© IIJP 2026 | Volume 2, Issue 4, pp. 927-943 | ISSN: 2636-4484

ADVANCING LEARNER-CENTRED PEDAGOGIES THROUGH DIGITAL INNOVATION

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ARTICLE INFO
Article No.: 0693
Accepted Date: 11/10/2026
Published Date: 09/11/2026
Type: Research

ABSTRACT
Digital technology has changed how teaching and learning take place in schools and universities, and a growing number of educators now agree that students learn better as active participants than as passive recipients. How digital tools can support this approach in practical, everyday classroom settings remains poorly understood. This study examined how digital innovation can help teachers put students at the centre of learning across different higher education environments. A mixed-methods design combined questionnaires completed by 240 students and 60 teachers in four higher education institutions in south-western Nigeria (two universities, a polytechnic and a college of education) with 18 interviews and 16 classroom observations. Survey data were analysed using descriptive statistics (means, standard deviations and percentages) and independent-samples t tests with Welch's correction, while interview and observation records were analysed thematically. Vygotsky's sociocultural theory and the Technology Acceptance Model (TAM) guided the study. Teachers rated digital tools as useful (M = 4.12) but only moderately easy to use (M = 3.30), and learner-centred use was moderate (students M = 3.05; teachers M = 3.37). Teachers reported more learner-centred use and higher perceived usefulness than students, whereas students rated ease of use and teachers' digital skills higher (all $p \leq .004$). Student engagement received the highest ratings of the four factors examined (students M = 3.65; teachers M = 3.53), whereas available facilities (students M = 2.76; teachers M = 2.96) and equitable access to devices and the internet (students M = 2.44; teachers M = 2.63) received the lowest. Four themes emerged from the interviews and observations: teacher skills and confidence, facilities and connectivity, student engagement through interaction, and equitable access to devices and data. The study concludes that the usefulness of digital tools is widely recognised but that learner-centred use is constrained mainly by inadequate facilities and unequal access, and it recommends targeted support for student devices and data, reliable campus connectivity and structured professional development for teachers.

Keywords: Digital innovation, learner-centred pedagogy, student engagement, technology integration, technology-enhanced learning

Introduction

Digital technology has changed how teaching and learning are organised in schools and universities, and the shift to emergency online instruction during the COVID-19 pandemic made that change difficult to ignore (Alenezi et al., 2023; Rapanta et al., 2021). Alongside this change, a growing number of educators accept that students learn better when they take part actively in the learning process than when they receive information passively. Learner-centred pedagogy gives that view a practical form by asking teachers to design tasks in which students construct understanding, discuss it with others and receive support as they do so, a direction that recent work on digital pedagogy has tried to connect to what technology makes possible (Huang et al., 2024; Røe et al., 2022).

Access to technology does not by itself produce learner-centred teaching, and the literature on post-pandemic higher education has asked how technology and pedagogy can be balanced so that tools serve teaching goals instead of setting them (Otto et al., 2024; Rapanta et al., 2021). What remains unclear is how digital tools can be used in practical, everyday classroom settings to support this kind of teaching, particularly where teachers and students work with uneven skills, facilities and access. Studies from sub-Saharan Africa point to persistent problems with infrastructure and technical support (Van der Merwe et al., 2023), to concerns among university lecturers about digital education (Chimbunde & Jakachira, 2025) and to wider barriers to quality education across the region (Zickafoose et al., 2024). The present study addresses this gap by setting student views, teacher views and observed classroom practice side by side.

The study therefore asks how digital innovation can help teachers put students at the centre of learning across different higher education environments. Three research questions follow from this aim: (1) How do teachers and students describe and experience the use of digital tools for learner-centred teaching? (2) What factors enable teachers to use digital tools in this way? (3) What factors constrain such use? The enablers and barriers considered in the study are teacher skills, available facilities, student engagement and whether all students have fair access to devices and the internet. A mixed-methods design was used, drawing on questionnaires completed by students and teachers, interviews and classroom observations in four higher education institutions, and the analysis is guided by Vygotsky's sociocultural theory (Vygotsky, 1978), which holds that learners develop through interaction and support, and by the Technology Acceptance Model (Davis, 1989), which explains how people decide to adopt or reject a new technology.

The findings are intended to offer clear, practical suggestions for teachers, institutional administrators and education policymakers, and to add to ongoing conversations about improving teaching and learning through technology. The paper first reviews the concepts, theory and empirical studies that frame the question, then describes the methodology and reports the results, and finally discusses the findings against earlier work and states the conclusions.

