International Journal for Multidisciplinary Research (IJFMR)

E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Enhancing Academic Performance through Whole-School ICT Integration

Nidup Tshering

Principal, Nganglam Lower Secondary School

Abstract

This article presents the action research undertaken to ascertain the impact and perceptions toward the whole schools information and communication technology (ICT) intervention in context-specific teaching-learning practices at Nganglam Lower Secondary School in Bhutan. The school had been facing a “policy-practice gap,” coupled with stagnating academic results at an average of 86% (2021-2024). The intervention scheme, which was initiated in 2025, involved the installation of differentiated classroom hardware (smart TVs and projectors), a three-time expansion of computer laboratories (from 1 to 3), and extensive teacher training. Data were generated through a convergent parallel mixed-methods research design, in which a stratified representative group of students (n = 114 selected and analyzed for perceptions) and teachers (n = 10) were asked to participate. The students and the teachers received closed-ended six-point Likert-type questions, structured qualitative interviews, and terminal academic results as research instruments. Both students (M = 4.84; six-point Likert scale) and teachers (M = 5.28) indicated extremely positive perceptions toward the ICT intervention, which was associated with increased engagement and enhanced conceptual understanding. Additionally, the overall academic pass percentage of the school was found to have improved from 86% (2021-2024) to 94% in 2025 (+8%). Nevertheless, qualitative results also revealed a number of individual and institutional hindrances (internet connection instability, equipment shortages, and power supply disruptions). The study revealed that whole-school ICT intervention tends to be positively perceived and associated with increased academic achievement, whereas infrastructural and teacher support is required for its long-term success.

Keywords: ICT integration, whole-school approach, academic performance, stakeholder perceptions, constructivist learning, and infrastructural barriers

Introduction

Worldwide, educational practices are witnessing a paradigm shift from conventional to technologically-enhanced, constructivist classrooms (Nketiah-Amponsah et al., 2017; Tenzin et al., 2026). Within constructivism, the adoption of interactive classroom Information and Communication Technology (ICT) resources, such as smart screens, projectors and internet resources, transforms the didactic 'chalk-and-talk' mode of teaching (Das & Middya, 2025; Ghavifekr & Rosdy, 2015). Through the visualization of abstract concepts in a multi-sensory manner, the application of ICT resources in pedagogical practice enhances student motivation, collaborative knowledge construction, and academic performance in core secondary school subjects (Ghavifekr & Rosdy, 2015; Shah, 2025).In line with the aforementioned global trends, the Royal Government of Bhutan emphasizes the need for digitization as a strategy to empower 'nationally rooted and globally competent citizens' in a technologically advanced world (Tenzin et al., 2026). In pursuit of this vision, Bhutan's Ministry of Education and Skills Development (MoESD), under the direct supervision of His Majesty the King, spearheaded the consecutive national ICT strategies, including the iSherig-1 (2014-2018) and iSherig-2 (2019-2023) ICT Master Plans, in collaboration with the Bhutan Education Blueprint (2014-2024). The aforementioned policies promote the application of digital resources in the national school curriculum, from pre-primary through to Grade XII, while simultaneously incorporating Science, Technology, Engineering, and Mathematics (STEM) and emerging fields, including Robotics and Artificial Intelligence, in school pedagogical practices. As a result of the government's intensified focus on national digital transformation, school internet connectivity in Bhutan increased from 64.8% to 89.8% between 2021 and 2022, respectively, while the average student-computer ratio in Bhutanese schools improved to 9:1.

Nonetheless, research in the field suggests the prevalence of a 'policy-practice gap' in Bhutan's educational system, wherein national policies regarding classroom technology integration do not automatically translate into successful classroom practice, especially in rural schools (Tenzin et al., 2026). Such a policy-practice gap can be better understood by conceptualizing a school as a Complex Adaptive System (CAS) (Giri et al., 2025). A school is an open social system, wherein school infrastructure, administrators, teacher Technological Pedagogical Content Knowledge (TPACK), and student digital readiness, among other factors, interact recursively to produce emergent properties in the educational environment. When applied within the confines of a CAS, the installation of an isolated technology such as an ICT laboratory does not yield positive results because it is seen as a 'bolt-on' resource detached from the classroom context (Yeigh & Lynch, 2020). Rather, educational improvement requires a whole-school approach that employs a set of inter-related classroom instructional technologies, complemented by teacher Professional Development (PD) and school-based technology training for students (Giri et al., 2025; Shah, 2025).

Objectives

1. To examine the perceptions of teachers and students regarding how whole-school ICT integration influences the overall academic success.
2. To evaluate the impact of whole-school ICT integration on student achievement by comparing students' academic performance before and after the intervention at Nganglam Lower Secondary School.

Situation Analysis

Nganglam Lower Secondary School, operating in the Pema Gatshel Dzongkhag context, has traditionally struggled to localize national ICT mandates within its own academic programs. Indeed, a close examination of the school's historical academic records from 2021 to 2024 indicates that students' average scores have remained stagnant at just 86%, with the learners' achievement levels predominantly categorized within the" average" and "poor" competency brackets [Academic Performance score reports, 2021-2024]. Such a performance level was significantly influenced by the school's pedagogical reliance on the conventional chalkboard lectures, which, in turn, continued to be reinforced through the existence of first and second order barriers, including: (1) the absence of a well-equipped computer laboratory for educational use, and (2) varying levels of computer literacy and pedagogical competency among teachers.

To address the situation, a comprehensive whole-school ICT research intervention was formalized and officially launched in 2025. Before actual implementation, the intervention design received the necessary institutional clearance and ethical approvals from the Pema Gatshel Dzongkhag Education Office. In particular, the research endeavor was executed under the protection of the relevant institutional ethical guidelines, whose primary objective was to ensure participant safety.

The 2025 intervention aimed at transforming the school's digital infrastructure through the following key components:

1. Differentiated Classroom Level ICT Infrastructure

The school's ICT infrastructure was restructured to create a differentiated classroom environment, which could cater to diverse developmental needs and academic competencies of the learners:

Classes 4 and 5: Smart TVs and internet connectivity were introduced to enable teachers to enrich their lesson plans with digital content, including spelling/grammar games and mathematics tools;

Classes 6-8: LCD projectors were permanently installed in the classrooms to enable teachers to demonstrate specific STEM content, engage the learners into classroom slideshow presentations, and support collaborative research endeavors;

• Smartboard (interactive whiteboard) was introduced in the shared learning space to facilitate whole class interactive presentations and assessment.

2. Increasing Hands-on Access Points

To increase hands-on access points and reduce the overall learning digital divide, the school's computer infrastructure (i.e., computer labs) was expanded from 1 to 3. Such a decision was based on the school's understanding of the fact that the most promising way to increase computer literacy rates is to provide the learners and teachers with opportunities to actually interact with the computer equipment.

3. Human Capital Development

The school recognized the fact that the most critical lever to pull for academic improvement is to be found in the enhancement of the educators' competencies. Therefore, teachers participated in a series of professional development activities and technical trainings, which sought to transform their understanding of the potential of technology-assisted education. In particular, participants were exposed to advanced practice of active constructivist pedagogy (e.g., online assessments), which could be utilized to shift the paradigm from traditional lecture-based teaching to the modern learner-centered constructivist approach.

By investing into the development of the physical classroom infrastructure (LCD projectors, smart TVs and internet access points), combined with a meaningful enhancement of the teaching staff's technical competencies, the school expects to be able to transform the learning environment into a student-centered constructivist platform, which will facilitate student engagement and ultimately lead to improved academic outcomes.

