schools.

*Sample size.* Sample sizes were calculated with Yamane's formula **[29]**, $n = N / (1 + Ne^2)$, at a 5% margin of error, giving n = 212 for students (453 / 2.1325) and n = 78 for teachers (96 / 1.24). The formula assumes simple random sampling and does not account for the clustered design, and it is not a power calculation for the teacher–student comparison. The calculated sizes are therefore treated as descriptive targets, not as precision guarantees. Table 2 reports allocation across schools and the distributed and usable questionnaires.

**Table 2.** Sampling allocation and questionnaire return

| School | Eligible students (Grades 9–12) | Student questionnaires distributed | Returned usable | Eligible teachers | Teacher questionnaires distributed | Returned usable |
|---|---|---|---|---|---|---|
| Charcher | 98 | 46 | 44 | 21 | 17 | 17 |
| Hirna | 91 | 43 | 40 | 19 | 16 | 15 |
| Bedesa | 87 | 41 | 39 | 20 | 16 | 16 |
| Gelemso | 94 | 44 | 42 | 18 | 15 | 14 |
| Mechara | 83 | 38 | 37 | 18 | 14 | 14 |
| Total | 453 | 212 | 202 | 96 | 78 | 76 |

*Note.* Usable teacher questionnaires: n = 76 after listwise deletion of two cases with more than 20% missing data. Usable student questionnaires: n = 202. Missing data were examined for patterns; Little's MCAR test was non-significant (p = .21) **[30]**, and listwise deletion was used for the small proportion (< 4%) of incomplete cases.

*Language.* The questionnaire was administered in English to teachers and in Amharic to students. Interviews were conducted in Amharic, the working language of the schools and the researchers, although the setting is Afan Oromo-speaking: school records and instruction in the sampled schools are predominantly in Amharic or English, and pilot respondents indicated greater comfort with Amharic for the interview topics. This choice may have excluded nuances available in Afan Oromo and is reported as a limitation (Section 5.6).

### 3.3 Questionnaire development and measurement quality

The questionnaire was developed for this study and had four parts: background information (Part A); implementation of active learning (Part B, 12 items); perceptions of active learning and ICT-supported learning environments (Part C, 15 items); and challenges (Part D, 10 items). Responses to Parts B to D were recorded on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Items were mapped to constructs as follows. The 12 implementation items were organised into five practices informed by the ICAP framework: group work and collaborative tasks; problem-based and inquiry tasks; use of digital learning resources; feedback and formative assessment; and learner self-reflection and planning. The 15 perception items were organised into four dimensions based on technology acceptance, social cognitive and UTAUT constructs: perceived usefulness, ease of use, competence and support. The 10 challenge items were organised into six categories reflecting first- and second-order barriers **[27]**. Composite scores were computed as dimension means (range 1–5), not as sums of heterogeneous items.

Three educational researchers reviewed each item for relevance and clarity, and items with a content validity index below .78 were revised. Pilot testing with 30 teachers and 40 students outside the sampled schools led to minor wording changes. Three negatively worded items in the challenges section were reverse-coded before analysis. Reliability is reported at dimension level and separately for teachers and students in Table 3, using Cronbach's alpha **[31]** with values of .70 or above regarded as acceptable **[32]**. Alpha is not interpreted as evidence of construct validity, and factor-analytic evidence for the structure of the instrument was not examined.

**Table 3.** Dimension-level reliability by group (Cronbach's α)

| Dimension | Items (n) | Teacher α | Student α |
|---|---|---|---|
| Implementation practices | 12 | .79 | .76 |
| Perceived usefulness | 4 | .82 | .78 |
| Perceived ease of use | 3 | .74 | .71 |
| Perceived competence | 4 | .77 | .73 |
| Perceived support | 4 | .81 | .79 |
| Challenges | 10 | .72 | .69 |

*Measurement equivalence.*

The teacher and student versions were administered in different languages (English and Amharic) and contained some group-specific wording. Measurement equivalence is not claimed. The teacher–student comparison is therefore reported as an exploratory comparison of group response patterns, not as a test of equivalent constructs. Item wording for both versions is provided in Supplementary File 1.

### 3.4 Data collection procedure

Permission to collect data was obtained from the woreda education offices and school directors. Questionnaires were administered to teachers and students in the participating schools between February and April 2023, and teachers were not present during student administration. Semi-structured interviews lasting 30–50 minutes were conducted with principals, supervisors and ICT technical staff in school offices, audio-recorded with consent, transcribed and translated into English for analysis. Interview participants are identified by role and number (PR = principal, SV = supervisor, ICT = ICT technical staff).

### 3.5 Data analysis

#### *3.5.1 Quantitative analysis*

Quantitative data were analysed in SPSS version 26. Frequencies, percentages, means and standard deviations were computed for each item, dimension and group. The "% agree" figures are the percentage of respondents selecting 4 or 5. Mean scores were interpreted as low (< 2.50), moderate (2.50–3.49) or high (≥ 3.50). The 3.50 threshold for "high" is a conventional midpoint between neutral (3) and agree (4); it is arbitrary, and continuous means are reported alongside the categorical labels.

Teacher and student means were compared with Welch's t-test **[33]**, which does not assume equal variances, and effect sizes are Cohen's d **[34]** with 95% confidence intervals for the mean difference. Overall implementation and overall perception were treated as two planned comparisons. Holm's sequential correction **[35]** was applied within two families of dimension-level comparisons, defined by research question and construct: the five implementation practices (RQ1) and the four perception dimensions (RQ2). Each family addresses a separate question with a separate set of items, so a conclusion about perceptions should not depend on how many implementation practices happen to be tested alongside them. Because the choice of family determines which results survive correction, a more conservative pooled family of all nine dimension-level tests is also reported as a sensitivity analysis, together with the unadjusted p-

values, so that readers can judge the effect of each choice (Table 8). Differences in the percentage endorsing each challenge were examined with chi-square tests and are exploratory. The analysis plan is summarised in Table 4. "Overall % agree" in Table 6 is the average of five practice-level percentages; it is an aggregated descriptive indicator and not the proportion of respondents agreeing with the overall construct.