Literature review

Key Concepts

Four concepts underpin the study, and Table 1 sets out the working meaning given to each. Learner-centred pedagogy refers to teaching in which students are active participants who construct, discuss and apply knowledge, a view that writing on digital pedagogy has placed at the centre of its case for change (Dhakal, 2023; Huang et al., 2024; Røe et al., 2022). Digital innovation is used here for the introduction of digital tools and practices that change how teaching and learning are organised, which is how discussions of digital education in higher

education tend to frame it (Alenezi et al., 2023; Rapanta et al., 2021). Technology integration and technology-enhanced learning describe the degree to which such tools are built into teaching and learning activities and not merely present in the institution (Otto et al., 2024; Schlebusch et al., 2024). Student engagement covers the effort, interaction and involvement that students show in learning tasks, and studies of collaborative learning and of single tools have examined it as part of the learning process (Hossain, 2023; Qureshi et al., 2023).

Table 1

Key Concepts and Their Working Meaning in This Study

Concept	Working meaning in this study	Related studies
Learner-centred pedagogy	Teaching in which students are active participants who construct, discuss and apply knowledge with teacher support	Dhakal (2023); Huang et al. (2024); Røe et al. (2022)
Digital innovation	Introduction of digital tools and practices that change how teaching and learning are organised	Alenezi et al. (2023); Rapanta et al. (2021)
Technology integration and technology-enhanced learning	Building digital tools into teaching and learning activities so that they shape what students and teachers do	Otto et al. (2024); Schlebusch et al. (2024)
Student engagement	Effort, interaction and involvement shown by students in learning tasks	Hossain (2023); Qureshi et al. (2023)

Note. Meanings are working definitions adopted for this study.

Theoretical framework

Two theoretical frameworks guide the study, and each addresses a different question. Vygotsky's (1978) sociocultural theory holds that learners develop through interaction with others and with the cultural tools available to them, with support matched to the gap between what a learner can do alone and what the learner can do with help, a gap Vygotsky termed the zone of proximal development. Rigopouli et al. (2025) draw on Vygotsky's ideas about creativity when considering the design of technology-enhanced learning. Applied to this study, the theory directs attention to whether digital tools allow discussion, joint work and timely feedback, which are the conditions under which teachers can place students at the centre of learning.

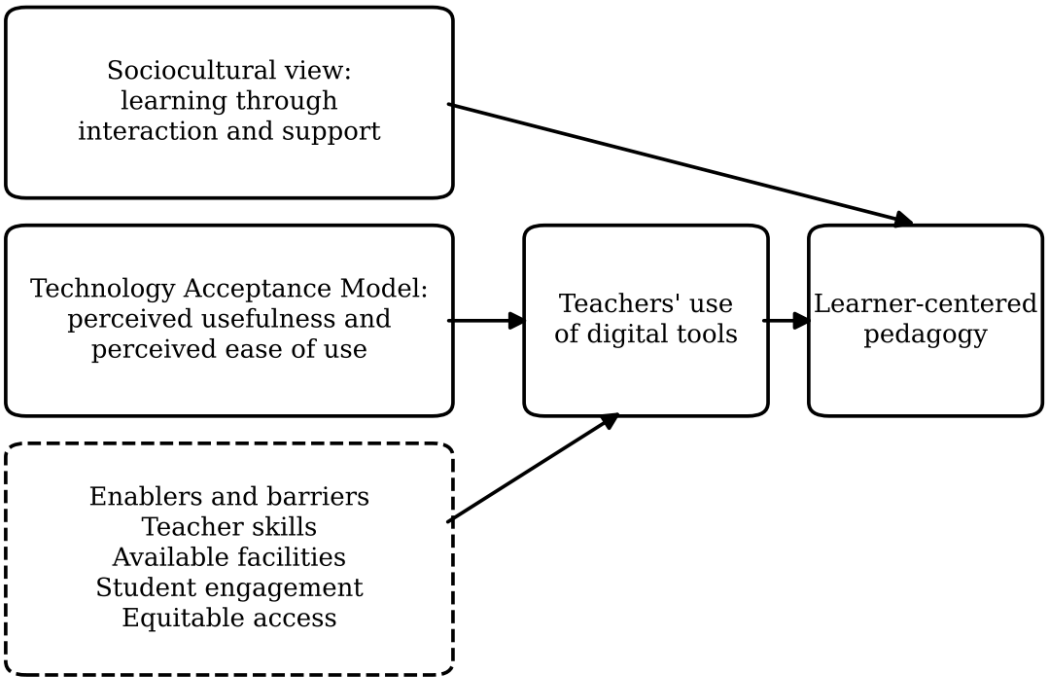
The Technology Acceptance Model addresses a different question, namely why teachers and students take up a tool or set it aside. Its central proposition, as first formulated by Davis (1989), is that perceived usefulness and perceived ease of use shape attitudes towards a technology and the intention to use it. A review of the theories and models used to explain technology in education (Sackstein et al., 2023) and a meta-analysis of the model in the study of artificial intelligence in education (Xue et al., 2026) indicate how widely it has been applied and extended. The extensions differ in what they add and where they are applied, including virtual classrooms (Kemp et al., 2024), digital academic reading tools (Lin & Yu, 2023), flipped classrooms (Alyoussef, 2022), chatbots (Al-Abdullatif, 2023) and AI tools in language classrooms (Kong, 2025). Work with teachers has asked whether digital competence influences