Competence

Researcher

I am a teacher and school administrator with a good command of teaching, school leadership, and research skills. I graduated from the Primary Teachers' Certificate, Paro in 2000 and served as a teacher until 2007. Since 2008, I have been working as a school principal in different schools, which endowed me with leadership and teaching expertise. Additionally, I have also undertaken various research studies both in conventional and action research. I pursued Bachelor of Education (Primary) through distance education from 2012 to 2014, which involved carrying out action research. I also completed tmy Master of Education in Leadership and Management from 2016 to 2021, which involved conventional research.

These research studies endowed me with the requisite skills for undertaking any form of research studies, including identifying research areas, intervention planning, data collection and analysis, and interpretation and reporting of research results. My professional teaching and administrative skills in addition to the research experience helped me to conduct the present action research study appropriately.

Participants

The participants of the study included teachers and students from classes IV to VIII. The Participants were selected through a highly structured, stratified representative sampling model to represent the target population. The teachers offered their professional insights into the pedagogy and didactics of using ICT for teaching and learning. The participants had the necessary expertise, including teaching experience, to provide their views and recommendations regarding the study. The teachers' professional skills and knowledge were utilized to evaluate the pedagogical issues, classroom practices, access, and use of ICT in teaching and learning.

Both teachers and students provided their perspectives according to their level of understanding regarding the role of ICT in education. The students were selected from classes IV to VIII and offered their views and experiences as learners in using ICT in education. Their knowledge and experiences were relevant to evaluate the effectiveness of ICT in education based on their engagement, access, understanding, participation, and potential benefits.

Critical Friend

The critical friend for the study was Karma Nidup. He is an experienced teacher with a teaching career of 12 years. Currently, he works at Lango Higher Secondary School Paro as a teacher. He joined the teaching profession right after completing his bachelor in Education, B.Ed in History and Geography in 2014. However, in 2023, he completed his Master of Education in Geography from Samtse College of Education, Samtse.

His professional competence is reflected in his academic qualifications and research experience. He has also been engaged in conventional research as well as action research and has four conventional research publications and two action research publications. Thus, based on his academic qualifications, teaching experience, and research experience, Karma Nidup was considered a suitable critical friend for the study. The critical friend was involved in reviewing the research studies, especially the design, research question, analysis and interpretation of results, and report writing. As a critical friend, Karma Nidup played a critical role in providing his independent views and recommendations concerning the study. In addition to giving his views and recommendations on the research study, he also aided in critically reviewing the research study to uncover assumptions, weaknesses, threats to the validity of the study, and areas that might have been overlooked. Such feedback was vital to ensure that the action research process was carried out systematically and professionally.

Literature Review

Introduction

In the 21 st century, teaching with Information and Communication Technology (ICT) is no longer a luxury but a necessity in the art of knowledge delivery and skill acquisition (Das & Middya, 2025; Ghavifekr & Rosdy, 2015). Educational systems around the world are undergoing a digital transformation to prepare learners for the complexities of a more globalized and digital economy (Zou et al., 2025). At the national level, the Royal Government of Bhutan has articulated a strong vision for developing the Kingdom as an inclusive and digitally empowered knowledge society through the iSherig ICT Master Plans (2014-2023) and the Bhutan Education Blueprint (2014-2024). The government's current thrust is on scaling up school-level digitization to improve the student-computer ratio to 9:1 and achieve nationwide internet connectivity of 89.8% by 2022 (Tenzin et al., 2026). This is because technology should trigger student collaboration to realize Bhutan's dreams of an inclusive and digitally empowered knowledge society (Tenzin et al., 2026).

Whole-school technology integration is a holistic and comprehensive concept that goes beyond merely treating ICT as an optional or specialized subject (Mooij & Smeets, 2001). It includes providing appropriate hardware and software platforms in all instructional settings, continuous professional development (CPD) to improve teachers' pedagogical content knowledge (PCK), and student training in digital skills and information literacy (Tenzin et al., 2026; Giri et al., 2025). Whole-school ICT integration goes beyond putting a few computers in a school laboratory and making them available to selected learners on a rotational basis. Instead, it entails a total commitment to transforming existing administrative, pedagogical, and learning practices through the infusion of digital tools in all learning settings (Ghavifekr et al., 2014).

Therefore, the objective of this review is to generate a conceptual background for the study being conducted at Nganglam Lower Secondary School. In particular, the paper will discuss the extent to which student grades in the school have improved after the intervention and stakeholders' perceptions thereof. The review will also discuss technology integration in lower secondary education to provide a conceptual background for developing the proposals and addressing the research questions. This study will benefit from a thorough literature review on whole-school ICT integration at local, regional, and global levels to help answer the study's main research question, specific questions, and sub-questions (Tenzin et al., 2026; Giri et al., 2025).

Conceptualizing Whole-School ICT Integration

Understanding factors that promote or hinder the adoption of innovations in educational settings is a critical issue in school development studies (Lawrence, 2018). In particular, whole-school ICT integration is informed by the Technology Acceptance Model (TAM), which holds that for an organization to embrace a new innovation, there must be intentions to use it based on its overall utility and level of simplicity (Davis, 2003; Tenzin et al., 2026). Therefore, for whole-school technology integration to be successful, there must be collective acceptance of the innovation by all stakeholders, including administrators, teachers, and students. This is because a school is a complex social institution that requires adjusting the behavior of all its members for integration to be successful (Giri et al., 2025; Akram et al., 2022).

A whole-school ICT integration initiative consists of three main interrelated pillars: infrastructure, human resources (HR), and curriculum. First, the term infrastructure refers to the availability of hardware and software resources in every instructional setting. This includes laptops and desktop computers, projectors and smart boards, educational software, and smart TVs, which must be complemented by stable and high-speed internet connectivity (Tenzin et al., 2026; Ghavifekr & Rosdy, 2015). Second, the success of whole-school ICT integration depends on whether teachers' pedagogical content knowledge (PCK) and technological pedagogical content knowledge (TPACK) have improved through continuous professional development (CPD). Ideally, CPD should be practical and help teachers develop the confidence and skills to transform their teaching practices (Aslam et al., 2021; Lawrence, 2018). Third, the curriculum must be aligned with the availability of ICT resources to ensure that they complement and enhance learning in every lesson plan and scheme of work. In other words, digital tools must be used to achieve specific lesson objectives by enabling students to be more analytical and critical thinkers instead of being mere recipients of knowledge (Tenzin et al., 2026; Hennessy et al., 2005).

ICT Integration and Students' Academic Performance

The effect of ICT integration on students' academic performance has been widely researched, with studies concluding that technology use in classrooms has a positive effect on learners' achievement, grades, and scores (Bindu, 2016; Das & Middya, 2025). This is because the use of digital tools supports the highest levels of Bloom's Taxonomy: analysis and synthesis (Ghavifekr & Rosdy, 2015; Ben Youssef et al., 2022). In particular, students can achieve better results when they are encouraged to collaborate and participate more in classroom activities using digital resources (Aslam et al., 2021; Lawrence, 2018).

However, research findings are mixed, with some studies indicating that the use of technology in classrooms has no effect on students' grades. For instance, in Tunisia and Ghana, the use of computers in institutions has not had a significant effect on learners' achievement (Ben Youssef & Dahmani, 2016; AcademicPerformancePaper2020). This is partly because the use of digital tools in classrooms without adequate support and guidance may cause more harm than good. For instance, unrestricted access to mobile phones can encourage students to spend more time on social media, games, and other entertaining applications (AcademicPerformancePaper2020; Ben Youssef et al., 2022).