*School clustering.* With only five schools, multilevel models are unreliable. As a sensitivity check, school fixed-effects models (school dummies as covariates) were estimated for the teacher–student perception comparison. The fixed-effects coefficient for the difference in overall perception was not statistically significant ($\beta = 0.18$, SE = 0.14, $p = .21$), indicating that the unadjusted result ($p = .006$) is not robust to school-level clustering. The teacher–student perception difference is therefore reported as exploratory and is not treated as conclusive.

**Table 4.** Analysis plan linking research questions to data sources and methods

| Research question | Data source | Analytic method | Output |
|---|---|---|---|
| RQ1: Implementation | Questionnaire Part B (teachers, students) | Frequencies, %, means, SD; Welch's t-test | Tables 6 and 8 |
| RQ2: Perceptions | Questionnaire Part C (teachers, students) | Frequencies, %, means, SD; Welch's t-test with Holm correction; school fixed-effects check | Tables 7 and 8 |
| RQ3: Challenges | Questionnaire Part D; interviews | Ranked %; chi-square; reflexive thematic analysis | Tables 9 and 10 |
| RQ4: Integration | Interview transcripts; all strands | Thematic analysis; joint display | Tables 10 and 11 |

### *3.5.2 Qualitative analysis*

Interview transcripts were analysed using reflexive thematic analysis **[36]**. Interviews were audio-recorded, transcribed verbatim in Amharic and translated into English, and back-translation checks were performed on 20% of transcripts. Coding was inductive and semantic. Codes were initially pooled across informant groups, and themes were developed by examining shared patterns *and* differences across groups, without assuming convergence. Descriptive categories (topic summaries) were distinguished from interpretive themes by asking what each pattern revealed about the conditions shaping ICT-supported active learning. Where a theme drew on only one or two groups, this is stated explicitly in Section 4.6 and Table 10.

*Researcher positionality and reflexivity.* The first author is an educational planning researcher trained in mixed methods and employed at a regional university; the second author is a psychologist with qualitative research experience. Neither author held a supervisory or administrative role in the sampled schools. During coding, reflexive memos were kept to document how the authors' assumptions, particularly the expectation that teachers would report more favourable perceptions than students, shaped initial code development. The first author conducted the initial coding. The second author coded 30% of the transcripts independently, and the two authors then compared and discussed their codes and interpretations. This second coding served as reflexive dialogue, to question assumptions and enrich theme development, and not as a test of inter-coder reliability; no agreement statistic was calculated, because reflexive thematic analysis treats coding as an interpretive practice that does not aim at coder convergence **[36]**. Discrepancies were resolved through discussion, and the coding frame was revised iteratively.

*Trustworthiness.* Trustworthiness was addressed through four criteria **[37]** that fit reflexive thematic analysis, which does not treat quality as a matter of reliability. Credibility was supported by drawing on informants from three role groups, working from verbatim transcripts and checking translation through back-translation of 20% of transcripts. Dependability was supported by recording coding decisions and revisions to the coding frame in reflexive memos. Confirmability was supported by the same memos, which documented how the authors' assumptions shaped coding, and by identifying every extract by informant code so that readers can trace themes to data. Transferability was supported by describing the setting, sampling and participants (Sections 3.2 and 3.4); the findings are not intended to generalise beyond the five schools. The back-translation checks and the second coding of 30% of transcripts therefore belong to these procedures: the first protects the meaning of the translated data, and the second supported reflexive dialogue between the authors and was not a measure of inter-coder reliability.

### 3.6 Integration

A joint display **[38, 39]** (Table 11) classifies each finding as convergent (both strands point in the same direction), complementary (one strand explains or extends the other) or divergent (the strands suggest different interpretations). Integration is interpretive, not causal. The analytic workflow is shown in Figure 3.

