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Effectiveness of Nearpod and Edpuzzle as Technology-Enhanced Learning Platforms in Teaching Electricity Concepts to Class Ten Students

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Abstract

This study explored how technology-enhanced platforms, Nearpod and EdPuzzle, support student engagement, conceptual understanding, and motivation while learning electricity concepts in class ten. Using a quasi-experimental design, data were collected through pre- and post-tests, surveys, and focus group discussions. A sample of 53 students was divided into two experimental groups to compare the effectiveness of the Nearpod or EdPuzzle tool in physics lessons. The findings indicated that both tools improved learning outcomes, but in different ways. Nearpod's real-time quizzes, polls, and other interactive features fostered engagement and interactivity, while EdPuzzle supported independent learning and critical thinking. Nevertheless, rather than using the tools as competing platforms, they are most effective when used in a complementary way. The study highlights that aligning digital tools with learning objectives optimises students' understanding and engagement in physics. For teachers, EdPuzzle can be used for pre-class learning and Nearpod for in-class interactive instruction, aligning with contemporary STEM pedagogy. Therefore, relevant stakeholders should invest in infrastructure and teacher training to support effective technology-enhanced learning.

Research Article

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Introduction

An integration of technology in education has transformed teaching and learning experiences, particularly in STEM (Science, Technology, Engineering, and Mathematics) subjects (Nkomo et al., 2021). Digital tools are increasingly employed to foster student engagement, improve conceptual understanding, and enhance learning outcomes. In physics, topics such as electricity present conceptual

difficulties due to their abstract nature, often leading students to rely on rote learning. To address this, studies highlight the transformative impact of digital technologies in improving learning outcomes and promoting meaningful engagement (Ares et al., 2018; Haleem et al., 2022; Wang & Tahir, 2020). The rapid shift to digital learning environments highlighted the need for innovative instructional approaches that support active and flexible learning.

In this context, tools such as artificial intelligence (AI), gamified learning, and multimedia applications enhance learner autonomy and engagement (Huang et al., 2023; Xia et al., 2022). These tools enable interactive, student-centred learning beyond traditional instructions. Accordingly, technology-enhanced learning (TEL) platforms such as Nearpod, EdPuzzle, Kahoot, Quizziz, and Google Classroom have gained prominence (Sanmugam et al., 2019; Shelby & Fralish, 2021). They integrate multimedia content, formative assessment, and interactive features to support active participation and understanding. Nearpod enables interactive lessons with immediate feedback, while EdPuzzle enables self-paced learning through embedded questions in videos.

The significance of STEM education and the need for technology investments in education have been highlighted in the Royal Decree on education reform (Royal Kasho, 2020). In response, the Ministry of Education and Skill Development (MoESD) established the STEM and Innovation Division to facilitate technology integration through resources, professional development, and institutional support (MoESD, 2025). This initiative provides a strong foundation for advancing STEM education in Bhutan. However, its success depends on how effectively students engage with technological tools and innovative platforms in classroom practice.

Chedup et al. (2023) found that access to STEM technologies enables students to design and develop projects through hands-on experiences and real-time applications of automation, enhancing conceptual understanding, creativity, and problem-solving skills. Despite increasing awareness of STEM's importance, there is limited empirical evidence on whether technology-supported STEM education is more effective than conventional approaches in Bhutan.

Similar gaps are evident internationally. Studies on Nearpod used different methodological approaches, but have limitations. Paramita (2023) employed qualitative interviews to explore students' perceptions, while Zahran (2025) adopted a quasi-experimental pre-post-test design to measure its effect on reading comprehension. However, most Nearpod research focuses on language learning rather than science or physics (Alqahtani, 2022; Paramita, 2023), with a few studies addressing STEM or conceptual topics. Research on related tools such as Kahoot (Wang & Tahir, 2020), Quizziz (Wulaningrum & Novitasari, 2024), and Google Classroom (Azhar & Iqbal, 2018) primarily measures engagement and motivation rather than deeper conceptual understanding. Moreover, no studies directly

compared multimedia tools like Nearpod and EdPuzzle in Physics instruction (Alqahtal, 2022; Zahran, 2025). While the existing research has explored the general impact of digital learning platforms on engagement and academic achievement, these studies often examined the tools in isolation or within the broader educational contexts rather than subject-specific applications.

