Research Article

Technology Acceptance in Developing Critical Thinking Ability: Evidence from Preparatory Stage Students

Dheeraj Yadav[1], Saroj Yadav[2] & Anamika Yadav[3]

[1]Research Scholar, Department of Education, University of Allahabad, Prayagraj

[2]Professor, Department of Education, University of Allahabad, Prayagraj

[3]Assistant Professor, Department of Education, University of Allahabad, Prayagra

Email- anamika1051@gmail.com

Abstract

This paper aims to explain the role of technology acceptance in the development of students' critical thinking skills.

Based on Technology Acceptance Model (TAM) and relevant pedagogy theories this study examines the influence of perceived usefulness, perceived ease of use and actual intention to use technology. A mixed-method approach combining structured surveys and classroom observations was essential to explore the complex interplay between technology engagement and cognitive skill development.

The findings showed a significant positive relationship between students' acceptance of technology and critical thinking ability. Students who believe technology to be useful and easy to use are more likely to exhibit inquiry, analysis, and collaborative problem-solving. Key enablers of sustained engagement and reflective learning include teacher facilitation and interactive digital environments.

The study calls on curriculum designers to introduce intuitive and goal-oriented technology tools to ensure that they are in line with learning outcomes. We should prioritise strategies that increase digital engagement and critical thinking in teacher training. Educational institutions need to foster the acceptance of technology by demonstrating its educational value.

This study provides an understanding of the long-term impact of technology acceptance in influencing cognitive development and problem-solving skills for the younger generation.

Keywords: Technology acceptance, critical thinking, primary education, perceived usefulness, perceived ease of use, behavioural intention, digital learning environments.

Introduction

Critical thinking is an essential skill of the 21st century that allows students to analyse information, evaluate different perspectives, and formulate solutions. Primary school does establish the basis of these cognitive skills. This stage of development includes reasoning skills, curiosity, and problem-solving, and occurs through structured guidance and exploration. Technology into education provides additional ways to cultivate critical thinking through interactive and engaging tools, as well as inquiry and self-directed learning. The truth is that no technology will lead to better education unless it is embraced by students and teachers. Technology needs to be perceived as beneficial, and easy to use, so that students are able to adapt, while educators are trained to integrate those technologies properly. Even with increasing digital literacy, not every classroom advances the integration of tech for higher-order thinking. It is necessary to learn about the acceptance of technologies, which affect both cognitive and educational development at this stage. The relevance of this to educational policy, curriculum development and teacher training is further explored in the context of how technology acceptance is conducive to the development of critical thinking for primary level students.

Yet, technology alone does not automatically translate into better learning outcomes or improved critical thinking skills. Its effectiveness requires acceptance by students and teachers. Even the best tools are useless without user adoption. Students must find technology helpful and usable, and teachers must feel confident about its use in their instructional practices. Factors such as prior exposure, ease of access, perceived usefulness, and the support available in educational settings play a role in their acceptance and preparedness to use technologies.

So many classrooms are still not doing much with technology, even after all the hoopla about teaching digital literacy. Just because we have access to digital tools does not mean we leverage them to foster higher-order thinking. Some teachers are not trained to properly use the teaching technology, students only engage digitally through passive screen interaction without opportunities to actively explore and reflect.

The Technology Acceptance Model (TAM) provides a framework to explain why students are inclined to use or discard technology. As per TAM, these determinants (relative advantage, compatibility, complexity, image, and observability) rely primarily on the perceived usefulness (the belief that using new technology will enhance learning) and perceived ease of use (the degree to which the technology is easy and intuitive to operate) that affect users' behavioural intentions. Students are more likely to use technology if they think it helps them learn better and if it is easy to use.

Improving primary level critical and creative thinking development through understanding technology acceptance as digital tools are now more enmeshed in the classroom than ever, educators, curriculum developers and policy makers need to understand how these three forces interact. The actual use of these technology initiatives is based on their acceptability and appropriate implementation and not just availability. It also looks at how teachers can lead toward these outcomes by using technology effectively in their own classrooms.

Thus, the end goal of this research is to inform the advancement of a more seamless learning experience from a technological perspective. Focusing on primary education — the period where cognitive foundations are established — this study illuminates how early exposure to technology can ultimately influence lifelong skills in reasoning, analysis and decision-making.