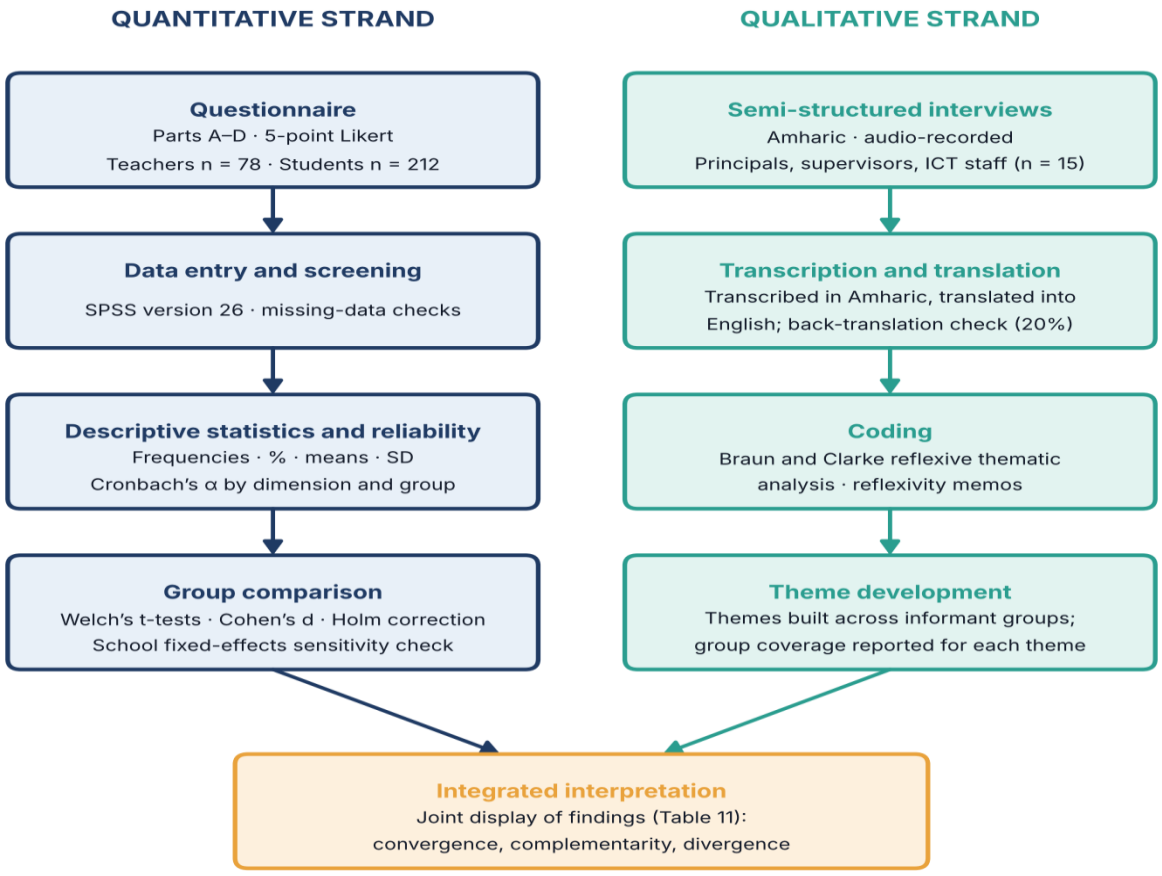



**Fig. 3** Analytic workflow for the quantitative and qualitative strands, converging in an integrated interpretation

### 3.7 Ethical considerations

The study was approved by the Research Ethics Committee of Oda Bultum University and followed the ethical guidelines for educational research of the British Educational Research Association **[40]** and the Ethiopian National Research Ethics Review Guideline **[41]** (see Declarations). Written informed consent was obtained from all teachers and key informants. Because the mean age of the student sample was 17.4 years (Table 5), many students were under 18; written assent was obtained from each student, and written parental or guardian consent was obtained for all students under 18. Participation was voluntary and anonymous and could be withdrawn without consequence. Teachers were not present during student questionnaire administration, and completed questionnaires were collected in sealed envelopes to reduce perceived pressure. Participants are identified in this paper only by role and number, and the datasets are not shared publicly, to protect confidentiality.

## 4. Results

### 4.1 Respondent profile

Table 5 reports the profile of questionnaire respondents. The 78 teachers and 212 students correspond to 81.3% and 46.8% of their respective populations. The interview sample comprised five principals, five supervisors and five ICT technical staff (Section 3.2).

**Table 5.** Profile of questionnaire respondents

| Characteristic | Teachers (n = 78) | Students (n = 212) |
|---|---|---|
| Male, n (%) | 52 (66.7) | 118 (55.7) |
| Female, n (%) | 26 (33.3) | 94 (44.3) |
| Age, mean (SD) | 34.2 (7.8) | 17.4 (1.2) |
| Grade level, n (%) | — | Grade 9: 52 (24.5); Grade 10: 48 (22.6); Grade 11: 56 (26.4); Grade 12: 56 (26.4) |
| Teaching experience, years, mean (SD) | 10.5 (6.3) | — |
| Access to ICT at school, n (%) | 58 (74.4) | 142 (67.0) |
| Proportion of population sampled, % | 81.3 | 46.8 |

### 4.2 Implementation of active learning (RQ1)

Reported implementation was moderate in both groups (Table 6). The teachers' mean across the five practices was 3.42 (SD = 0.68) and the students' mean was 3.28 (SD = 0.74). Group work and collaborative tasks was the most frequently reported practice (teachers 74.4% agree; students 68.9%), and learner self-reflection and planning the least frequently reported (52.6%; 48.6%). Students' means were lower than teachers' on every practice, by 0.10 to 0.16 scale points, but the overall difference was not statistically significant, $t(148) = 1.52$, $p = .131$, $d = 0.19$, 95% CI [−0.04, 0.32], and it was not significant for any single practice (Table 8). This non-significant result is not interpreted as evidence of equivalence, because the confidence interval includes differences of potential practical relevance; implementation is described as similar in the two groups' reports, not as equivalent.

**Table 6.** Reported implementation of active learning in ICT-supported learning environments

| Practice | Teachers mean (SD) | Students mean (SD) | Teachers % agree | Students % agree |
|---|---|---|---|---|
| Group work and collaborative tasks | 3.78 (0.72) | 3.62 (0.79) | 74.4 | 68.9 |
| Problem-based and inquiry tasks | 3.45 (0.81) | 3.31 (0.85) | 62.8 | 57.5 |
| Use of digital learning resources | 3.21 (0.89) | 3.08 (0.92) | 56.4 | 51.9 |
| Feedback and formative assessment | 3.52 (0.76) | 3.38 (0.81) | 66.7 | 61.3 |
| Learner self-reflection and planning | 3.12 (0.84) | 3.02 (0.88) | 52.6 | 48.6 |
| **Overall implementation** | **3.42 (0.68)** | **3.28 (0.74)** | **62.6** | **57.6** |

*Note.* Five-point scale: 1 = strongly disagree; 5 = strongly agree. "% agree" = proportion selecting 4 or 5. Overall mean = mean of the five practice means; overall % agree = mean of the five practice-level percentages (an aggregated indicator, not respondent-level agreement).

### 4.3 Perceptions of active learning and ICT-supported learning environments (RQ2)

Teachers reported a higher overall perception mean (M = 3.65, SD = 0.62; high level) than students (M = 3.41, SD = 0.71; moderate level) (Table 7). Perceived usefulness was the highest-scoring dimension for both groups (teachers 3.92; students 3.68), and perceived support from the school and woreda was the lowest (3.38; 3.14).

**Table 7.** Perceptions of active learning and ICT-supported learning environments

| Perception dimension | Teachers mean (SD) | Students mean (SD) | Teachers' level | Students' level |
|---|---|---|---|---|
| Perceived usefulness for learning | 3.92 (0.58) | 3.68 (0.66) | High | High |
| Perceived ease of use of digital tools | 3.58 (0.71) | 3.35 (0.78) | High | Moderate |
| Perceived competence to use active methods | 3.72 (0.64) | 3.48 (0.72) | High | Moderate |
| Perceived support from school and woreda | 3.38 (0.79) | 3.14 (0.84) | Moderate | Moderate |
| **Overall perception** | **3.65 (0.62)** | **3.41 (0.71)** | **High** | **Moderate** |

*Note.* Level: low (< 2.50); moderate (2.50–3.49); high (≥ 3.50). Overall = mean of the four dimension means.