To address this gap, the present study employed a mixed-method quasi-experiment design, supplemented by survey data, to compare the impact of Nearpod and EdPuzzle on students' conceptual understanding of electricity concepts, an area not previously explored. It contributes evidence that effectiveness depends not only on tool features but on their integration into teaching. A strategic combination of interactive and self-paced tools may offer a holistic learning experience.

Literature review

Educational challenges in STEM learning

Modern education continues to face challenges in fostering an interactive classroom environment due to increasing student enrollment numbers and limited physical space. A total of 1,56,272 students are enrolled nationwide, with the highest concentration in Thimphu Thromde (NSB, 2024). The student-teacher ratio (STR) in lower, middle and higher secondary public schools is 16:1, exceeding the benchmark of 15:1 (NSB, 2024; OECD, 2025). Class sizes vary by location and school context, often resulting in overcrowded classrooms that limit teacher-student interaction and affect educational quality (Chophel & Choden, 2024; Dorji, 2020; NSB, 2024). As Hornsby and Osman (2014) note, both student-teacher and peer interactions decline in larger classes, reducing student engagement.

In addition to structural constraints, students face conceptual challenges in STEM subjects. Many rely on memorisation rather than developing conceptual understanding in foundational topics, such as electrons, current, potential difference, and voltage (Dendup et al., 2021; Wangdi & Tshomo, 2019). This weak foundation hinders their ability to comprehend advanced concepts, including Ohm's law, resistance, Kirchoff's law, alternating current and direct current. These challenges reflect a broader limitation of traditional instructional approaches, which often fail to promote deep understanding and active learning.

ICT integration in addressing engagement and conceptual understanding

Information and Communication Technology (ICT) integration is widely recognised for improving engagement, interaction, and conceptual understanding. Research suggests that embedding technology in teaching enhances participation and interaction (Ryan, 2017). Mobile and digital tools have also transformed assessment practices by enabling immediate and interactive feedback (Nikou & Economides, 2018). These developments reflect a shift from teacher-centred to student-centred pedagogies, where students actively construct knowledge.

Interactive platforms, such as Kahoot, Quizizz, Classcraft, ClassDojo, and Duolingo illustrate how technology can enhance motivation and engagement. In this context, Nearpod and EdPuzzle offer complementary solutions: Nearpod promotes real-time interaction and collaborative learning (Ryan, 2017), while EdPuzzle supports self-paced, reflective learning through interactive video content. Together, they address issues such as low engagement, limited interaction, and difficulties in understanding abstract STEM concepts.

However, ICT integration in Bhutanese classrooms faces constraints, such as low internet bandwidth, inconsistent connectivity, limited infrastructure, and insufficient teacher training (Dhendup & Sherab, 2022; Sharma, 2023). Additionally, restrictions on mobile phone use during school hours further limit integration (Dorji, 2020). These factors highlight the gap between the pedagogical potential of ICT tools and the practical implementation. Dorji (2020) also identifies additional issues, including a disconnect between the policy makers and the actual classroom practice, inadequate teacher training, lack of assessment mechanisms, resource inequality, and heavy workloads, which collectively hinder the shift toward interactive digital pedagogy.