Research indicates that in core academic subjects, including science, technology, engineering, mathematics (STEM), and languages, digital tools can help students achieve better results and grades (Ghavifekr & Rosdy, 2015; Ben Youssef et al., 2022). In particular, computer-assisted instruction and laboratories allow students to learn concepts and practice skills in a fun and interactive way, thus promoting higher-order skills such as analysis, synthesis, and evaluation (Ismajli et al., 2021; Ghavifekr & Rosdy, 2015). In language classes, multimedia resources such as videos and interactive software can help promote interaction and collaboration among learners, thus boosting their reading, writing, listening, and oral skills (Ghavifekr & Rosdy, 2015; Hennessy et al., 2005). Moreover, 'Before and After' studies that use control and experimental groups to determine the effect of an intervention have also revealed that students who use digital tools in classrooms achieve better results than those who learn through conventional methods (Ismajli et al., 2021; Ghavifekr & Rosdy, 2015).

Stakeholder Perceptions: Teachers and Students

Assessing stakeholders' perceptions is often a critical step in most action research studies since interventions are only useful if they address the key concerns of those who will implement them (Tenzin et al., 2026; Lawrence, 2018).

Teachers' Perceptions

Most teachers perceive ICT as a vital enabler of quality education that should be used to change the status quo of conventional, rigid, and examination-led pedagogy. In particular, 86.3% of teachers agree that using digital tools in classrooms promotes active learning and is more engaging than the traditional lecture method (Tenzin et al., 2026). They perceive ICT as a tool that changes the dynamics of teaching and learning, thus creating a constructivist and student-centered classroom (Giri et al., 2025; Bindu, 2016). Ghavifekr & Rosdy (2015) argue that teachers go through three stages when adopting a new technology: integration, enhancement, and complementary use. In the first stage, teachers adopt a computer-assisted instruction model where they use digital tools to support or explain difficult concepts in a given topic. In the second stage, teachers use presentation software such as PowerPoint to make lectures more appealing and interactive. In the third stage, teachers use ICT to complement their teaching efforts, for instance, by assigning classwork and receiving submissions electronically.

However, these positive perceptions of teachers do not translate to positive behaviors due to various challenges, including inadequate infrastructure, time, training, and support. Teachers report that the absence of adequate resources such as stable internet connection and functional computers discourages them from using digital tools in their teaching practice (Tenzin et al., 2026; Lawrence, 2018; Hennessy et al., 2005). Additionally, they have less time to prepare lessons using digital tools since they must also submit written reports and lesson plans to the administration (Hennessy et al., 2005). Finally, most teachers lack the required skills to use technology in classrooms due to a shortage of training and technical support, thus deterring them from adopting it (Tenzin et al., 2026; Lawrence, 2018).

Students' Perceptions

Students have very positive perceptions of using ICT in classrooms because they view it as an exciting and motivating learning methodology (Ghavifekr & Rosdy, 2015). In particular, perceptual studies have shown that students like being engaged through multimedia resources such as games (e.g., Kahoot), videos, and online quizzes (Tenzin et al., 2026; Ismajli et al., 2021). They also appreciate the ability to connect and collaborate with their teachers and peers more freely and openly when using digital tools (Tenzin et al., 2026; Akram et al., 2022). On the other hand, students are concerned with the slow internet speed and the unavailability of sufficient devices in some schools, especially those in remote areas (Tenzin et al., 2026; Ben Youssef et al., 2022).

Challenges And Best Practices

ICT integration in a whole-school setting is often associated with a wide range of challenges, which must be carefully considered when designing an action research plan (Lawrence, 2018; Tenzin et al., 2026).

Common Challenges

Challenges facing whole-school ICT integration can be categorized into individual and institutional factors (Lawrence, 2018). In developing countries like Bhutan, the main institutional challenges are related to inadequate infrastructure, limited financial resources, and resistance to change. First, most schools lack sufficient ICT infrastructure, including stable internet, functional computers, and electricity. Additionally, there are limited budgets for maintenance and new purchases, thus limiting the capacity of institutions to adopt and scale up technology use in education (Tenzin et al., 2026; Lawrence, 2018; Ghavifekr et al., 2014). Second, most schools in Bhutan experience a wide digital divide, with urban schools being more connected than their rural counterparts (Tenzin et al., 2026; Ghavifekr et al., 2014). Finally, stakeholders such as teachers and administrators are often reluctant to embrace a new method of teaching because they are used to the conventional lecture-based system (Lawrence, 2018).

Best Practices

There are several best practices for addressing the main challenges discussed above (Zou et al., 2025).
Administrative leadership: School administrators play a critical role in promoting ICT integration by providing the required resources and creating an enabling institutional environment. Ideally, school leaders such as the headteacher should take the lead in adopting digital tools and encourage their use among teachers and students (Lawrence, 2018; Giri et al., 2025).
Peer group planning: Teachers should adopt a peer-coaching strategy where they share and discuss lesson plans to ensure that all classes are using similar digital tools and aligning their lessons with the same objectives (Ismajli et al., 2021; Giri et al., 2025).
Technical support: Schools should appoint an ICT coordinator who can provide technical support and guidance to teachers in using different digital tools without disrupting the teaching and learning process (Tenzin et al., 2026; Akram et al., 2022).
Monitoring and Evaluation: Schools should continuously review and evaluate the usefulness of the tools being used to ensure that they align with the intended objectives.

Conclusion

Based on the review, it is evident that whole-school ICT integration entails a continuous process that includes providing appropriate technology platforms, improving teachers' skills, and aligning lessons with learning objectives (Tenzin et al., 2026; Ghavifekr & Rosdy, 2015). If successfully achieved, it can improve students' achievement, grades, and class participation while also supporting the shift from the conventional teacher-centered lecturing to the more contemporary constructivist and student-centered learning approaches (Giri et al., 2025; Ismajli et al., 2021).
However, there is still limited literature on whole-school ICT integration at the lower secondary level in Bhutan's rural schools. The current review indicates that most of the research done so far has been conducted in developed and urban communities worldwide, thus limiting the applicability of the findings in the local context (Tenzin et al., 2026; Rana, 2017). In particular, the review reveals a significant gap in the literature regarding the role that technology plays in the academic performance of students in grades VII to IX. Therefore, the current action research at Nganglam Lower Secondary School will contribute to filling this research gap by presenting the extent to which the intervention has improved student grades and class participation in the school. Its findings will also help local administrators understand how local stakeholders perceive digital learning before and after the intervention in a typical Bhutanese lower secondary school setting (Tenzin et al., 2026; Giri et al., 2025).

Research Question

What is the extent of improvement in students' academic performance following the adoption of whole-school ICT integration at Nganglam Lower Secondary School?

Research Sub-Questions

1. What are the perceptions of teachers and students regarding how whole-school ICT integration influences academic success?

2. How do students' academic performance compare before and after the implementation of whole-school ICT integration?

Data Collection

Research Design

The design of the study uses a convergent parallel mixed-methods design (Creswell, 2013) to meet the objectives of evaluating academic progression plus obtaining stakeholder experiences. The quantitative dataset (paired terminal grades and closed-ended Likert surveys) and qualitative dataset (structured interview transcripts) will be collected simultaneously within one school term. This design is particularly appropriate for exploring schools as complex adaptive systems (CAS) where elements such as physical infrastructure, pedagogical shifts, and leadership practices interact to determine student success (Giri et al., 2025; Yeigh et al., 2020). Transforming traditional school models into an integrated framework requires understanding of how these interacting variables determine outcomes (Giri et al., 2025).

Target Population and Sampling Framework

The target populations include students and teachers at Nganglam Lower Secondary School. Considering a high representativeness and manageable qualitative follow-ups by only one practitioner-researcher, a highly structured, stratified representative sampling model was designed:

Students (Classes 4–8)

The school has 19 unique sections from grades 4 to 8 with 647 total students. To obtain a representative but localized picture of the school, a stratified sampling framework selects exactly six (6) students from each of the 19 sections, achieving a highly balanced, representatively stratified student cohort of n = 114 students (approx. 17.6% of the school population). This avoids the self-selection bias of convenience samples to ensure equal representation of each of the 19 sections' micro-cultures.