### 4.4 Teacher–student comparison

The unadjusted Welch's t-test for overall perception was $t(156) = 2.81$, $p = .006$, $d = 0.35$, 95% CI of the difference [0.07, 0.41] (Table 8). The difference was in the same direction on all four dimensions ($d = 0.29$ to 0.38). After Holm correction within the family of four perception dimensions, all four remained significant (adjusted $p = .012$ for perceived usefulness, .021 for perceived competence, .038 for ease of use and .038 for support). Under the more conservative pooled family of nine dimension-level tests, only perceived usefulness remained significant (adjusted $p = .028$; .056 for competence, .130 for ease of use and .154 for support), so the dimension-level result depends on how the family is defined. No implementation practice was significant under either approach (adjusted $p \geq .522$). However, the school fixed-effects sensitivity analysis rendered the overall difference non-significant ($\beta = 0.18$, SE = 0.14, $p = .21$). The perception difference is therefore reported as exploratory: teachers *reported* somewhat more favourable perceptions, but the evidence is not robust to the clustered design, and the comparison is further limited by the absence of measurement equivalence. The percentages of teachers and students endorsing each challenge did not differ significantly (all chi-square $p > .11$; Table 9).

**Table 8.** Teacher–student differences in implementation and perception scores (Welch's t-test)

| Measure | Mean diff. | 95% CI | t (df) | p | Holm p (within family) | Holm p (pooled, 9 tests) | d |
|---|---|---|---|---|---|---|---|
| **Overall implementation** | **0.14** | **[−0.04, 0.32]** | **1.52 (148)** | **.131** | — | — | **0.19** |
| Group work and collaboration | 0.16 | [−0.03, 0.35] | 1.63 (150) | .104 | .522 | .522 | 0.21 |
| Problem-based and inquiry tasks | 0.14 | [−0.07, 0.35] | 1.29 (143) | .200 | .696 | .696 | 0.17 |
| Use of digital resources | 0.13 | [−0.11, 0.37] | 1.09 (141) | .276 | .696 | .696 | 0.14 |
| Feedback and formative assessment | 0.14 | [−0.06, 0.34] | 1.37 (146) | .174 | .696 | .696 | 0.18 |
| Self-reflection and planning | 0.10 | [−0.12, 0.32] | 0.89 (143) | .376 | .696 | .696 | 0.12 |
| **Overall perception** | **0.24** | **[0.07, 0.41]** | **2.81 (156)** | **.006** | — | — | **0.35** |
| Perceived usefulness | 0.24 | [0.08, 0.40] | 3.01 (155) | .003 | .012 | .028 | 0.38 |
| Perceived ease of use | 0.23 | [0.04, 0.42] | 2.38 (150) | .019 | .038 | .130 | 0.30 |
| Perceived competence | 0.24 | [0.07, 0.41] | 2.74 (153) | .007 | .021 | .056 | 0.34 |
| Perceived support | 0.24 | [0.03, 0.45] | 2.25 (145) | .026 | .038 | .154 | 0.29 |

*Note.* Mean difference = teachers minus students. d = Cohen's d (pooled SD). Holm-adjusted p-values are given within the family of each construct (five implementation practices; four perception dimensions) and, as a sensitivity analysis, across all nine dimension-level tests pooled; overall scores were tested as two planned comparisons. Students are nested in five schools, which these tests do not model; the school fixed-effects model for overall perception gave $\beta = 0.18$, SE = 0.14, $p = .21$. Teacher and student versions were not shown to be measurement-equivalent, so all comparisons are exploratory.

## 4.5 Challenges in implementation (RQ3)

Heavy workload and large class sizes was the most frequently endorsed challenge (teachers 87.2%; students 79.2%), followed by limited ICT infrastructure and connectivity (82.1%; 76.4%) and insufficient training in active and digital methods (78.2%; 68.9%) (Table 9). The ranking follows the teachers' percentages; students ordered the challenges slightly differently, placing limited curriculum time and examination pressure (72.6%) third. At least 58% of respondents in each group agreed that each of the six challenges applied. No teacher–student difference reached $p < .05$; the largest differences concerned workload and training (Cramér's V = .09 for each).

**Table 9.** Challenges reported by teachers and students, ranked by teachers' level of agreement

| Rank | Challenge | Teachers (% agree) | Students (% agree) | $\chi^2$ (1) | p | V |
|---|---|---|---|---|---|---|
| 1 | Heavy teaching workload and large class sizes | 87.2 | 79.2 | 2.37 | .124 | .09 |
| 2 | Limited ICT infrastructure and connectivity | 82.1 | 76.4 | 1.05 | .305 | .06 |
| 3 | Insufficient training in active and digital methods | 78.2 | 68.9 | 2.43 | .119 | .09 |
| 4 | Language barriers with English-medium materials | 71.8 | 65.6 | 1.00 | .316 | .06 |
| 5 | Limited time within the curriculum and examination pressure | 69.2 | 72.6 | 0.33 | .567 | .03 |
| 6 | Insufficient technical support and maintenance | 64.1 | 58.5 | 0.75 | .387 | .05 |

*Note.* The ten items of Part D are grouped into six categories. % agree = proportion selecting 4 or 5. $\chi^2$ tests are Pearson tests on the 2 × 2 table of teachers/students by agree/not agree, without continuity correction; V = Cramér's V. Tests are exploratory and unadjusted.

## 4.6 Qualitative findings (RQ3 and RQ4)

Reflexive thematic analysis of the 15 interviews produced five themes. Table 10 shows which informant groups contributed to each theme. Only Theme 2 drew on all three groups; Themes 1, 4 and 5 drew on principals and supervisors, and Theme 3 on ICT staff and principals. Teachers and students were not interviewed, so no theme reflects their own voices. A shared thread runs through the themes, a gap between what policy expects and what schools can do, but it is described

by informants from their own positions and is an interpretation, not a tested relationship. Extracts are identified by informant code.