Nearpod and EdPuzzle in enhancing interactive learning

The literature indicates that both Nearpod and EdPuzzle play a significant role in promoting interactive and student-centred learning environments. Nearpod supports synchronous, teacher-guided learning through real-time interaction using features such as gamified quizzes, polls, interactive videos, and collaboration activities. These features promote active participation and reduce passive learning (Sarginson & McPherson, 2021; Musa & Momani, 2022). Studies also show that tools like Nearpod enhance student engagement, enjoyment, and motivation by enabling teachers to design interactive lessons with embedded formative assessments, providing immediate feedback and enabling continuous monitoring of student understanding (Janjic & Stojanovic, 2019; Prasetyo & Andayani, 2024). This real-time feedback supports classroom discussion, reduces fear of judgement through anonymous responses, and enhances participation (Delacruz, 2014; Sanmugam et al., 2019).

In contrast, EdPuzzle facilitates asynchronous and self-paced learning by transforming video content into interactive instructional material. By embedding questions, audio explanations, and feedback within videos, it promotes active engagement and deeper cognitive processing (Mayang et al., 2021). Its pause-and-rewatch feature supports comprehension and reduces cognitive overload, making it effective for self-regulated learning (Setiawati et al., 2025; Silverajah & Govindaraj, 2018). This approach is particularly beneficial for low-achieving students, allowing them to revisit challenging concepts and learn at their own pace (Tshering et al., 2022).

Together, these tools illustrate the complementary nature of synchronous and asynchronous learning in ICT-integrated education. Nearpod enhances immediate interaction and collaborative engagement in the classroom, whereas EPuzzle extends learning beyond the classroom through independent and reflective learning. Both tools support higher-order thinking skills, including critical thinking, problem-solving, and metacognitive awareness (Jhanine et al., 2024; Mayang et al., 2021; Nurrokhma et al., 2024; Ramadhan & Fibriana, 2025; Siswati et al., 2023).

Furthermore, both platforms contribute to improve academic performance across subjects. Studies indicate that students using Nearpod-integrated lessons demonstrate higher achievement (Jhanine et al., 2024; Siswati et al., 2023). Similarly, EdPuzzle has been associated with measurable improvements in academic outcomes, including increased quiz scores and enhanced comprehension in subjects such as biology, language learning, and mathematics (Jemenez et al., 2021; Kholid et al., 2024; Shelby & Fralish, 2020; Sooksomchitra, 2024).

Despite these benefits, both tools face implementation challenges. Their effectiveness depends on stable internet connectivity, user-friendly design, and teacher readiness (Caroy, 2023; Feri & Zulherman, 2021; Wati et al., 2024). EdPuzzle's limited real-time interaction and Nearpod's reliance on strong connectivity highlight the trade-offs in ICT integration (Mischel, 2018). These limitations reinforce the importance of aligning technology use with contextual realities and pedagogical goals.

Their effectiveness is also influenced by contextual factors such as infrastructure, teacher preparedness, and policy constraints, particularly in Bhutan. This highlights the need for context-sensitive ICT implementation (Dorji & Nima, 2025). Despite emerging evidence, limited research has examined their combined impact within Bhutanese classrooms, indicating a need for further empirical investigation.

General aims and objectives

This study aims to compare the effectiveness of Nearpod and EdPuzzle in enhancing class ten students' conceptual understanding of electricity concepts through ICT-based learning interventions.

Research questions

How do Nearpod and EdPuzzle impact the effectiveness of learning electricity concepts among class ten students?

Methodology

Quantitative data were collected through pre- and post-tests and a survey questionnaire. The test included 17 questions (17 marks), covering electricity concepts, types of connections, and appliance connections. A pilot test with 6

students (three high achievers and three low achievers) was employed to assess the difficulty and discriminability of the variables. Three questions were discarded, and two questions improved. Overall, the indices indicated 'very good' discrimination abilities as shown in Table 1.