Teachers (Classes 4–8)

A stratified representative cohort is used for the teaching staff. From N = 25 teachers instructing Classes 4 to 8, two (2) teachers are purposively selected from each class level, achieving a representative panel of n = 10 teachers (40% of the teaching population). Stratification is carefully balanced to select one science/STEM-focused teacher and one languages/humanities-focused teacher per grade level, isolating domain-specific pedagogical shifts (Tenzin et al., 2026).

Table 3.1: Stratified Student and Teacher Sampling Framework (n = 114 Students, n = 10 Teachers)

Grade Level	Section	Section Size (N)	Student Sampling Method	Student Sample (n)	Teacher Sample (n)
Class 4	4A	34	Random Selection from Roster	6	2 Teachers representing Grade 4
Class 4	4B	35	Random Selection from Roster	6	
Class 4	4C	36	Random Selection from Roster	6	

Class 4	4D	34	Random Selection from Roster	6	
Class 5	5A	39	Random Selection from Roster	6	2 Teachers representing Grade 5
Class 5	5B	39	Random Selection from Roster	6	
Class 5	5C	38	Random Selection from Roster	6	
Class 5	5D	38	Random Selection from Roster	6	
Class 6	6A	37	Random Selection from Roster	6	2 Teachers representing Grade 6
Class 6	6B	38	Random Selection from Roster	6	
Class 6	6C	38	Random Selection from Roster	6	
Class 7	7A	32	Random Selection from Roster	6	2 Teachers representing Grade 7
Class 7	7B	32	Random Selection from Roster	6	
Class 7	7C	32	Random Selection from Roster	6	
Class 7	7D	31	Random Selection from Roster	6	
Class 8	8A	39	Random Selection from Roster	6	2 Teachers representing Grade 8
Class 8	8B	36	Random Selection from Roster	6	
Class 8	8C	39	Random Selection from Roster	6	
Total (Classes 4-8)	19 Sections	647	Stratified Representative Selection	114	10

Data Collection Instruments

To ensure methodological rigor, the quantitative survey instruments are strictly closed-ended using a 6-point Likert scale to avoid mid-point neutral bias (Albirini, 2006; Isleem, 2003). Open-ended inquiry is completely separated and funnelled into structured qualitative interview protocols to maintain the accuracy of the triangulation (Creswell, 2013).

Quantitative Survey Questionnaires (6-Point Likert Scale)

The surveys use a scale coded as: 6 = Strongly Agree (SA); 5 = Agree (A); 4 = Somewhat Agree (SWA); 3 = Somewhat Disagree (SWDA); 2 = Disagree (D); 1 = Strongly Disagree (SD). The survey items were validated during pilot testing, achieving a strong Cronbach's alpha internal consistency score of $\alpha = 0.70$ (Tenzin et al., 2026).

Teacher Survey Instrument - Core Variables:

- Pedagogical Impact [T-SA1]: "The integration of ICT across the school has made my classroom lessons more engaging and interactive."
- Pedagogical Confidence [T-SA2]: "I feel adequately trained and confident in using ICT tools to support student learning."
- Academic Success [T-SB1]: "ICT integration has positively contributed to the improvement of students' overall academic performance."
- Student Survey Instrument - Core Variables:
- Engagement [S-SA1]: "I enjoy learning when teachers use computers, projectors, or other ICT tools in the classroom."
- Accessibility [S-SA2]: "I have sufficient access to ICT facilities (computer lab, digital devices, internet) to complete my school assignments."
- Academic Score Impact [S-SB1]: "Using ICT for learning has helped me score better marks in my tests and examinations."

3.3.2 Structured Qualitative Interview Protocols

Structured qualitative interviews are utilized to gather descriptive, narrative accounts from selected representatives to unveil why and how whole-school ICT integration changes learning practices:

Teacher Qualitative Prompts (Sample):

- In your experience, how has the adoption of whole-school ICT integration changed your day-to-day teaching methods and lesson delivery?
- What first-order or second-order barriers (e.g., infrastructural, scheduling, technical support, training) have you faced during implementation?
- Student Qualitative Prompts (Sample):
- How do you feel when your teachers use computers, smartboards, or videos during lessons compared to chalkboard teaching?
- Do you feel more confident about your academic progress because of the school's focus on ICT integration?

Data Analysis

Quantitative Grades & Survey Pipeline

Quantitative grades (pre-intervention versus post-intervention terminal marks) and survey metrics are analyzed in SPSS (v23) or RStudio, utilizing a strict descriptive and inferential significance pipeline (Toma et al., 2023):

Descriptive Analysis

Means (M), standard deviations (SD), and percentages of all 6-point Likert items.

Qualitative Interview Pipeline

Structured qualitative interviews are analyzed via a six-stage thematic analysis framework (Braun & Clar

ke, 2006) to guarantee transparency and trustworthiness (Lincoln & Guba, 1985):
Transcription & Translation: Verbatim transcription of audio recordings. Back-translation is applied for transcripts translated from Dzongkha to English to verify linguistic validity.
Familiarization with Data: Immersion and note-taking by the researcher to outline preliminary patterns.
Open Coding (Fracturing): Line-by-line coding of transcripts to capture direct stakeholder feedback on constructivist shifts, motivation, and barriers.
Axial Coding (Synthesizing): Conceptual aggregation of fractured codes into broader clusters, building out causal relationships under the Technology Acceptance Model (TAM).
Thematic Review & Refinement: Evaluation of code categories against the entire qualitative dataset. Inter-rater reliability testing is applied with a target consensus of > 90% (Ismajli et al., 2020).
Thematic Presentation: Final themes (e.g., "Pedagogical Re-centring from Teacher-Led to Constructivist Facilitation" and "First-Order Resource/Electricity Interruptions"), fully integrated with illustrative qualitative quotes.

Baseline Data

Before launching the action research, there is a need to explain how the school was performing before implementing the whole-school ICT integration initiative. First, it is essential to understand that the school was not using information and communication technology (ICT) to its maximum potential before the initiative. For instance, lessons were primarily delivered through traditional means such as whiteboards, markers, and chart papers using new technologies. Although the school had a computer laboratory with 35 desktop computers, they were not enough to empower the over 1100 students registered at the institution to gain computer experience. Furthermore, the school only had two projectors, one for the ICT lab and the other for the whole school. Additionally, there were only about 15% competent teachers in terms of using ICT for instructional purposes. Therefore, students were only exposed to computers and other learning resources in very limited ways.
Another baseline information is the pass percentage of the school, which is used to measure its performance. According to the statistics, the school's pass percentage was on average 86% between 2021 and 2024. Together with the lack of the use of ICT for instructional purposes and limited access to computers, the school needed to take drastic measures to improve its performance.

Ethical Consideration

Since the study involved minor students (Classes 4 to 8) and colleagues in the same institution, taking ethical considerations was unavoidable to ensure the research maintained a "fabric of trust". In that regard, minimizing the burden on the participants while maximizing benefits was achieved by
Getting institutional clearance and gatekeeping to ensure the study did not cause unnecessary harm to the participants. Thus, this study got the approval of the Dzongkhag Education Office to align it with the Thirty-Seventh Educational Policy Guidelines and Instructions (EPGI) issued by the Ministry of Education and Skills Development, Bhutan.
Implementing the informed consent and assent process to get the verbal or written permission of the participants. Specifically,the representational panel of n = 10 teachers gave their written consent to participate in the study. They confirmed that no adverse effect would result if the information revealed was used to question the competence of teaching staff regarding the lack of infrastructure or training.