**Table 10.** Themes from the semi-structured interviews, with contributing informant groups

| Theme | Sub-themes | Groups | Illustrative extract (code) |
|---|---|---|---|
| 1. Policy without matching school-level resources | Policy awareness; priorities; resource allocation | PR, SV | "We have received policy documents from the woreda, but translating them into daily practice is difficult when we lack basic resources." (PR-02) |
| 2. Teacher capacity and training | Training needs; confidence with active methods; digital skills | PR, SV, ICT | "Many teachers want to use active learning, but they have not received adequate training on how to integrate technology into their lessons." (SV-01) |
| 3. Infrastructure and technical support | Devices; connectivity; maintenance; power supply | ICT, PR | "The school has some computers, but the internet connection is unreliable. When the network fails, teachers cannot use digital resources." (ICT-03) |
| 4. Monitoring and supervision | Feedback loops; supervisory support; data use | SV, PR | "Supervisors visit the school, but the focus is on administrative matters rather than supporting teachers to improve their practice." (SV-04) |
| 5. Student readiness, language and support | Self-regulation; language; examination pressure; home support | PR, SV | "Students are under immense pressure to pass the national exam. They focus on memorisation rather than active learning." (PR-05) |

*Note.* PR = principal; SV = supervisor; ICT = ICT technical staff. Groups = informant groups whose extracts are presented under the theme.

### *Theme 1. Policy without matching resources*

Principals were aware of national policy on active learning and digital tools but described it as arriving without the conditions needed to carry it out. Class size was the example they gave most often.

> *"The policy says we should use active learning and digital tools, but our classrooms have 60 to 70 students. How can a teacher manage group work with so many students?" (PR-01)*

> *"We have received tablets and laptops from the government, but without internet and technical support, they just sit in the office." (PR-04)*

### *Theme 2. Teacher capacity and training*

All three groups identified teacher capacity, but each framed it differently. Principals stressed the form of professional development, supervisors stressed confidence, including confidence in English, and ICT staff stressed basic digital skills.

> *"Teachers need continuous professional development. One-time workshops are not enough. We need ongoing support and follow-up." (PR-03)*

> *"Teachers themselves sometimes lack confidence in English, so they rely on lecturing in the local language rather than using active methods." (SV-01)*

> *"Some schools have smartboards, but nobody knows how to use them. They were installed but never used because there was no training." (ICT-02)*

### *Theme 3. Infrastructure and technical support*

ICT staff gave the most detailed accounts of constraints that principals also noted: too few computers, slow and unreliable connectivity, power outages and too few technical staff. In the informants' view, these constraints interrupted lessons and led teachers back to traditional methods.

*"We have 20 computers for over 400 students. The ratio is very poor. Even when computers are available, frequent power outages disrupt lessons." (ICT-01)*

*"The internet connection is very slow. Downloading educational resources takes a long time. Teachers often give up and return to traditional methods." (ICT-04)*

***Theme 4. Monitoring and supervision***

Supervisors were frank about the limits of their own role. They described regular school visits that checked records and compliance, not instruction, and a supervision checklist that did not ask how teachers teach.

*"We visit schools to check records and compliance with regulations. We do not have enough time or expertise to provide instructional coaching." (SV-02)*

*"The supervision checklist focuses on whether teachers have lesson plans, not on how they teach or whether students are learning actively." (SV-03)*

***Theme 5. Student readiness, language and support***

Principals and supervisors linked student readiness to three conditions: examination pressure, the move to English-medium instruction and support at home. In their accounts, these conditions pushed students toward memorisation and made it harder for them to express ideas in group tasks.

*"The curriculum materials are in English, but many students struggle with the language. This makes active learning difficult because students cannot express their ideas." (SV-05)*

*"Many students come from families where parents cannot help with schoolwork. The school must provide extra support, but we lack the resources." (PR-02)*

### 4.7 Integration of quantitative and qualitative findings (RQ4)

Table 11 presents the joint display. The two strands converged on the partial implementation of active learning and on the main challenges. The interviews complemented the questionnaire by identifying school-level conditions, such as supervision practice and the language of instruction, that questionnaire items did not capture. The questionnaire finding that teachers reported more favourable perceptions than students is not directly explained by the interviews, and this remains an unresolved difference. The interviews also partly qualify the questionnaire picture of ICT access: 74.4% of teachers and 67.0% of students reported access at school, whereas ICT staff described too few and unreliable devices. Claims about the mechanisms behind the challenges are interpretive, not causal.

**Table 11.** Joint display of quantitative and qualitative findings

| Research question | Quantitative finding | Qualitative finding | Relationship |
|---|---|---|---|
| RQ1: Implementation | Moderate overall implementation (teachers M = 3.42; students M = 3.28; difference not significant). Group work most common; self-reflection least common. | Principals and supervisors described active learning as partly implemented; large classes and infrastructure limited what teachers could do (Themes 1, 3). | Convergence |
| RQ2: Perceptions | Teachers' perceptions more favourable than students' (3.65 vs. 3.41; p = .006, d = 0.35; not robust | Supervisors acknowledged limited pedagogical support; ICT staff noted gaps in teachers' digital skills (Themes | Complementarity; teacher–student difference unresolved |

| | | | |
|---|---|---|---|
| | to school clustering). Perceived support lowest in both groups. | 2, 4). The teacher–student difference was not addressed. | |
| RQ3: Challenges | Top challenges: workload and class size, ICT infrastructure, insufficient training (both groups > 68%). | Infrastructure, training and language were emphasised (Themes 2, 3, 5); supervisors added limited supervision (Theme 4). | Convergence |
| ICT access | Access reported by 74.4% of teachers and 67.0% of students. | ICT staff described too few and unreliable computers (Theme 3). | Partial divergence: access exists but is uneven and insufficient for regular use |
| RQ4: Integration | Challenges were endorsed by most respondents in both groups; the teacher–student perception difference was exploratory and not robust to school clustering. | Informants located the challenges in school-level conditions (policy without resources, under-supported teachers, unreliable equipment, compliance-focused supervision, language and examination pressure; Themes 1–5) but did not address why teachers and students differ. | Complementarity. Meta-inference: the interviews locate the reported challenges in school-level conditions but leave the teacher–student difference unexplained |

# 5. Discussion

## 5.1 Summary and contribution relative to existing Ethiopian research

In five Ethiopian secondary and preparatory schools, active learning in ICT-supported environments was reported as implemented to a moderate extent by both teachers and students. The contribution of this study is not the identification of implementation barriers, which are well documented **[7–10]**, but the combined examination of teacher and student perceptions alongside institutional perspectives. The finding that teachers and students *reported similar implementation levels* while teachers *reported somewhat more favourable perceptions* is consistent with existing evidence of a belief–practice gap and adds a comparative dimension that is rarely examined. The institutional interviews qualify this picture by showing that supervision practice and language support shape implementation in ways the questionnaire items could not capture.