Cohen et al. (2007) formula, reflected below, was employed to find the index of discriminability.

$$\frac{A - B}{\frac{1}{2}(N)}$$

Where;

A – number of correct answers from the high achievers
B – number of correct answers from the low achievers
N – total number of students

Similarly, the difficulty level of test items was calculated using the following formula,

$$\frac{A}{N} \times 100$$

Where;

A – total number of students who answered correctly.
N – total number of students who attempted the item

Table 1

Average Difficulty and Discrimination Indices for Test Questions of The Pilot Test

Index	Average
Difficulty Index	0.6
Discrimination Index	60%

Similarly, five-point Likert-scale questionnaires were designed around engagement, creativity, assessment, motivation and learning, as the pre-post-tests measured only content knowledge. The pre-test established baseline knowledge and ensured group comparability. The Nearpod questionnaire demonstrated high reliability (Cronbach's alpha = 0.92), while the revised EdPuzzle questionnaire demonstrated acceptable reliability (Cronbach's alpha = 0.78).

Qualitative data were collected through purposive sampling using focus group discussions with open-ended questions. Two focus groups of four participants, one from each group, were included to explore perceptions of Nearpod and EdPuzzle and their impact on learning electricity concepts.

Classroom instructions

A total of six lessons were conducted using Nearpod and EdPuzzle, focusing on basic electrical quantities such as charge, voltage, conductor, insulator, resistance, direction of flow of electrons and current. Each lesson included gamified activities such as time to climb, matching of pairs, quizzes, drawing, true or false, multiple-choice and open-ended questions. Videos with embedded interactive activities were used to support learning. Similarly, existing EdPuzzle videos with the interpolated questions were assigned using a flipped-classroom technique, followed by activities such as open discussion, group activities, and a presentation based on the video content.

Research participants

The study adopted a non-equivalent quasi-experimental design with a control group pre-test post-test format. Two intact class ten sections (53, 28 males and 25 females) were selected to compare Nearpod and EdPuzzle in learning electric circuits. As sections were pre-existing and students could not be randomly reassigned, randomisation was not feasible. One section used Nearpod, and the other used EdPuzzle (Table 2). An independent sample t-test of pre-tests revealed no significant difference ($p > 0.05$), indicating similar prior knowledge and comparability. Thus, any differences in post-test performance could be attributed to the intervention rather than the initial disparities.

Table 2

Overview of An Intervention and Data Collection Across the Groups

Section	Pre-test	Nearpod	EdPuzzle	Post-test
10 A (CG1)	√		√	√
10 B (CG2)	√	√		√

Data analysis

The descriptive and inferential statistical tests were administered to analyse the quantitative data, including measures such as mean, standard deviation, and level of significance. Qualitative data were analysed using Braun and Clarke's (2019) six-phases of the thematic analysis. The findings from the questionnaires and interviews were triangulated to provide a clear understanding of the study. For clarity and consistency, participants are identified using coded abbreviations. For example, F1S1- F1S4 represent speakers 1-4 from focus group 1, while F2S1- F2S4 denote speakers 1-4 from focus group 2. This system ensures anonymity and enables precise referencing of responses.

Ethical considerations

For ethical reasons, written permission was obtained from the head of school, who served as an auditor to ensure procedural compliance. To minimise power imbalances, the head had no role in intervention, data collection, or data analysis, and no access to students' responses. Verbal consent was obtained from all participants aged 18 and above, while written consent was obtained from parents or guardians of those below 18. Participation was voluntary, with the right to withdraw at any time without any academic consequences. Participants were assured that their decision would not affect their grades, classroom standing, or relationship with teachers or administration. The researcher clarified that the participation was independent of academic evaluation, and all data were anonymised to protect confidentiality. The study complied with the School Research Committee (SRC) ethical guidelines.

Results

EdPuzzle: Pre-post-tests analysis

A paired sample t-test examined the effect of EdPuzzle and revealed a significant improvement in students' test scores after the intervention. The mean pre-test score was lower than the post-test score, indicating a positive learning outcome (Tables 3 & 4). The difference was statistically significant ($p < .001$), with a mean score difference of -2.13 (SD = 2.49). These findings suggest that EdPuzzle effectively enhanced students' conceptual understanding of electricity. A slight increase in the standard deviation indicated greater variation in post-test scores. However, confounding factors such as students' ICT exposure, digital literacy, teaching styles, and classroom environment may have influenced outcomes.