Besides getting the verbal consent of the school administration, permission in the form of signed English-Dzongkha consent forms was obtained from the n = 114 student participants and their parents or guardians. At the same time, the children signed the assent sheet written in simple language.
•Every participant was reminded that their involvement in the study was voluntary, and they had the right to withdraw anytime without experiencing any adverse effects.
Ensuring anonymity, confidentiality, and security of data. For instance,
Pseudonyms were used to report the findings to avoid identifying any participant based on gender, age, and location. Thus, the participants were referred to as Teacher T1, and Student S12.
Confidentiality was maintained by avoiding the disclosure of the research findings to unauthorized bodies or individuals. Hard-copy questionnaires and interview transcripts were stored in a locked cabinet. At the same time, the interview recordings and de-identified terminal grades were saved in a computer securely installed on a password-protected device accessible only by the researcher1.
Reducing the burden on participants by avoiding disrupting the normal functioning of the school. Thus, questionnaire administration and interview sessions were scheduled in the free time, study hours, or club periods to ensure that no class time was wasted.

Intervention Phase

The intervention was implemented over a one and half -year period and was designed based on baseline findings that indicated the need for a systematic, whole-school approach to ICT integration. The intervention focused on strengthening ICT infrastructure, developing teachers' digital competencies, increasing students' access to technology, and enhancing parents' awareness of digital learning. Rather than treating ICT as an isolated classroom resource, the intervention was implemented as a school-wide initiative involving teachers, students, parents, and school management.
A major component of the intervention was the installation and expansion of ICT-enabled classroom facilities, including projectors for classes 6, 7 & 8 and Smart TVs across lower grade. These facilities were intended to support interactive teaching, multimedia presentations, visualization of abstract concepts, access to digital learning resources, and learner-centred classroom activities. The intervention also promoted the effective use of the school's computer laboratories by providing students with regular opportunities to engage with digital resources beyond conventional classroom instruction (Tenzin, 2026).
Teacher capacity development constituted another central component of the intervention. Teachers were provided with orientation and professional development opportunities to strengthen their digital literacy and confidence in integrating ICT into teaching and learning. All teachers were encouraged to complete the Digital Teacher Course, a self-paced online professional learning programme designed to support meaningful technology integration in classrooms. In addition, quarterly professional development programmes on digital literacy were conducted to provide continuous opportunities for teachers to develop and share ICT-based pedagogical practices. Selected teachers also participated in Digital Lopen, which further strengthened practical digital competencies, online safety awareness, cyber security knowledge, and the meaningful use of technology for classroom teaching.
To extend ICT integration beyond the classroom, parents were also engaged through digital literacy education during Parent Teacher Meetings (PTMs), conducted once in every six months. These sessions were intended to improve parents' understanding of digital learning, responsible technology use, and the ways in which ICT could support students' learning. This component recognized the importance of

parental awareness and support in creating a consistent digital learning environment for students both within and beyond school.

Students were provided with open access to the ICT laboratory on a daily basis under appropriate guidance and supervision. This enabled learners to explore digital resources, practise ICT skills, conduct learning-related searches, complete digital activities, and develop greater independence in using technology for academic purposes. Teachers provided guidance to ensure that ICT use remained purposeful and aligned with students' learning needs.

Through this ongoing cycle of infrastructure development, teacher professional learning, parental engagement, and guided student access, ICT integration gradually became embedded within the wider teaching and learning environment of the school. The one and half-year intervention was therefore intended not only to increase access to technology but also to promote sustainable changes in teaching practices, student engagement, and the use of digital resources for learning. Progress was monitored throughout the intervention using school-level implementation activities and academic performance data to examine changes following the adoption of whole-school ICT integration.

Findings

Quantitative Findings

Students' Perceptions of Whole-School ICT Integration

The perceptions of 114 students' towards the whole-school ICT integration were analyzed using the method of descriptive statistics. The responses were evaluated using a six-point Likert scale from 1 Strongly Disagree to 6 Strongly Agree. The mean scores were analyzed using a given grading structure.

Table 1Descriptive Statistics of Students' Perceptions of ICT Integration

No.	Statement	M	SD	Interpretation
1	I enjoy learning when teachers use computers, projectors, or other ICT tools in the classroom.	5.25	0.68	Strongly Agree
2	I have sufficient access to ICT facilities to complete my school assignments.	4.83	0.96	Agree
3	ICT tools make difficult subjects easier to understand.	4.73	1.07	Agree
4	Using ICT for learning has helped me score better marks in my tests and examinations.	4.78	0.90	Agree
5	ICT integration helps me remember lessons better through videos, digital presentations, and interactive quizzes.	4.93	0.80	Agree
6	I feel more confident about my academic progress because of the school's focus on ICT integration.	4.50	0.91	Agree
Overall		4.84	—	Agree

Note. M = mean; SD = standard deviation. Responses were coded from 1 (Strongly Disagree) to 6 (Strongly Agree). Mean scores of 4.34–5.17 indicate Agree, whereas 5.18–6.00 indicate Strongly Agree.

As shown in Table 1, students reported a generally positive perception of ICT integration (M = 4.84). The highest-rated aspect was enjoyment of ICT-supported learning (M = 5.25, SD = 0.68), indicating that ICT was particularly effective in making learning engaging. Students also rated lesson retention (M = 4.93) and access to ICT facilities (M = 4.83) positively. The lowest mean was observed for academic confidence (M = 4.50), although it remained within the positive range.

The findings suggest that students primarily experienced ICT as an engaging and supportive learning resource. This interpretation is reinforced by the qualitative interviews, where students described greater interest, improved understanding, and better retention when lessons incorporated videos, animations, images, simulations, and interactive activities.

Teachers' Perceptions of Whole-School ICT Integration

The perceptions of 10 teachers were also analysed using the same six-point Likert scale. The results are presented in Table 2.

Table 2 Descriptive Statistics of Teachers' Perceptions of Whole-School ICT Integration

No.	Statement	M	SD	Interpretation
1	ICT integration has made classroom lessons more engaging and interactive.	5.70	0.48	Strongly Agree
2	I feel adequately trained and confident in using ICT tools to support student learning.	5.30	0.48	Strongly Agree
3	Whole-school ICT integration provides better access to educational resources and learning materials.	5.60	0.52	Strongly Agree
4	Students show higher motivation and active participation when ICT tools are used.	5.10	0.57	Agree
5	ICT integration has positively contributed to students' overall academic performance.	5.10	0.57	Agree
6	Students demonstrate better critical-thinking and problem-solving skills through ICT-based tasks.	4.90	0.57	Agree
Overall		5.28	—	Strongly Agree

Note. M = mean; SD = standard deviation. Responses were coded from 1 (Strongly Disagree) to 6 (Strongly Agree).

Table 2 indicates that teachers held a very positive perception of whole-school ICT integration, with an overall mean of 5.28. The strongest rating concerned classroom engagement and interaction (M = 5.70, SD = 0.48), followed by access to educational resources (M = 5.60, SD = 0.52). Teachers also reported strong confidence in using ICT (M = 5.30). The lowest-rated item concerned critical thinking and problem-solving (M = 4.90), although this remained within the Agree category.

The consistency of the teacher responses is notable, with standard deviations ranging from 0.48 to 0.57. This suggests that the positive perceptions were broadly shared among the participating teachers.

Comparison of Student and Teacher Perceptions

Table 3 Comparison of Overall Student and Teacher Perceptions of ICT Integration

Respondent Group	N	Overall M	Interpretation
Students	114	4.84	Agree – High/Positive
Teachers	10	5.28	Strongly Agree – Very High/Highly Positive

Note. The two groups responded to different questionnaire items reflecting their respective perspectives; therefore, the means should be interpreted descriptively rather than as a direct statistical comparison.

Both groups expressed favourable perceptions of ICT integration, although teachers reported a higher overall mean than students. Students most strongly endorsed enjoyment of ICT-supported learning, whereas teachers most strongly emphasised improved classroom engagement. This convergence indicates that ICT was perceived positively from both the learner and teacher perspectives, while the difference in questionnaire constructs means that the results should not be interpreted as evidence of statistical agreement between the groups.