technology acceptance in vocational education (Antonietti et al., 2022) and has mapped the connections among the factors reported to shape teachers' acceptance (Galimova et al., 2024). Ndebele and Mbodila (2022) used the model to examine technology acceptance in learning and teaching at a historically disadvantaged university in South Africa.

Taken together, the two frameworks suit the problem addressed here. The sociocultural theory describes what learner-centred teaching with digital tools should make possible, and the acceptance model describes what must hold for teachers to adopt the tools that make it possible. The enablers and barriers examined in this study, which are teacher skills, available facilities, student engagement and equitable access, sit between the two, because they influence both whether teachers judge a tool worth using and whether the interaction that the sociocultural view requires can occur. Figure 1 shows the relationships assumed in the study.

Figure 1

Conceptual Framework of the Study



Note. The dashed box marks the four factors examined as enablers and barriers.

Review of empirical studies

Table 2 lists the studies that bear most directly on the four factors, and the discussion that follows takes each factor in turn. The studies come from different regions, education levels and designs, so they are compared by what each can and cannot show.

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Table 2
Selected Studies Related to the Four Factors Examined

Factor	Study	Context	Design	Focus
Teacher skills	Antonietti et al. (2022)	Vocational education	Cross-sectional	Teachers' digital competence and technology acceptance
	Ogunbodede et al. (2023)	University teachers, Nigeria	Cross-sectional	Digital competencies and 21st-century skills
	Galimova et al. (2024)	Teachers, multiple settings	Systematic review	Factors influencing teachers' technology acceptance
Facilities	Van der Merwe et al. (2023)	Higher education, sub-Saharan Africa	Systematic review	ICT infrastructure, technical support, student bandwidth
	Zickafoose et al. (2024)	Quality education, sub-Saharan Africa	Literature review	Barriers to quality education
	Matee et al. (2023)	Higher education, Lesotho	Case study	Virtual collaborative learning
Engagement	Qureshi et al. (2023)	Students	Cross-sectional	Collaborative learning, engagement and learning performance
	Hossain (2023)	Australian classroom	Case study	Padlet and student engagement
	Omeh et al. (2024)	Nigerian private universities	Quasi-experimental	Achievement, engagement and digital skills
Equitable access	Ndibalema (2025)	Higher education, sub-Saharan Africa	Systematic review	Digital literacy gaps
	Oladele et al. (2023)	Higher education, selected sub-Saharan African countries	Cross-sectional	Students' experience of technology adoption in STEM
	Zongozzi & Ngubane (2025)	Higher education, South Africa	Systematic review	Access for students with disabilities

Note. Designs are as described for each study in its source.

Teacher skills

Teachers' digital competence appears repeatedly as a condition for effective use of technology, although the studies differ in setting and design. Antonietti et al. (2022) asked, through a cross-sectional survey, whether teachers' digital competence influences technology acceptance in vocational education, whereas Ogunbodede et al. (2023) surveyed the digital competencies and 21st-century skills of university teachers in Nigeria. Chimbunde and Jakachira (2025) turned to the concerns that university lecturers themselves hold about digital education in

sub-Saharan Africa, and Galimova et al. (2024) combined a systematic review with network analysis to map the factors that shape teachers' technology acceptance. These studies treat competence as a possible influence on acceptance, as a measured attribute and as a source of concern, but they come from different education levels and regions, which limits direct comparison. A study in an experimental setting adds that teaching method matters alongside skill: Omeh et al. (2024), in a quasi-experimental study of second-year computer education students in Nigerian private universities, reported higher achievement, engagement and digital skills after instruction that used Google Classroom and Google Meet within innovative teaching strategies.