Table 3

Descriptive Analysis of The Pre- and Post-Test Results for Edpuzzle

		Mean	N	SD
10 A	Pre-Test	8.83	24	1.71
	Post-Test	10.96	24	2.35

Table 4

Statistically Significant Test for EdPuzzle

	Mean	SD	SE Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pre-Post	-2.13	2.49	.51	-3.18	-1.07	-4	23	.000

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Nearpod: Pre-post-test analysis

A paired-sample t-test revealed a statistically significant improvement in test scores following a Nearpod intervention ($p < .001$). Students performed better in the post-test compared to the pre-test, suggesting the effectiveness of Nearpod in enhancing learning. Detailed descriptive statistics and test results are presented in Tables 5 and 6.

Table 5

Descriptive Analysis of Test Scores

		Mean	N	SD
10 B	Pre-Test	9.96	24	2.16
	Post-Test	13.63	24	1.79

Table 6

Statistically Significant Test

	Mean	SD	SE Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pre-Post	-3.67	2.41	.49	-4.68	-2.65	-7.5	23	.000

Mean difference between the groups based on post-test scores

The independent sample t-test indicated a significant difference in post-test scores between group A and group B (Tables 7 & 8). The t-test for equality of means was also statistically significant ($p < .001$), with a mean difference of -2.66 (95% CI [-3.88, -1.45]). These findings suggest that the Nearpod group outperformed the other group in the post-test. The lower standard deviation in group B indicated less variability in performance and more consistent learning improvement.

Table 7

Post-test Scores

	Section	N	Mean	SD
Post-Test	A	24	10.96	2.35
	B	24	13.63	1.79

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Table 8

Mean Difference Between the Groups for Post-Test Scores

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Err Diff.	95% CI of the Difference	
									Lower	Upper
Post Test	Equal variances assumed	1.00	.32	-4.42	46	.000	-2.66	.60	-3.88	-1.45
	Equal variances not assumed			-4.42	42.96	.000	-2.66	.60	-3.88	-1.45

Qualitative analysis

The survey results were interpreted using a five–point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), to determine students' overall agreement responses across the measured themes.

Nearpod

Theme 1: Student engagement and participation in Nearpod lessons

Table 9 revealed a high level of student engagement and participation during Nearpod lessons (M-4.37, SD - 0.73). Survey results indicated strong agreement that Nearpod activities were engaging and that their interactive features increased engagement, resulting in a positive perception of active learning. Focus group interviews corroborated these findings. For example, F1S1 said, "Nearpod has been a great experience as a teacher can share videos, questions, and polls with the whole class, I remained interactive and focused". Similarly, F1S4 highlighted the engaging nature of simulations, web content, videos, quizzes, and games. However, although students agreed that Nearpod facilitated peer interaction, this aspect received a slightly lower rating.

Table 9

Students' Responses to Engagement and Participation in Nearpod Lessons (N=24)

Statements	Mean	SD
During Nearpod activities, I interact with other students that helps me or them to learn.	4.19	0.75
The activities engaged me throughout the lesson.	4.46	0.65
Nearpod enhances my work and participation.	4.35	0.75
Interactive tools in Nearpod increases my engagement.	4.46	0.76
Overall mean	4.37	0.73

Theme 2: Students' perceptions of creativity in Nearpod lessons

The survey (Table 10) indicated strong student perception that Nearpod facilitated creative expression (M – 4.30, SD – 0.79). Students agreed that Nearpod facilitated sessions enabled creativity through drawing, picture-taking, and free responses. Focus group findings supported this, with F1S3 and F1S2 stating that the drawing feature helped them present learning and showcase creative skills. F1S4 highlighted flexibility in responding through pictures, videos, voice recordings, and text, providing varied opportunities for creativity. Although students generally agreed that interactive tools enhanced creative expression, this aspect was rated slightly lower compared to other creative features.