## 5.2 Implementation: group work is easier than reflection

The moderate level of implementation matches recent Ethiopian findings that teachers favour active learning but use it only partially, and that crowded classrooms, limited time and weak resources hold it back **[7, 8]**. The pattern across practices is informative. Group work was the most frequently reported practice, and self-reflection and planning the least frequent. Group work can be added to a lesson by rearranging seating or tasks, whereas reflection and planning depend on students' self-regulation **[22]**, which itself needs time, feedback and structured support. In social cognitive terms **[19]**, the environment (large classes, short curriculum time, examination pressure) may favour the practices that are easiest to run under those conditions. This interpretation is consistent with informants' reports that students concentrate on memorisation (PR-05) and that active methods are hard to manage with 60 to 70 students (PR-01), but the design cannot show that the conditions cause the pattern.

Use of digital learning resources was the second-least reported practice. The interviews suggest a plausible reason: equipment was present but often unusable because of connectivity, power, maintenance and training gaps (ICT-01, ICT-02, PR-04). The questionnaire data show that ICT

access was reported by 67.0% to 74.4% of respondents (Table 5), which qualifies any characterisation of the schools as lacking devices: access exists but is uneven and insufficient for regular classroom integration. Taken together, the findings suggest that the ICT-supported environments in the sampled schools function at the level of basic provision and are some distance from the adaptive, context-aware systems described in the smart learning environment literature **[4, 6]**.

### 5.3 Interpreting the teacher–student perception difference

Perceived usefulness was the highest-rated dimension for both groups and perceived support the lowest. This is the pattern the technology acceptance and UTAUT frameworks would lead one to expect where people value a technology but facilitating conditions are weak **[23, 24]**, and it is consistent with the interview accounts of confident but under-supported teachers. Teachers' perceived competence (M = 3.72) exceeded their rating of institutional support (M = 3.38). Social cognitive theory suggests that confidence without adequate training or equipment is hard to turn into practice **[20, 21]**; the present data describe this combination but do not test it.

The unadjusted perception difference ($p = .006$) should not be over-interpreted. The school fixed-effects analysis ($p = .21$) and the absence of measurement equivalence mean that the difference is exploratory. It is not claimed that teachers "have more favourable perceptions" as a settled finding; the data show that teachers *reported* somewhat more favourable responses, that this pattern was not robust to clustering, and that the interview data do not explain it. Four explanations are worth testing in future work. First, teachers design and lead activities and may rate the value of their own practice more favourably, and perceived competence is by definition self-referential **[20]**. Second, teachers, more than students, may feel that supporting national policy is the expected answer **[42]**. Third, students experience the effects of unreliable equipment without controlling it, and fewer students than teachers reported ICT access (67.0% vs. 74.4%). Fourth, examination pressure may lead students to judge methods by their usefulness for the national examination, as informants suggested (PR-05). Differences in the language of administration could also contribute through imperfect measurement equivalence.

One practical implication follows even from this cautious reading: monitoring based only on teachers' self-reports may give a more favourable picture than students would give, so student voice should be part of any school-level review. Studies that pair teacher and student reports within the same classes and add classroom observation would show whether the gap reflects different experiences of the same lessons or different values.

### 5.4 Challenges and constraints

The three most frequently endorsed challenges, workload and class size, ICT infrastructure and insufficient training, were endorsed by most respondents in both groups, and no teacher–student difference in endorsement was significant. These challenges closely resemble those reported in earlier Ethiopian studies **[7–10]**. Read through Ertmer's distinction **[27]**, five of the six challenge categories (workload and class size, infrastructure, training, curriculum time and technical support) are first-order, external barriers, with language straddling the two orders. The interviews,

however, also point to second-order elements, namely teachers' confidence in English (SV-01) and students' orientation toward memorisation (PR-05), which suggests that supplying equipment and time alone may not be sufficient.

The interview interpretation that limited use of digital resources reflected environmental constraints rather than rejection of technology is an interpretation offered by informants and not a tested relationship, and it is presented as such. The interviews add that the constraints operate together: unresourced policy (Theme 1), under-supported teachers (Theme 2), unreliable equipment (Theme 3) and compliance-focused supervision (Theme 4) mean that teachers rarely receive the continuing, practice-focused support that principals and supervisors say is needed.

Language deserves separate mention. Nearly two-thirds of students (65.6%) and more than 70% of teachers (71.8%) agreed that English-medium materials were a barrier, and supervisors reported that limited confidence in English leads teachers to lecture in the local language (SV-01) and prevents students from expressing their ideas (SV-05). This agrees with earlier Ethiopian work on English-medium instruction **[43, 44]** and is particularly relevant to active learning, which depends on students talking, explaining and questioning in the language of instruction.

### 5.5 Implications

The implications below follow from respondents' and informants' reports and are offered as suggestions, not as evidence that a given action will improve outcomes. The findings suggest that ICT provision, teacher capacity, supervision and language support require coordinated attention; they do not establish that coordinating these factors would improve implementation.

*Education authorities* might pair ICT provision with teacher training, maintenance, power and connectivity, because equipment without these was reported to go unused, and accompany active-learning policy with the resources needed for large classes. *School leaders* might provide continuing, practice-focused professional development in place of one-off workshops and protect planning time for active lessons. *Supervisors* might move part of the supervisory role from checking compliance toward instructional coaching and include student views of active learning in school reviews. *Teachers* might introduce practices that build students' planning and reflection gradually, within existing class sizes, since these were the least used. *ICT technical staff* might develop maintenance arrangements and short, practical digital-skills sessions for teachers.