Available facilities

Infrastructure and technical support recur in the African studies reviewed here. A systematic review of e-learning implementation in sub-Saharan Africa for 2016 to 2022 found that the challenges were not new but persistent, with ICT infrastructure, technical support and student bandwidth still unresolved (Van der Merwe et al., 2023). Zickafoose et al. (2024) place problems of this kind within a wider set of barriers to quality education in the region, and case studies from Lesotho and from two southern African universities examined challenges for virtual collaborative learning and the integration of technology in teacher education (Matee et al., 2023; Schlebusch et al., 2024). The question for the present study is therefore less whether facilities matter than how their limits show up inside lessons designed to be learner-centred.

Student engagement

Engagement is usually studied through particular tools or teaching formats. Qureshi et al. (2023) surveyed students on factors affecting learning performance through collaborative learning and engagement, Hossain (2023) offered a reflection on using Padlet to engage students in an Australian classroom, and Pichardo et al. (2021) reported on students' and teachers' use of Mentimeter as a response to the disruption of the pandemic and its aftermath. Kayi (2024) examined how instructors and adult learners experienced the move to blended learning in three Ghanaian universities during COVID-19. The tool-specific and course-specific character of much of this work makes it difficult to determine how engagement behaves across institutions, which is one reason the present study asks teachers and students about engagement in the same instrument and then compares those reports with classroom observation.

Equitable access

Fair access to devices and the internet determines who can take part in any digital approach, and it has been examined from several directions. Ndibalema (2025) reviewed digital literacy gaps among higher education students in sub-Saharan Africa in relation to 21st-century skills, and Oladele et al. (2023) surveyed students' experience of technology adoption for STEM education in selected sub-Saharan African countries. Zongozzi and Ngubane (2025) reviewed equitable access to digital higher education for students with disabilities in South Africa, extending the question of access to a group that devices and connectivity alone may not reach.

Position of the present study

Most of the studies reviewed above examine a single factor, tool or setting, and few combine the perspectives of teachers and students with direct observation of lessons. The present study examines the four factors together, draws on the views of both teachers and students, and compares those views with what happens in observed lessons, so that the practical conditions for learner-centred teaching can be described in one account.

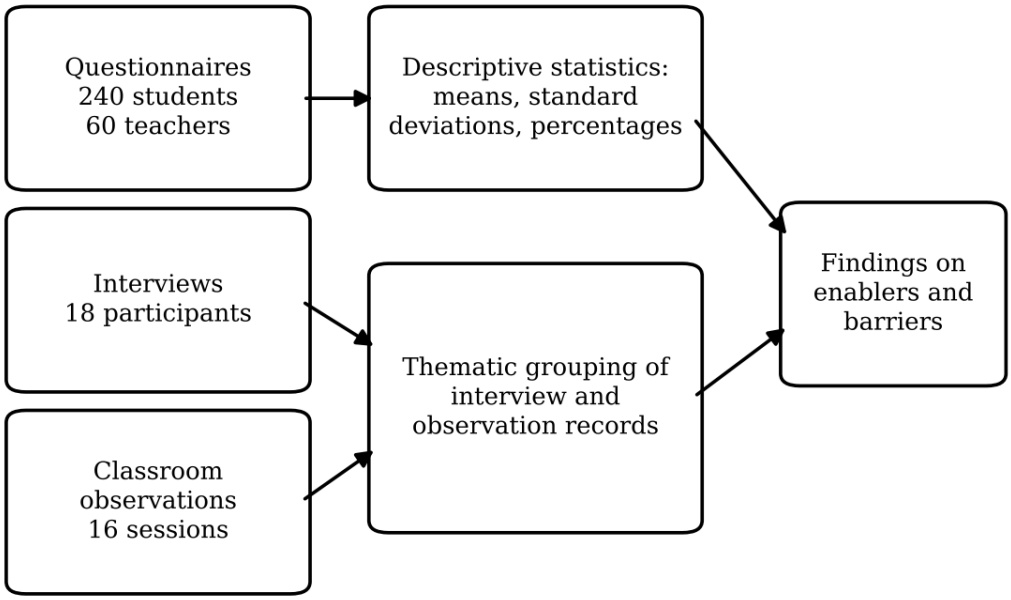
Methodology

Research design

The study adopted a convergent parallel mixed-methods design in which a quantitative strand and a qualitative strand were carried out during the same academic term and integrated at the interpretation stage. The quantitative strand consisted of questionnaires completed by students and teachers, and the qualitative strand consisted of semi-structured interviews and classroom observations. Figure 2 shows how the data sources were analysed and combined. The design was chosen because the aim concerns both how widely certain views and practices are held and how they operate inside lessons, questions that a single method would answer only in part.

Figure 2

Research Design and Flow of Analysis



Note. Participant numbers refer to the four institutions combined.