Table 10

Students' Responses to Creativity in Nearpod Lessons (N=24)

Statements	Mean	SD
We can draw, take pictures, and write free responses while using the Nearpod.	4.27	0.83
I am able to express myself creatively.	4.46	0.81
The interactivity tools enhance my creativity of presenting ideas/concepts to the class.	4.19	0.75
Overall mean	4.30	0.79

Theme 3: Students' perceptions of assessment in Nearpod lessons

Table 11 shows that the students' agreement level has an overall mean of 4.37 and a standard deviation of 0.72. This result indicates that students have a strong conviction that Nearpod can effectively assess learning through providing immediate feedback and results. To support this, the focus group interview revealed that students recognised Nearpod's role in assessment. For instance, F1S2 stated that "using Nearpod, teachers will be able to know whether the student has studied or not, and also there are a lot of benefits for the students, like they can respond to the teacher immediately and get the result after the activity". Similarly, F1S4 confirmed this observation, noting that Nearpod allowed teachers to determine whether students had studied.

Table 11

Students' Responses to Assessment in Nearpod Lessons (N=24)

Statements	Mean	SD
Nearpod gave immediate feedback to our responses.	4.38	0.58
I feel that my teacher knows how I am doing with the materials provided.	4.23	0.77
The various interactivity tools used helped me to evaluate my learning.	4.50	0.71
My teacher knows my level of learning with immediate result provided.	4.35	0.80
Overall mean	4.37	0.72

Theme 4: Students' perceptions of motivation in Nearpod lessons

Students' level of agreement on motivation in Nearpod lessons is higher, with a mean of 4.43 (Table 12). They also reported strong agreement regarding their teacher's use of Nearpod, their interest in the topics, their participation in sharing answers, and their awareness of the learning progress. Qualitative data supported this finding, highlighting Nearpod's role in fostering motivation. Specifically, F2S1 reported, "I felt motivated to learn when I got the immediate feedback on my work. Moreover, all those features such as quizzes, videos with interpolated questions, multiple-choice questions, and fill-in-the-blanks kept me engaged throughout". Overall, the qualitative results reinforced survey results, indicating that Nearpod's interactive features and immediate feedback effectively enhanced motivation.

Table 12

Students' Responses to Motivation in Nearpod Lessons (N=24)

Statements	Mean	SD
Nearpod gave immediate feedback to our responses.	4.38	0.58
I feel that my teacher knows how I am doing with the materials provided.	4.23	0.77
The various interactivity tools used helped me to evaluate my learning.	4.50	0.71
My teacher knows my level of learning with immediate result provided.	4.35	0.80
Overall mean	4.37	0.72

Theme 5: Students' perceptions of learning in Nearpod lessons

The survey (Table 13) indicated a strong consensus that Nearpod effectively facilitated the learning of electricity concepts. Students strongly agreed that varied questions enhanced their understanding and that collaborative tools improved comprehension. They also perceived Nearpod as highly effective in grasping abstract concepts. This aligns with qualitative feedback highlighting its positive impact. For example, F1S3 noted that Nearpod improved understanding, motivation, participation and engagement through virtual experimentation. Similarly, F2S1 emphasised that embedded PhET simulations helped to visualise phenomena like the flow of charges, which are difficult to observe in natural settings.

Table 13

Students' Responses to Learning in Nearpod Lessons (N=24)

Statements	Mean	SD
Nearpod enhanced my learning on electricity.	4.19	0.80
Nearpod helped me to understand the abstract concepts.	4.46	0.58
The collaborative tools increased my understanding.	4.50	0.71
Varieties of questions helped me to understand better.	4.58	0.54
Overall mean	4.43	0.66

EdPuzzle

Theme 1: Students' perceptions on lesson preparation and learning in EdPuzzle

The quantitative data revealed a high level of agreement among students (M = 3.94) regarding the benefits of EdPuzzle (Table 14). Students reported that EdPuzzle videos supported their class preparation and improved their understanding of key concepts. The embedded questions promoted full concentration, and the platform provided immediate feedback (Table 15). Qualitative data from students' interviews corroborated these findings. Student F2S1 highlighted EdPuzzle as engaging, emphasising the value of embedded questions and immediate feedback, and noted its usefulness for pre-lesson preparation, stating that watching videos and answering questions helped before new topics.