### 5.6 Limitations

*Design and inference.* The cross-sectional, descriptive design allows no causal inference. Statements about what constrains practice reflect respondents' and informants' own accounts, and associations among implementation, perceptions and challenges were not analysed.

*Self-report.* Implementation was measured by self-report and is subject to social desirability **[42]** and common-method variance **[45]**. Teachers, who evaluate their own practice, may overstate it; the similar implementation scores of teachers and students offer some reassurance, but both are perceptions and not observations.

*Sampling and generalisability.* Five schools were drawn from five woredas in one area, and key informants were purposively selected, so the findings cannot be generalised to Ethiopia or even to all schools in the region. Because students are nested in five schools, the unadjusted tests probably understate standard errors, and the fixed-effects check, though informative, is limited with so few clusters. The Yamane formula assumes simple random sampling and does not account for clustering.

*Measurement.* Evidence for the questionnaire is limited to expert review, a pilot and Cronbach's alpha; factor-analytic evidence was not examined, and measurement equivalence between the English teacher version and the Amharic student version cannot be assumed. The teacher–student comparison is therefore exploratory. Conducting interviews in Amharic rather than Afan Oromo may also have excluded nuances.

*Scope of constructs and qualitative strand.* The study examined basic ICT-supported environments, not adaptive or context-aware ones, and collected no measure of academic resilience or learning analytics. The qualitative strand drew on 15 school-level post-holders, and teachers' and students' own accounts were captured only through closed questionnaire items.

## 6. Conclusion

Reported implementation of active learning in the sampled ICT-supported schools was moderate, with group work most common and self-reflection least common, and teacher–student differences in reported implementation were not statistically significant. Teachers reported somewhat more favourable perceptions than students, but this difference was exploratory and did not remain robust to school-level clustering. Challenges centred on workload and class size, ICT infrastructure and training, and interviews with school leaders, supervisors and ICT staff described a consistent gap between policy intentions and school conditions. The contribution of the study lies in combining teacher, student and institutional perspectives; its limitations include clustered sampling, a researcher-developed instrument without established construct validity, and the absence of measurement equivalence across language versions.

The study did not measure academic resilience or learning analytics and makes no claims about causal mechanisms. Future research should (a) use larger samples and validated instruments, including tests of measurement invariance between teachers and students; (b) use multilevel designs that account for students nested in schools; (c) pair teacher and student reports within the same classes and add classroom observation; (d) include teachers' and students' voices in the qualitative strand; (e) evaluate professional development and support programmes through intervention designs; and (f) where resilience and learning analytics are of interest, include validated resilience measures and longitudinal data, collected with attention to ethical principles of transparency and student agency **[46]**.

## Declarations

### Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of Oda Bultum University (approval no. OBU/REC/2022/014) and complied with the Ethiopian National Research Ethics Review Guideline and the BERA ethical guidelines for educational research. Written informed consent was obtained from all teachers and key informants. For student participants (mean age 17.4 years), written assent was obtained from each student and written parental or guardian consent was obtained for all students under 18. Participation was voluntary, anonymous and could be withdrawn without consequence. No consent waivers were granted.

### Consent for publication

Not applicable; no identifying information is included.

### Data availability

The datasets generated and analysed during the study are not publicly available because they contain information that could compromise participant privacy, but they are available from the corresponding author on reasonable request.

### Competing interests

The authors declare no competing interests.

### Funding

No funding was received.

### Author contributions

Assefa Kibret Melaku: Conceptualization, Methodology, Investigation, Formal analysis, Writing original draft. Mengesha Shumet Dessalegn: Methodology, Validation, Formal analysis, Writing – review & editing, Supervision. Both authors read and approved the final manuscript.

### Acknowledgements

The authors thank the participants for their time and cooperation, and the woreda education offices and school directors for granting permission to conduct the study.

### Supplementary information

Supplementary File 1 contains the full questionnaire (Parts A–D) and the interview guide.

### Clinical trial number.

Not applicable

## References


1. Ministry of Education. Ethiopian education development roadmap (2018–30): an integrated executive summary. Addis Ababa: Federal Democratic Republic of Ethiopia; 2018.
2. Freeman S, Eddy SL, McDonough M, Smith MK, Okoroafor N, Jordt H, et al. Active learning increases student performance in science, engineering, and mathematics. Proc Natl Acad Sci U S A. 2014;111(23):8410–5. https://doi.org/10.1073/pnas.1319030111
3. Prince M. Does active learning work? A review of the research. J Eng Educ. 2004;93(3):223–31. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x
4. Hwang GJ. Definition, framework and research issues of smart learning environments: a context-aware ubiquitous learning perspective. Smart Learn Environ. 2014;1:4. https://doi.org/10.1186/s40561-014-0004-5
5. Spector JM. Conceptualizing the emerging field of smart learning environments. Smart Learn Environ. 2014;1:2. https://doi.org/10.1186/s40561-014-0002-7
6. Zhu ZT, Yu MH, Riezebos P. A research framework of smart education. Smart Learn Environ. 2016;3:4. https://doi.org/10.1186/s40561-016-0026-2
7. Dagnew A. Implementation of active learning strategies: the case of secondary schools. Rev Elem Izobr. 2023;16(1):107–25. https://doi.org/10.18690/rei.16.1.1315
8. Addisu M, Regassa T. Factors affecting English teachers' implementation of active learning: a case from Ethiopia. J Foreign Lang Teach Learn. 2026;11(1):33–58. https://doi.org/10.18196/ftl.v11i1.27441
9. Telore T, Damtew A. New challenges to the implementation of active learning methods at secondary schools in Kambata Tambaro zone, Ethiopia. J English Educ Soc. 2023;8(2). https://doi.org/10.21070/jees.v8i2.1773
10. Jang IC. Teachers' beliefs and practices of ICT use in secondary schools in Addis Ababa, Ethiopia [doctoral thesis]. Norwich: University of East Anglia; 2020.
11. Cassidy S. The Academic Resilience Scale (ARS-30): a new multidimensional construct measure. Front Psychol. 2016;7:1787. https://doi.org/10.3389/fpsyg.2016.01787
12. Martin AJ, Marsh HW. Academic resilience and its psychological and educational correlates: a construct validity approach. Psychol Sch. 2006;43(3):267–81. https://doi.org/10.1002/pits.20149
13. Martin AJ, Marsh HW. Academic resilience and academic buoyancy: multidimensional and hierarchical conceptual framing of causes, correlates and cognate constructs. Oxf Rev Educ. 2009;35(3):353–70. https://doi.org/10.1080/03054980902934639
14. Masten AS. Ordinary magic: resilience processes in development. Am Psychol. 2001;56(3):227–38. https://doi.org/10.1037/0003-066X.56.3.227
15. Siemens G, Long P. Penetrating the fog: analytics in learning and education. EDUCAUSE Rev. 2011;46(5):30–2.
16. Ifenthaler D, Yau JYK. Utilising learning analytics to support study success in higher education: a systematic review. Educ Technol Res Dev. 2020;68(4):1961–90. https://doi.org/10.1007/s11423-020-09788-z
17. Viberg O, Hatakka M, Bälter O, Mavroudi A. The current landscape of learning analytics in higher education. Comput Human Behav. 2018;89:98–110. https://doi.org/10.1016/j.chb.2018.07.027