Setting and participants

Four higher education institutions were purposively selected to reflect different educational environments: two universities (Institutions A and B), one polytechnic (Institution C) and one college of education (Institution D). The institutions are located in four states of south-western Nigeria (Lagos, Ogun, Osun and Oyo), one in each state. The target population comprised all full-time students in the participating faculties and all teaching staff in the same units, and each institution supplied class registers and staff lists as sampling frames. Students were selected by proportionate stratified random sampling, with level of study as the stratum, and teachers were selected from the staff lists by simple random sampling, which gave 240 students and 60 teachers. The sample size was set to detect a medium difference between students and teachers ($d = 0.5$) with a power of about .93 at the .05 level, and the number drawn from each institution followed the size of its participating faculties. Eighteen of these respondents, 10 teachers and 8 students, also took part in interviews, and four lessons in each institution were observed, making 16 sessions. Interview participants were chosen to include

different levels of experience with digital tools, and observed lessons were selected with the agreement of the teachers concerned.

Instruments

Table 3 lists the instruments. The student and teacher questionnaires were parallel, with each of seven constructs measured by four items on a five-point scale on which higher scores indicated more of the construct. The constructs were use of digital tools in learner-centred activities, perceived usefulness, perceived ease of use, teacher digital skills, available facilities, student engagement and equitable access to devices and the internet. Perceived usefulness and perceived ease of use come from the Technology Acceptance Model, and the remaining constructs reflect the enablers and barriers named in the research questions. In the student version, teacher digital skills were students' ratings of their teachers, while in the teacher version they were self-ratings, and equitable access was rated by students for themselves and by teachers for their students. The interview guide asked participants to describe how digital tools were used to involve students in learning, what supported that use and what interfered with it. The observation checklist recorded whether digital tools were used, who acted through them, whether students contributed or worked together, and any interruptions caused by facilities, connectivity, shared devices or difficulty with a tool.

Table 3

Data Collection Instruments

Instrument	Participants or units	Content	Analysis
Student questionnaire	240 students	Seven constructs of four items each, five-point scale, plus device and internet indicators	Means, standard deviations, percentages, t tests
Teacher questionnaire	60 teachers	The same seven constructs in parallel wording, plus device and internet indicators	Means, standard deviations, percentages, t tests
Semi-structured interview guide	18 participants (10 teachers, 8 students)	Use of digital tools to involve students, supports and obstacles	Thematic grouping
Classroom observation checklist	16 sessions	Tool use, who acts through the tool, student contributions, interruptions	Thematic grouping and session counts

Note. Both questionnaires also asked about ownership of a smartphone and a laptop and the reliability of home and campus internet.

Procedure and analysis

Students completed the questionnaires in class, and teachers completed theirs during staff meetings. Ethical approval was obtained before data collection began, informed consent was obtained from all participants, and they were assured of anonymity. Interviews lasted between 25 and 40 minutes, were audio-recorded with the permission of participants and then transcribed. Each observed lesson was recorded on the checklist together with field notes.

Each construct score was the mean of its four items, and mean scores were interpreted as low (1.00 to 2.49), moderate (2.50 to 3.49) or high (3.50 to 5.00). Survey data were analysed

using descriptive statistics, namely means, standard deviations, frequencies and percentages, computed separately for students and teachers, and differences between the two groups were tested with independent-samples t tests using Welch's correction, with Cohen's d as the effect size and a Bonferroni-adjusted significance level of .007 for the seven comparisons. Interview transcripts and observation notes were analysed thematically; they were read repeatedly, coded and grouped into themes that captured patterns and meanings across participants, and for each theme the number of interviews and observed sessions in which it appeared was recorded. The two strands were compared at the stage of interpretation to see where they agreed and where they differed.

Results

Respondent profile

Table 4 shows the distribution of participants across the four institutions. The survey reached 240 students and 60 teachers, a ratio of four students to every teacher. Institution A, a university, contributed the largest numbers (70 students and 18 teachers), followed by Institution C, a polytechnic (60 students and 16 teachers), Institution B, a second university (60 students and 14 teachers), and Institution D, a college of education (50 students and 12 teachers). Eighteen interviews were conducted, ten with teachers and eight with students, and four lessons were observed in each institution, giving 16 sessions in all.

Table 4

Participants by Institution

Institution	Type	Students	Teachers	Interviews	Observed sessions
Institution A	University	70	18	5	4
Institution B	University	60	14	4	4
Institution C	Polytechnic	60	16	5	4
Institution D	College of education	50	12	4	4
Total		240	60	18	16

Note. Interviews and observed sessions are counts of participants and lessons.