Similarly, F2S4 stated:

> My experiences with EdPuzzle are when I have a presentation, I use to go with EdPuzzle to prepare for my presentation, which makes me easy. The questions are given in the video itself, and we can immediately answer the questions; we know whether the answers are wrong or right.

Table 14

Students' Responses to Lesson Preparation and Learning (N=24)

Statements	M	SD
Watching the videos helped me prepare for the class	4.00	.84
Watching the videos before the lectures helped me to understand better concepts delivered in the class	4.12	.81
The questions embedded in the video helped me to learn with full concentration	3.96	.77
EdPuzzle provided immediate feedback to our responses	3.69	.97
Valid N (listwise)	3.94	0.67

Theme 2: Students' perceptions of EdPuzzle for skills development

The survey data revealed a strong consensus (M = 4.13) on the positive impact of EdPuzzle on skills development. Students agreed that it promoted critical thinking and independent learning, and strongly agreed that it enhanced listening skills and that repeated video viewing improved understanding (Table 15). Qualitative findings supported this. F2S3 stated that EdPuzzle enabled independent learning and improved critical thinking and listening skills. The student explained that the platform required focused listening to answer questions, enhancing listening skills and highlighted its flexibility and demanded concentration, which contributed to skill development.

Table 15

Students' Responses to Skills Development (N=24)

Statements	M	SD
Edpuzzle helped me to think critically and enhanced my critical thinking skills.	3.88	.71
Edpuzzle helped me to learn independently.	4.08	.74
It helped to enhance my listening skills.	4.27	.87
I could repeatedly watch/listen to the parts that I did not fully understand.	4.31	.88
Valid N (listwise)	4.13	0.8

Theme 3: Students' perceptions of EdPuzzle videos as a source of enjoyment

The survey data (Table 16) indicated that students generally enjoyed learning through EdPuzzle. They agreed that it supported peer interaction during activities. Overall, students associated EdPuzzle with enjoyment. F2S4 reported consistent enjoyment of the activities, noting that receiving feedback on answers enhanced the learning experience. The student highlighted the appeal of the videos and interactive features, particularly the embedded multimedia content, such as multiple-choice questions, open-ended and true/false questions, which contributed to their positive learning experience.

Table 16

Students' Responses on Edpuzzle Videos as a Source of Enjoyment (N=24)

Statements	M	SD
I enjoyed learning through EdPuzzle.	4.13	.81
It was burdensome to watch the videos as I was under an obligation to study in addition to the classes.	3.00	1.2
It helped me in interacting with friends while doing activities.	4.13	.72
Valid N (listwise)	3.75	

Discussion

The findings of this study reinforced the growing body of research on the effectiveness of technology-enhanced learning platforms in promoting student engagement and improving academic performance (Delacruz, 2014; Shehata et al., 2019). Consistent with previous studies by Delacruz (2014) and Shehata et al. (2019), both Nearpod and EdPuzzle significantly enhanced students' conceptual understanding of electricity. This study further extends existing literature by offering a direct comparison of the two tools within the same instructional context.

The statistically significant improvement observed in the Nearpod group suggests that interactive, real-time learning environments play a crucial role in enhancing conceptual understanding. Higher post-test scores and lower variability indicate improved performance and more consistent learning outcomes among students (Table 6). This can be attributed to Nearpod's interactive features, such as real-time quizzes, collaborative activities, and immediate feedback, which actively engaged students in the learning process. These findings align with recent studies (Jhanine et al., 2024; Dorji & Nima, 2025; Siswati et al., 2023), emphasising that interactive multimedia tools support deeper cognitive processing and improved retention, particularly in STEM education. From a pedagogical perspective, Nearpod's synchronous interaction reduces passive learning and promotes active knowledge construction, which is critical for understanding abstract physics concepts.