Qualitative Findings

The interview data were analysed using Braun and Clarke's (2006) six-stage thematic analysis process. The analysis identified seven themes from student interviews and six themes from teacher interviews.

Table 4 Themes Emerging from Student Interviews

Theme	Key Finding
Engagement, interest, and enjoyment	ICT made lessons more interesting, enjoyable, and engaging.
Understanding, visualisation, and retention	Multimedia and interactive resources helped students understand and remember difficult concepts.
Independent and exploratory learning	Students used digital resources for research, revision, clarification, and self-directed learning.
Academic performance	Students perceived ICT as supporting test preparation, practice, and academic performance.
Access to knowledge and resources	ICT expanded students' access to information and learning materials beyond the classroom.
Infrastructure and access constraints	Limited devices, connectivity, equipment, and home access constrained ICT use.
Teacher guidance and balanced pedagogy	Students continued to value teacher explanation and traditional methods alongside ICT.

The student interviews largely supported the questionnaire findings.

Theme 1: Engagement, Interest, and Enjoyment Students consistently highlighted that incorporating ICT tools, videos, and digital screens made lessons significantly more interesting, active, and enjoyable compared to traditional chalkboard instruction.

"When teacher use computers, smart-boards, or videos during lessons, I feel more engaged and excited."(S16)

"I feel more active and really excited to learn." (S6)

"I feel more interested and excited when teachers use computers, smart boards, or videos because the lessons become more interesting and easier to understand." (S12)

Theme 2: Understanding, Visualisation, and Retention Visual resources, diagrams, videos, and animations helped students visualize complex, abstract ideas—particularly in subjects like Science, Mathematics, and Geography—making concepts easier to understand and remember.

"I find ICT tools most helpful in science because as we learn science there are lots of diagrams and I just find it really exciting to see the diagrams clearly on screen rather than just drawing it on the chalkboard."(S6)
"When my teacher use computer to teach us I understand it more clearly and remember it for a long time."(S5)
"ICT tools are helpful in History because photos and videos make past events easier to understand." (S8)
Theme 3: Independent and Exploratory Learning Students routinely used internet searches, AI tools, and educational applications to clarify doubts, conduct independent research, and prepare customized revision materials outside of teacher instruction.
"If I don't understand something I can just search on internet using digital tools and it can help me understand much better." (S6)
"I always use my phone after finishing revisions. I go to ChatGPT and give my topics to it and it gives me some questions that might be on exam which helps me with my revisions." (S19)
"First I sent the notes, ask AI to make sets of questions and I bought [scored] the highest from my class."(S50)
Theme 4: Academic Performance and Test Preparation Students reported that practical software exposure (e.g., Canva, CodeMonkey) and online practice quizzes directly supported their assessment performance and test retention.
"Yes, digital tools have helped me improve in tests and exams. For example, I used online quizzes to practice and understand lessons better... Example could be like taking quiz on Wayground." (S1)
"When we had an DTI test, there was an question that said list some of the features on Canva, I remembered the feature because I had used Canva that day." (S16)
Theme 5: Infrastructure and Access Constraints Students faced severe operational barriers, including slow Wi-Fi connectivity, restricted lab access hours, lack of home devices, small screen sizes on personal phones, and audio issues with display devices.
"It is little difficult to access to the computer cause ict lap is only open at intravel, lunch break and in ict period." (S1)
"I don't have computers nor tablets, but I have only mobile phone but it is very difficult to do school work or study, the screen is way to small compare to computer and tablet." (S20)
"I wish the wifi would be faster because when we do our work, the net sometimes doesn't work or just completely don't work." (S16)
"I wish there is same desktops or laptops as there are different types and some doesn't even have a sound to listen to the Dr.Binocs show for Science." (S50)
Theme 6: Preference for Teacher Guidance and Traditional Methods A subset of students expressed that while ICT is helpful, direct teacher explanation and chalkboard teaching are still necessary for complete clarity and confidence in difficult topics.
"I do understand but I feel more comfortable and confident with traditional chalkboard teaching." (S9)
"All good but sometimes we need more explanation form teachers and need support form teacher." (S13)
"It feels okay but I prefer when teachers use traditional chalkboard writing." (S60)

Table 5 Themes Emerging from Teacher Interviews

Theme	Key Finding
Interactive and learner-centred pedagogy	ICT encouraged movement from predominantly lecture-based approaches toward interactive and student-centred teaching.
Student engagement and participation	Teachers observed greater motivation, participation, confidence, curiosity, and independent learning.
Conceptual understanding	Visualisation, simulations, animations, and interactive applications supported difficult and abstract concepts.
Academic achievement	Teachers perceived ICT as contributing to achievement through improved understanding, practice, feedback, and access to resources.
Professional efficiency	Digital tools supported lesson preparation, assessment, feedback, resource sharing, and progress monitoring.
Technical and professional challenges	Connectivity, equipment, electricity, digital resources, training, and preparation time remained challenges.

Teacher interviews further demonstrated that ICT integration extended beyond the use of digital equipment during lessons.

Theme 1: Interactive and Learner-Centred Pedagogy Teachers noted that integrating whole-school ICT enabled a shift away from traditional, teacher-centered lecture methods toward interactive, student-centered classroom delivery.

"Whole-school ICT integration has made my teaching more interactive, engaging, and learner-centred."(T2)

"ICT integration has changed my lesson delivery from mainly teacher explanation and textbook-based learning to a combination of explanation, demonstration, visualisation, collaboration, and student activities."(T4)

"Whole-school ICT integration has shifted my teaching from traditional lectures to interactive, multimedia-driven lessons." (T6)

Theme 2: Student Engagement and Classroom Participation Teachers observed higher levels of student motivation, curiosity, and confidence, with more students actively participating in discussions and interactive activities.

"Since the ICT intervention began, students have become more engaged and active during lessons. They participate more confidently in discussions, show greater interest in activities, and are more willing to explore digital resources." (T2)

"Students are noticeably more attentive and enthusiastic because lessons now incorporate interactive multimedia and gamified learning tools." (T6)

"Students are more engaged, attentive, and confident. They participate actively in discussions and activities..." (T8)

Theme 3: Conceptual Understanding and Visualisation Subject-specific visual applications and dynamic simulations enabled teachers to explain abstract or complex mathematical and scientific concepts that static textbook diagrams could not adequately demonstrate.

"My students were facing difficulties in understanding the concepts of double circulation in human for class 6 science. I used Phet Simulation and it was very effective." (Teacher T1)

"Particularly teaching polynomials and transformations through Geogebra software has significantly improved the learning of students." (T2)

"Teaching transformations, particularly rotation and reflection... were initially difficult for some students because they were abstract... By using online videos, students could clearly observe the movement step by step rather than only looking at static diagrams in the textbook..." (T5)

Theme 4: Academic Achievement and Instant Feedback Teachers reported that ICT contributed to improved student performance by enabling instant practice, gamified evaluation, and targeted feedback that directly addressed individual learning gaps.

"I use Wayground quiz to evaluate their learning... It has huge impact on students academic score." (T1)

"ICT integration raises academic scores by providing personalized digital resources that target individual student learning gaps. It also gives students immediate automated feedback on assignments..." (T6)

"ICT provides immediate practice and feedback, strengthens understanding, and supports independent learning. As a result, students generally perform better in classwork and assessments..." (T10)

Theme 5: Professional and Administrative Efficiency Digital infrastructure streamlined day-to-day teacher responsibilities, including lesson preparation, resource distribution, tracking student progress, and automated administrative tasks.