Survey findings

Table 5 reports the construct scores for students and teachers. Teachers reported using digital tools for learner-centred activities at a moderate level ($M = 3.37$, $SD = 0.66$), and students reported a slightly lower level of such use ($M = 3.05$, $SD = 0.72$). Among teachers, 47 of 60 (78.3%) used a learning platform at least weekly, compared with 31 (51.7%) for interactive quizzes or polling, 28 (46.7%) for shared documents, 24 (40.0%) for recorded lessons and 20 (33.3%) for discussion boards.

Table 5

Descriptive Statistics for Survey Constructs and Access Indicators

Construct	Students *M*	Students *SD*	Teachers *M*	Teachers *SD*	*t*	*p*	*d*
Use of digital tools in learner-centred activities	3.05	0.72	3.37	0.66	−3.30	.001	−0.45
Perceived usefulness	3.86	0.68	4.12	0.59	−2.96	.004	−0.39
Perceived ease of use	3.61	0.64	3.30	0.67	3.23	.002	0.48
Teacher digital skills	3.48	0.62	3.05	0.73	4.20	< .001	0.67
Available facilities	2.76	0.70	2.96	0.70	−1.98	.051	−0.29
Student engagement	3.65	0.71	3.53	0.66	1.24	.218	0.17
Equitable access	2.44	0.69	2.63	0.60	−2.13	.036	−0.28
Access indicators (percentage reporting)							
Own a smartphone	92.9		98.3				
Own a laptop	36.3		86.7				
Reliable home internet	27.5		68.3				
Reliable campus internet	41.3		45.0				

Note. Scores range from 1 to 5, and higher scores indicate more of the construct. Students, n = 240; teachers, n = 60. For teacher digital skills, students rated their teachers and teachers rated themselves. For equitable access, students rated their own access and teachers rated students' access. Percentages in the lower panel are shares of each group. The t and d values compare students with teachers (Welch's t tests; d uses the pooled standard deviation) and are computed as students minus teachers, so a negative sign means that teachers gave higher ratings. Significance is judged at .007, the Bonferroni-adjusted level for seven comparisons.

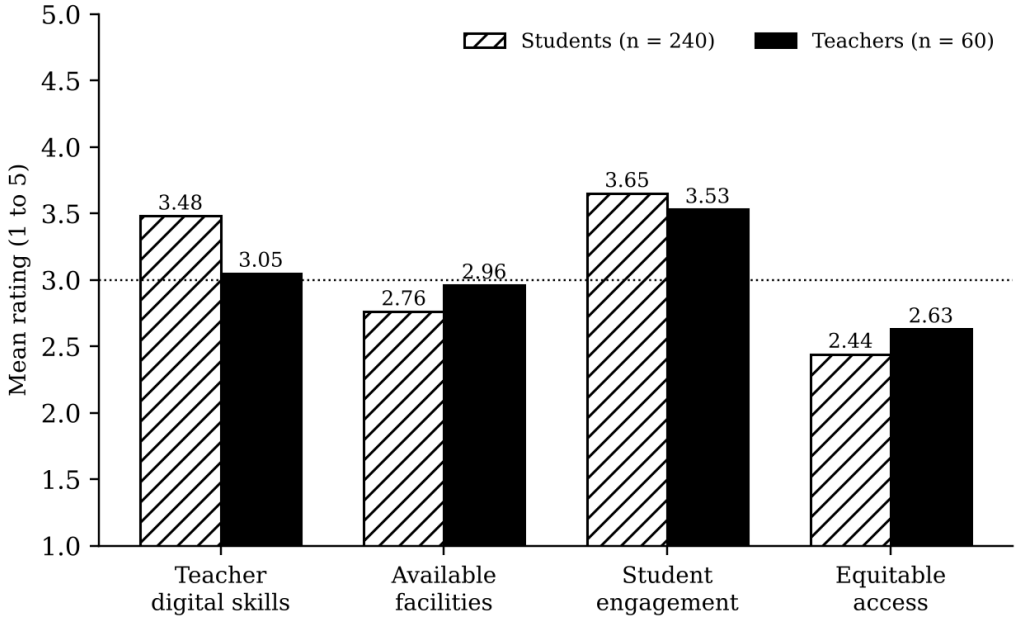
Perceived usefulness was rated highly by both groups, with a teacher mean of 4.12 (*SD* = 0.59) and a student mean of 3.86 (*SD* = 0.68). Perceived ease of use was rated lower, and the pattern between the groups was reversed, with teachers at 3.30 (*SD* = 0.67) and students at 3.61 (*SD* = 0.64).