18. Prinsloo P, Kaliisa R. Learning analytics on the African continent: an emerging research focus and practice. J Learn Anal. 2022;9(2):218–35. https://doi.org/10.18608/jla.2022.7539
19. Bandura A. Social foundations of thought and action: a social cognitive theory. Englewood Cliffs: Prentice Hall; 1986.
20. Bandura A. Self-efficacy: the exercise of control. New York: W.H. Freeman; 1997.
21. Tschannen-Moran M, Woolfolk Hoy A. Teacher efficacy: capturing an elusive construct. Teach Teach Educ. 2001;17(7):783–805. https://doi.org/10.1016/S0742-051X(01)00036-1
22. Zimmerman BJ. Becoming a self-regulated learner: an overview. Theory Pract. 2002;41(2):64–70. https://doi.org/10.1207/s15430421tip4102_2
23. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. 1989;13(3):319–40. https://doi.org/10.2307/249008
24. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: toward a unified view. MIS Q. 2003;27(3):425–78. https://doi.org/10.2307/30036540
25. Venkatesh V, Davis FD. A theoretical extension of the technology acceptance model: four longitudinal field studies. Manage Sci. 2000;46(2):186–204. https://doi.org/10.1287/mnsc.46.2.186.11926
26. Chi MTH, Wylie R. The ICAP framework: linking cognitive engagement to active learning outcomes. Educ Psychol. 2014;49(4):219–43. https://doi.org/10.1080/00461520.2014.965823
27. Ertmer PA. Addressing first- and second-order barriers to change: strategies for technology integration. Educ Technol Res Dev. 1999;47(4):47–61. https://doi.org/10.1007/BF02299597
28. Creswell JW, Plano Clark VL. Designing and conducting mixed methods research. 3rd ed. Thousand Oaks: SAGE; 2018.
29. Yamane T. Statistics: an introductory analysis. 2nd ed. New York: Harper & Row; 1967.
30. Little RJA. A test of missing completely at random for multivariate data with missing values. J Am Stat Assoc. 1988;83(404):1198–202. https://doi.org/10.1080/01621459.1988.10478722
31. Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika. 1951;16(3):297–334. https://doi.org/10.1007/BF02310555
32. Nunnally JC. Psychometric theory. 2nd ed. New York: McGraw-Hill; 1978.
33. Welch BL. The generalization of “Student’s” problem when several different population variances are involved. Biometrika. 1947;34(1–2):28–35. https://doi.org/10.1093/biomet/34.1-2.28
34. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale: Lawrence Erlbaum; 1988.
35. Holm S. A simple sequentially rejective multiple test procedure. Scand J Stat. 1979;6(2):65–70.
36. Braun V, Clarke V. One size fits all? What counts as quality practice in reflexive thematic analysis? Qual Res Psychol. 2021;18(3):328–52. https://doi.org/10.1080/14780887.2020.1769238

37. Lincoln YS, Guba EG. Naturalistic inquiry. Newbury Park: Sage; 1985.
38. Fetters MD, Curry LA, Creswell JW. Achieving integration in mixed methods designs—principles and practices. Health Serv Res. 2013;48(6 Pt 2):2134–56. https://doi.org/10.1111/1475-6773.12117
39. Guetterman TC, Fetters MD, Creswell JW. Integrating quantitative and qualitative results in health science mixed methods research through joint displays. Ann Fam Med. 2015;13(6):554–61. https://doi.org/10.1370/afm.1865
40. British Educational Research Association. Ethical guidelines for educational research. 5th ed. London: BERA; 2024. https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2024
41. FDRE Ministry of Science and Technology. National research ethics review guideline. 5th ed. Addis Ababa: Federal Democratic Republic of Ethiopia; 2014.
42. Nederhof AJ. Methods of coping with social desirability bias: a review. Eur J Soc Psychol. 1985;15(3):263–80. https://doi.org/10.1002/ejsp.2420150303
43. Ayele ZW. A study on students' and teachers' perceptions, challenges and practices of using English as a medium of instruction: in focus of three public universities in North Western Ethiopia. Int J Res Teach Educ. 2018;9(4):15–24.
44. Bachore MM. The status, roles and challenges of teaching English language in Ethiopia context: the case of selected primary and secondary schools in Hawassa University Technology Village area. Rev Int Sociol Educ. 2015;4(2):182–96. https://doi.org/10.17583/rise.2015.1515
45. Podsakoff PM, MacKenzie SB, Podsakoff NP. Sources of method bias in social science research and recommendations on how to control it. Annu Rev Psychol. 2012;63:539–69. https://doi.org/10.1146/annurev-psych-120710-100452
46. Slade S, Prinsloo P. Learning analytics: ethical issues and dilemmas. Am Behav Sci. 2013;57(10):1510–29. https://doi.org/10.1177/0002764213479366