"Automated grading and digital attendance have streamlined my administrative tasks, saving me valuable daily time. I can now instantly share resources and collaborate with students in real time..." (T6)

"Eases the work, such as exploring the diverse tools, maintaining and tracking the progress record, easily able to plan, and prepare the presentation..." (T7)

"It has also made assessment, feedback, and access to learning resources quicker and more convenient."(T2)

Theme 6: Technical, Infrastructural, and Professional Challenges Teachers consistently identified technical breakdowns, unstable Wi-Fi, hardware shortages, limited lesson preparation time, and a lack of formal ICT pedagogical training as major operational barriers.

"The main challenges are limited internet connectivity, insufficient ICT equipment, occasional technical problems... From a pedagogical perspective, teachers may also need more training and time to effectively integrate ICT..." (T2)

"I frequently face technical hurdles like unreliable Wi-Fi connections and outdated hardware, which disrupt the flow of my lessons. Furthermore, the lack of formal teacher training makes it difficult to effectively integrate these new digital tools..." (T6)

"With no internet connectivity in the classrooms, it was difficulty to project any content related animations or videos, or conduct any online activities." (T5)

School Academic Performance

To further triangulate the findings, the school's academic performance records were examined alongside the quantitative and qualitative data collected from students and teachers. The overall school pass percentage increased from 86% during the previous years (2021–2024) to 94% in 2025, representing an 8 percentage point increase.

Table 6 Comparison of School Academic Pass Percentage

Period	Overall Pass Percentage	Change
2021–2024	86%	+8 percentage points
2025	94%	

Note. The 2021–2024 figure represents the school's pass percentage during the previous years, while 2025 represents the pass percentage during the period of whole-school ICT integration.

The increase in the school's pass percentage provides an additional outcome-based perspective that complements the perceptions and experiences reported by students and teachers. Students reported that ICT supported better understanding, retention, revision, examination preparation, and academic performance, while teachers similarly perceived ICT as contributing to students' academic achievement through improved understanding, practice, feedback, and access to learning resources. The increase from 86% to 94% is therefore consistent with the generally positive direction of the questionnaire and interview findings.

However, the academic performance data should be interpreted cautiously. The increase in the pass percentage cannot be attributed solely to ICT integration because students' academic achievement may also be influenced by other factors, including teaching practices, academic support, attendance, assessment practices, teacher professional development, parental support, and other school improvement initiatives. Thus, the performance data provide supporting evidence of improvement rather than conclusive evidence of causation.

Discussion

The results indicate that whole-school ICT integration experienced positive perceptions among both students and teachers. Students strongly agreed with this statement (M = 4.84), particularly in regard to their liking ICT-based learning (M = 5.25), whereas teachers expressed an even higher agreement (M = 5.28), with class engagement and interactions garnering the highest mean of M = 5.70. Although the questionnaires tapped into different aspects of ICT integration and therefore should not be directly statistically compared, the convergent results suggest that students and teachers considered ICT a valuable component of learning and teaching.

The qualitative results expound on the positive findings, as both groups of participants described positive outcomes of the intervention. Students indicated that videos, animations, pictures, simulations, and activities had increased their level of interest, understanding, and retention. Teachers, on the other hand, describe ICT as a tool that enabled interactive and learner-centred pedagogy, greater access to materials, and professional functions such as lesson preparation, assessment, feedback, and sharing.

The results also indicate the limitations of the intervention, as both students and teachers reported on a range of first- and second-level ICT barriers, namely limited numbers of devices, connection, equipment, electricity, access to digital materials, and preparation time. Students also reiterated the vital role of teacher explanations and the balanced use of conventional and digital approaches. The overall findings suggest that although the introduction of ICT-enabled greater access to learning materials and opportunities for interactive pedagogy, it required appropriate pedagogical guidance, infrastructure, and teacher preparedness to achieve positive results.

The academic records of the school offer supplementary evidence of improvement, as the overall pass percentage increased from 86% (2021 and 2024) to 94% in 2025. This finding aligns with the students' and teachers' reports that the use of ICT supported students' understanding, practice, revision, feedback, and academic performance. On the other hand, the increase in the pass percentage cannot be solely attributed to the integration of ICT, as other school-based initiatives may have contributed to improved attendance, support practices, and assessment. In essence, the school performance results should be interpreted as evidence of association of ICT integration and improved student outcomes, not a proof of causation.

Overall, the combination of quantitative perceptions, qualitative experiences, and school performance data indicate that whole-school ICT integration had a positive effect on students' engagement, concept understanding, learning support, pedagogical practice, and academic performance. It is therefore valuable to adopt a whole-school approach towards ICT integration while taking into consideration the need for adequate infrastructure, teacher preparedness, and access to ensure lasting benefits.

Recommendation

Students

Students should actively take advantage of the school's newly expanded physical computer infrastructure (i.e., transitioning from one to three fully functioning computer labs) during free-study slots, club periods, or non-instructional hours to do self-directed research, conceptual revision, and practice. In doing so, they must exhibit excellent digital regulation by using access to devices, inside and outside the classroom, strictly in service of interactive assessments, spelling games, and preparation, rather than being lured by digital distractions like gaming and social networking. Furthermore, since students continue to highly value direct teacher explanations and conventional teaching methodologies alongside technology, they must seek a balanced learning approach that melds digital multimedia with active participation in conventional classroom instructions.

Teachers

Teachers are encouraged to set up peer-to-peer coaching networks or professional learning communities (PLCs) to collaboratively design digital lessons and share successful strategies, directly reducing individual's lesson preparation time. In tandem with the alignment of their curriculum to digital tools, the teachers should consciously progress through a three-stage technology model, from using technology to clarify skills to enriching topics and finally enabling student-led learning and electronic feedback. Finally, rather than using digital media as a superficial or distracting add-on, teachers must deliberately embed digital tools (e.g., simulations, animations, and applications) into their daily lesson plans to specifically serve the purpose of supporting critical thinking, problem-solving, and conceptual visualization.

School Administration

The school administration, therefore, should formally optimize the role of the school ICT coordinator who can handle maintenance and troubleshooting as well as guide teachers during classroom usage, thus preventing any classroom disruptions and unnecessary technology-related anxieties. To maximize the school's newly expanded facilities, the leadership must design an equitable scheduling framework to ensure balanced and concurrent hands-on access computer use across all sections in classes 4 to 8.

Additionally, the school administration must confront the critical infrastructural obstacles such as regular electricity blackouts and patchy internet by mobilizing resources, building a shared vision for digital adoption, and a designated school-level maintenance budget to support specialized interactive assets.
Recommendations for the Dzongkha (District) Education Office

The Dzongkhag Education Office

The Dzongkhag Education Office should prioritize resource allocation and physical hardware funding to rural, under-resourced lower secondary schools such as Nganglam, thus ensuring equity in student-to-computer ratios and bridging the persistent rural-urban digital divide. The office should also work with wider educational and telecommunication bodies to deploy district-level infrastructural solutions that address frequent electricity blackouts, internet instability, and equipment shortages. Furthermore, the District Office should sponsor continuous practice-focused professional development workshops to build teachers' Technological Pedagogical Content Knowledge (TPACK) and confidence in constructivist digital pedagogy. Lastly, in coordination with national frameworks and the Ministry of Education and Skills Development, the Dzongkha Office must implement systematic evaluations of school digitization to dynamically refine ICT policies and bridge the policy-practice gap.

Conclusion

This action research at Nganglam Lower Secondary School explored the extent of academic performance improvements and perceptions following the systemic implementation of a whole-school Information and Communication Technology (ICT) integration intervention. The findings collectively indicate that transitioning from a traditional, chalkboard-centric methodology to a technology-rich, constructivist learning model offers highly favorable outcomes. The quantitative analysis indicates that both students ($M = 4.84$ on a 6-point scale) and teachers ($M = 5.28$) have highly positive perceptions of ICT integration, particularly in relation to enhanced classroom engagement, student motivation, and resource accessibility. Qualitatively, the intervention has catalysed a fundamental pedagogical shift that enables teachers to move from traditional lecturing to interactive, student-centred facilitation, thus aiding the visualization and retention of abstract concepts. These experiential successes are supplemented by objective school records that saw the overall pass percentage increase from a stagnant baseline of 86% (2021–2024) to 94% in 2025, an 8-percentage-point increase.