Welch's t tests showed significant group differences for learner-centred use, perceived usefulness, perceived ease of use and teacher digital skills (Table 5). Teachers reported more learner-centred use and higher perceived usefulness than students did. Students rated perceived ease of use and their teachers' digital skills higher than teachers did. The differences for available facilities, student engagement and equitable access were not significant at the adjusted level. Effect sizes ranged from small to moderate, with absolute values of d from 0.17 to 0.67.

Figure 3 compares the four factors examined as possible enablers and barriers. Student engagement received the highest ratings from both students (*M* = 3.65, *SD* = 0.71) and teachers (*M* = 3.53, *SD* = 0.66). Teacher digital skills were rated 3.48 (*SD* = 0.62) by students and 3.05 (*SD* = 0.73) by teachers themselves. Available facilities fell below the scale midpoint for both students (*M* = 2.76, *SD* = 0.70) and teachers (*M* = 2.96, *SD* = 0.70), and equitable access received the lowest ratings in both groups (students *M* = 2.44, *SD* = 0.69; teachers *M* = 2.63, *SD* = 0.60).

Figure 3

Mean Ratings of the Four Factors by Students and Teachers



Note. Ratings range from 1 to 5. The dotted line marks the scale midpoint of 3.00.

The access indicators in the lower panel of Table 5 show that smartphones were nearly universal among students (92.9%) and teachers (98.3%), whereas laptop ownership was reported by 36.3% of students and 86.7% of teachers. Reliable home internet was reported by 27.5% of students and 68.3% of teachers, and reliable campus internet by 41.3% of students and 45.0% of teachers.

Interview and observation findings

Four themes were identified in the interview and observation records, and Table 6 gives the number of interviews and observed sessions in which each appeared. Teacher skills and confidence featured in 15 of the 18 interviews. Participants described a small set of tools that they used with confidence, and most reported having learned them informally, while in 8 of the 16 observed sessions the lesson paused so that the teacher could resolve a difficulty with a tool. Facilities and connectivity were raised in 17 interviews, and disruptions linked to the network, power or device availability occurred in 9 sessions, of which 7 involved network interruptions.

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Table 6
Themes from Interviews and Classroom Observations

Theme	Pattern identified	Interviews (of 18)	Sessions (of 16)	Excerpt
Teacher skills and confidence	A narrow set of tools used with confidence; tools mostly learned informally	15	8	"I know what the tool can do, but I only learned it by trying it in front of the class." (T4)
Facilities and connectivity	Network interruptions, power and device availability halted digital activities	17	9	"When the network drops, the group activity stops and we fall back to the board." (T7)
Student engagement through interaction	Polling, shared documents and group tasks drew contributions from quieter students	14	7	"When the quiz is on our phones, even the quiet ones answer." (S3)
Equitable access to devices and data	Phones shared within groups; limited data for students without home internet	16	6	"Some of us share one phone for the group, so only that person is really doing the task." (S6)

Note. T = teacher; S = student. The counts show the number of interviews and observed sessions in which each theme appeared.

Student engagement through interaction was described in 14 interviews. Digital tools were used in 11 of the 16 observed sessions, and in 7 of these students contributed, produced or responded through the tool, whereas in the other 4 the tool was used by the teacher to display material. The remaining 5 sessions did not involve digital tools. Concerns about equitable access to devices and data were raised in 16 interviews, and students were seen sharing a device in 6 sessions.

Discussion

Digital tool use and learner-centred practice

Digital tools were in use at a moderate level and were judged useful, but the way they were used varied across lessons. Only 7 of the 11 observed lessons that used a digital tool

involved students acting through it, while in the other 4 the tool served the teacher's presentation. This split bears directly on the aim of the study, because the presence of a tool did not settle whether a lesson was learner-centred. It is consistent with the concern in writing on post-pandemic higher education that technology has to be balanced with pedagogy (Rapanta et al., 2021) and with the effort in reviews of student-centred learning environments to identify digital practices that specifically support such environments (Otto et al., 2024). Teachers' use of a learning platform at least weekly (78.3%) was far more common than weekly use of shared documents (46.7%) or discussion boards (33.3%), which suggests that tools supporting joint work were adopted less readily than tools that distribute material, although the data do not show why.

Enablers and barriers

Student engagement was rated highest of the four factors and was visible in the 7 sessions where students acted through a tool. Omeh et al. (2024) reported higher engagement, achievement and digital skills among computer education students taught with Google Classroom and Google Meet in a quasi-experimental study, and Hossain (2023) and Pichardo et al. (2021) described engagement gains from single tools in particular classes. The present study covers several tools and institutions, and its agreement in direction with those reports should be read with care, since its design is descriptive and cannot show that digital tools caused the engagement observed.