In contrast, EdPuzzle demonstrated a statistically significant improvement, with the post-test mean of 10.96 compared to pre-test mean of 8.83, consistent with findings (e.g., Aula, 2020; Kholid et al., 2024; Silverajah & Govindaraj, 2018). However, relatively lower mean scores and higher variability suggest that its effectiveness may depend on students' ability to engage in self-regulated learning. EdPuzzle's design supports autonomous learning through self-paced video instruction, allowing students to pause, rewind, and reflect. This aligns with the recent literature (Setiawati et al., 2025; Wati et al., 2024), which highlights the role of video-based learning in promoting self-regulation and reducing cognitive overload. However, the absence of real-time interaction may limit immediate clarification of misconceptions, which is particularly important when learning complex scientific concepts.

A key strength of this study lies in demonstrating that these tools are not interchangeable but serve complementary pedagogical functions. While previous research often examines these tools independently (Ryan, 2017), the present findings suggest that Nearpod is more effective for in-class interactive learning, whereas EdPuzzle is better suited for pre-class preparation and independent learning, within a flipped classroom model. This distinction is supported by recent studies (Ampera et al., 2021; Zahran, 2025), which emphasise the importance of aligning digital tools with instructional goals.

Furthermore, qualitative findings from the focus group discussion provide additional insights into students' learning experiences. Students reported that Nearpod enhanced engagement through interactive simulations and collaborative activities, which helped them visualise abstract concepts, and deepen their understanding, consistent with earlier findings by Hwang et al. (2015). In contrast, students valued EdPuzzle for its flexibility and usefulness in pre-class preparation, confirming its role in supporting flipped learning environments. Interactive features such as polls, quizzes, real-time interaction and feedback, and collaborative work

might have helped students improve their retention abilities and contributed to their learning

Despite these positive outcomes, the findings highlight important contextual factors influencing effectiveness. Variations in performance, particularly in the EdPuzzle group, may be attributed to differences in students' digital literacy, motivation and prior exposure to technology. Additionally, infrastructure challenges such as internet connectivity, as highlighted in Bhutanese studies (Dhendup & Sherab, 2022; Sharma, 2023), may affect consistent implementation. These findings suggest that while technology-enhanced learning platforms offer significant benefits, their success depends on both pedagogical design and contextual readiness.

Implications

This study provides empirical evidence supporting the effectiveness of Nearpod and EdPuzzle as instructional tools for teaching electricity concepts to class Ten students. Both tools significantly enhanced student engagement and conceptual understanding, although each served distinct instructional purposes. Nearpod, with its interactive real-time features, was more effective for in-class learning and consistent academic performance, while EdPuzzle facilitated self-paced learning, critical thinking, and pre-class preparation, making it suitable for flipped classrooms.

Rather than competing platforms, the tools are most effective when used complementarily. Teachers, particularly in Bhutan, can integrate EdPuzzle for pre-class learning and Nearpod for in-class interactive instruction, creating a balanced, student-centred learning environment that supports independent and collaborative learning. This blended approach aligns with contemporary STEM pedagogy. In this regard, educational stakeholders should invest in infrastructure and teacher training to support effective technology-enhanced learning.

Limitations

The findings should be interpreted cautiously due to the small sample size and focus on selected electricity concepts, which may affect generalisability. External factors, including students' digital literacy, access to technology, and internet connectivity, may also have influenced outcomes.

Future research should explore the long-term impact of integrating multiple digital tools across diverse subjects and educational contexts with larger samples with longitudinal approach.

Nonetheless, the strategic use of the interactive and self-paced digital tools has significant potential to enhance learning of complex scientific concepts, particularly in resource-constrained and evolving contexts like Bhutan.

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