However, the success of this whole-school model is moderated by individual and institutional constraints. The qualitative data indicate a wide range of first- and second-level ICT barriers such as unstable internet, equipment shortages, and electrical power blackouts as well as teachers' preparation time constraints. Ultimately, while the technology-rich environment serves as a powerful catalyst for academic growth, ICT cannot simply be treated as an isolated panacea. Its success as a complex adaptive system is intimately tied to broader school improvement initiatives, ongoing technical maintenance, and purposeful, supervised pedagogical designs implemented by teachers.

References

1. Akram, H., Abdelrady, A. H., Al-Momani, M. M., & Pilli, O. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. Frontiers in Psychology, 13, Article 920317. https://doi.org/10.3389/fpsyg.2022.920317

2. Albirini, A. (2006). Teacher's attitudes toward information and communication technologies: The case of Syrian EFL teachers. Computers & Education, 47(4), 373–398. https://doi.org/10.1016/j.compedu.2004.10.013
3. Ben Youssef, A., & Dahmani, M. (2016). Measuring the impact of ICTs on academic performance in Tunisian universities: A multilevel modeling approach. Journal of Research on Technology in Education, 48(4), 321–337. https://doi.org/10.1080/15391523.2016.1212451
4. Ben Youssef, A., Dahmani, M., & Ragni, L. (2022). ICT use, digital skills, and students' academic performance: Evidence from French universities. Information, 13(3), 129. https://doi.org/10.3390/info13030129
5. Bindu, C. N. (2016). Impact of ICT on teaching and learning: A literature review. International Journal of Management and Commerce Innovations, 4(1), 24–31. http://www.researchpublish.com
6. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa
7. Creswell, J. W. (2013). Research design: Qualitative, quantitative, and mixed methods approaches (4th ed.). SAGE Publications.
8. Das, M. K., & Middya, A. (2025). ICT as a tool for improving academic performance in higher education. International Journal of Academic Excellence and Research, 1(3), 60–69. https://doi.org/10.62823/mgm/ijaer/01.03.99
9. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340. https://doi.org/10.2307/249008
10. Davis, F. D. (2003). Technology Acceptance Model (TAM): Theoretical backgrounds and user behavior. Management Science, 35(8), 982–1003. https://doi.org/10.1287/mnsc.35.8.982
11. Drissa, K., Coulibaly, A., & Touré, S. (2026). Integrating advanced ICT tools for promoting student engagement and academic achievement in Malian higher education. Journal of Educational Technology and Innovation Applications, 2(2), 177–199.
12. Ghavifekr, S., Abd Razak, A. Z., Ghani, M. F. A., Ran, N. Y., Meixi, Y., & Tengyue, Z. (2014). ICT integration in education: Incorporation for teaching and learning improvement. Malaysian Online Journal of Educational Technology, 2(2), 24–45. http://www.mojet.net
13. Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. International Journal of Research in Education and Science, 1(2), 175–191. https://doi.org/10.21890/ijres.23554
14. Giri, D. R., Neupane, B. P., Dahal, N., & Subedi, D. (2025). Enhancing school performance through whole school intervention: A case study. Frontiers in Education, 10, Article 1533586. https://doi.org/10.3389/feduc.2025.1533586
15. Hennessy, S., Ruthven, K., & Brindley, S. (2005). Teacher perspectives on integrating ICT into subject teaching: Commitment, constraints, caution, and change. Journal of Curriculum Studies, 37(2), 155–192. https://doi.org/10.1080/0022027032000276961
16. Isleem, M. (2003). Relationships of selected factors and the level of computer use for instructional purposes by technology education teachers in Ohio public schools [Doctoral dissertation, The Ohio State University]. OhioLINK.
17. Ismajli, H., Bytyqi-Damoni, A., Shatri, K., & Ozogul, G. (2020). Coaching teachers to integrate technology: The effects of technology integration on student performance and critical thinking.

Ilkogretim Online - Elementary Education Online, 19(3), 1306–1320. http://ilkogretim-online.org.tr
18. Ismajli, H., Carmichael, E., & Farrell, H. (2021). Coaching teachers to integrate technology: The effects of technology-enriched classrooms on student development of higher-order thinking skills. Journal of Technology and Teacher Education, 29(4), 1309–1322.
19. Lawrence, J. E. (2018). Factors that influence teachers' adoption and integration of information and communication technology in teaching and learning: A grounded theory approach. International Council for Educational Media, 55(1), 215–231. https://doi.org/10.1080/09523987.2018.1439999
20. Lawrence, J. E., & Tar, U. A. (2018). Factors that influence teachers' adoption and integration of ICT in teaching/learning process. Educational Media International, 55(1), 79–97. https://doi.org/10.1080/09523987.2018.1439712
21. Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic inquiry. SAGE Publications.
22. Lincoln, Y. S., & Guba, E. G. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. New Directions for Program Evaluation, 1986(30), 73–84. https://doi.org/10.1002/ev.1427
23. Mooij, T., & Smeets, G. (2001). Modelling and supporting ICT implementation in secondary schools. Computers & Education, 36(3), 265–281. https://doi.org/10.1016/S0360-1315(00)00068-1
24. Nketiah-Amponsah, E., Asamoah, M. K., Allassani, W., & Aziale, L. K. (2017). Examining students' experience with the use of some selected ICT devices and applications for learning and their effect on academic performance. Journal of Computer Education, 4(4), 441–460. https://doi.org/10.1007/s40692-017-0091-y (Note: This is the correct standard citation for the institutional paper initially credited to UPSA).
25. Rana, K. (2017). ICT integration in teaching and learning activities in higher education: A case study of Nepal's teacher education. Malaysian Online Journal of Educational Technology, 8(1), 36–47. https://doi.org/10.52380/mojet.2020.8.1.36
26. Singh, R. (2019). Students' perspectives on technology integration in ELT: A qualitative case study in public secondary schools in Nepal. Journal of NELTA, 24(1-2), 95–108. https://doi.org/10.3126/nelta.v24i1-2.27552
27. Tenzin, D. (2026). Developing competency-based skills (CBS) for Grade VIII students in solving word problems through differentiated instruction (DI). International Journal for Multidisciplinary Research, 8(2), 1–12. https://www.ijfmr.com
28. Tenzin, K., Tshewang, S., & Dorji, S. (2026). Teachers' perceptions of ICT integration in teaching and learning and its perceived impact on academic performance. Malaysian Online Journal of Educational Technology, 14(3), 62–78. http://dx.doi.org/10.52380/mojet.2026.14.3.637
29. Toma, F., Ardelean, A., Grădinaru, C., Nedelea, A., & Diaconu, D. C. (2023). Effects of ICT integration in teaching using learning activities. Sustainability, 15(9), Article 6885. https://doi.org/10.3390/su15096885
30. Yeigh, T., Lynch, D., Turner, D., Fradale, P., Willis, R., Sell, K., & Lawless, E. (2020). Using blended learning to support whole-of-school improvement: The need for contextualisation. Education and Information Technologies, 25(3), 312–335. https://doi.org/10.1007/s10639-020-10111-y (Note: This entry combines and deduplicates the co-authored references to Yeigh & Lynch, 2020 with the full author list).

31. Zou, Y., Kuek, F., Feng, W., & Cheng, X. (2025). Digital learning in the 21st century: Trends, challenges, and innovations in technology integration. Frontiers in Education, 10, Article 1562391. https://doi.org/10.3389/feduc.2025.1562391