Facilities and equitable access received the lowest ratings, and the interviews and observations gave these ratings concrete form through network interruptions, shared phones and limited data. This pattern matches the persistence of ICT infrastructure, technical support and bandwidth problems found in the systematic review by Van der Merwe et al. (2023), and it sits within the wider set of regional barriers described by Zickafoose et al. (2024) and the institutional challenges reported from Lesotho by Matee et al. (2023). The access indicators also show a difference between groups that the means alone conceal: nearly all respondents owned a smartphone, but only 27.5% of students reported reliable home internet and 36.3% owned a laptop, a gap that echoes the concern with digital literacy and access among higher education students in sub-Saharan Africa (Ndibalema, 2025; Oladele et al., 2023). Students with disabilities were not identified separately in this study, so the findings cannot extend the work of Zongozzi and Ngubane (2025) on that group.

Teachers rated their own digital skills ($M = 3.05$) lower than students rated their teachers' skills ($M = 3.48$), a statistically significant difference, and the interviews suggested that teachers had learned tools informally and used a narrow set with confidence. This accords with the concerns voiced by lecturers in Chimbunde and Jakachira (2025) and with the interest in digital competence in the Nigerian setting examined by Ogunbodede et al. (2023). Antonietti et al. (2022) asked whether competence influences technology acceptance, and the present data cannot test that link, but the combination of high perceived usefulness and only moderate perceived ease of use among teachers is the pattern to which acceptance models direct attention (Alyoussef, 2022; Kemp et al., 2024; Lin & Yu, 2023).

Interpretation through the two frameworks

Viewed through Vygotsky's sociocultural theory, the sessions in which students responded to polls or worked in shared documents offered the kind of participation the theory requires, and the interview excerpt on quieter students answering a quiz suggests that the tools lowered the cost of taking part. Where one phone served a whole group, however, the task fell to one student, so the interaction and support that the theory treats as the source of growth were

unevenly spread. Rigopouli et al. (2025) discuss Vygotsky's ideas in the design of technology-enhanced learning, and the present observations suggest that equitable access is part of that design problem and not a separate matter.

Viewed through the Technology Acceptance Model, teachers' high perceived usefulness did not translate into frequent learner-centred use, which stood at a moderate level. Facilities and access appear to stand between judging a tool useful and being able to use it as intended. Reviews of the theories applied to technology in education and of teachers' technology acceptance describe models that have been extended with further factors (Galimova et al., 2024; Sackstein et al., 2023), and Ndebele and Mbodila (2022) applied the model in a resource-constrained university setting. The present findings are compatible with extending the model to include facilities and access, but the study did not test an extended model, and this remains a question for future research.

Implications for practice and policy

For teachers, the findings point towards starting with a small number of tools that invite student contribution, such as polling and shared documents, and planning activities that can continue offline when the network fails. Pairing students so that devices are shared by design and not by default may reduce instances in which one student carries a group task alone. Peer-led sessions in which teachers demonstrate tools to one another could address the informal and uneven learning of tools that interview participants described.

For institutional administrators, the ratings for facilities, together with the 9 observed sessions affected by disruption, indicate that reliable campus networks, power and technical support are conditions for learner-centred use and not additions to it. For education policymakers, the gaps in laptop ownership and home internet between students and teachers suggest that policies should address student access directly, through support for devices and data, and should monitor how tools are used and not only whether they are available. Attention to students with disabilities, raised by Zongozzi and Ngubane (2025), would extend such policies to students who may be missed by general measures.

Conclusion

The study set out to examine how digital innovation can help teachers put students at the centre of learning, and its findings answer the three research questions in turn. Teachers and students described digital tool use for learner-centred activities as moderate, and observation showed that in 7 of 11 lessons using a tool students acted through it. Student engagement through interaction and perceived usefulness of digital tools acted as enablers. Limited facilities and connectivity and unequal access to devices and data acted as the main barriers, with equitable access rated lowest by both students ($M = 2.44$) and teachers ($M = 2.63$), while teachers' limited confidence with tools, which most had learned informally, was a further constraint.

The study has some limitations. It covered four higher education institutions and 16 observed lessons, relied partly on self-reported ratings, and used a descriptive design, so it cannot show that digital tools caused the patterns reported. Future studies could test the relationships among usefulness, ease of use, facilities and access in an extended acceptance model, follow the same institutions over more than one term, and include students with disabilities as a separate group. The practical suggestions above are offered to teachers, institutional administrators and education policymakers as a starting point for improving teaching and learning through technology.

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