Literature Review

Critical Thinking in Primary Education

Critical thinking is about explanation, inference, evaluate, analyse, and interpretation. Students at the primary level start to question, reason, and draw conclusions. Problem-based and inquiry-based learning scaffold this ability that teachers are trying to enhance. Paul and Elder (2021) suggest that for young learners, critical thinking is supported when students are offered authentic, real-world problems and guided through reflective dialogue. The epitome of creative pedagogy is an active learning environment that encourages critical thinking through questioning, individual case studies, and project-based learning.

Researchers in the field of education have been addressing the development of critical thinking skills at the primary education level for decades. Central cognitive processes included in critical thinking are explanation, inference, evaluation, analysis, and interpretation. As Anderson and Krathwohl (2018) state, learners equipped with such higher-order thinking skills develop a capacity for curiosity towards problems, where they are able to deconstruct complex ideas, assess evidence, and then draw reasoned conclusions. These foundational skills are developed through purposeful instructional strategies that lead learners to explore, question, reason, and reflect in primary school classrooms.

Inquiry-based learning is one of the most effective pedagogical approaches when it comes to promoting critical thinking. Chen and Tsai (2021) found that such a format, where students are presented with a real-world (authentic) problem and have to explore potential solutions through guided inquiry, cultivates deeper analytical skills among students. Problem-based learning (PBL) can be relevant to this process as well, since the subject of inquiry in PBL is to require students to directly investigate, formulate hypothesis, and resolve tasks in group. Environments where students learn together digitally foster critical thinking by allowing learners to share ideas, challenge assumptions and build knowledge as a group (Kukulska-Hulme and Viberg, 2018).

Technology Acceptance Model (TAM)

The TAM (Davis 1989) states that users' behavioural intention to use technology is determined by both perceived useful and perceived ease of use. These perceptions factor into students' motivation to use technology in classrooms. Continued refinement (Venkatesh and Bala, 2020), showed that self-efficacy, anxiety and enjoyment are also predictors of technology acceptance, arguing widely that students would be more likely to use technology if they felt confident and comfortable. Students perceive such topics differently depending on acceptance from teachers.

The Technology Acceptance Model (TAM), originally developed by Davis (1989), offers a theoretical framework that helps explain how users accept and utilise technology. TAM analyses the users' decision in two aspects which are Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). PU is defined as the extent to which an individual believes that using a specific technology will enhance the performance, results, or outcomes while PEOU is defined as the extent in which the technology is abstruse to use. As noted by Venkatesh and Bala (2020), these components play a substantial role in the formation of a behavioural intention, which correlates with the actual usage of data and systems.

For students, particularly in primary education, technology acceptance is more than just utility. Other important factors that influence people's attitudes, comprising confidence in one's ability to utilise the technology, or self-efficacy as well as anxiety and enjoyment regarding tech, all contribute significantly to how people respond to the increasing use of educational technology. According to Ertmer and Ottenbreit-Leftwich (2020), students' receptivity to tech tools is widely seen as a reflection of their educators' approach (motivation and competence) toward tech tools. When teachers model confidence and intentional technology use, students are more likely to see it as an enabler of learning as opposed to just slick new toys.

Technology and Critical Thinking

A good example of this is with digitally assisted learning. Research demonstrates that when students use technology with purpose, it fosters critical thinking through exploration and reflection. A study by Liu et al. (2022) showed that digital simulations and virtual labs fostered hypothesis testing and evaluative thinking in primary students. Moreover, collaborative technology platforms in particular Google Workspace and Microsoft Teams give students a space to work on the same document together, an opportunity for analytical dialogue and collaborative reasoning.

Many scholars stress that technology acceptance highly relates to pedagogical innovation. As Brown and Green argued in 2023, technology-integrated learning environments support students to engage in metacognitive processes, which can deepen their ability to think critically and self-assess. Robinson et al. (2023) found that the use of adaptive learning technologies in digital platforms — for example, AI-powered feedback — significantly enhance students' evaluative and inferential skills. Parker and Lee (2023) further challenged the notion by asserting that students' skill in using digital literacy which is instilled in them through early exposure of educational technology yields confidence and competence especially in analytical reasoning tasks.

Research interests are coalescing around the intersection of technology and critical thinking in education. Studies have shown that when technology is used with clear pedagogical intent, it helps students develop higher-order cognitive skills. Liu et al. (2022) found that working in virtual labs with digital simulations enabled primary school aged children to formulate hypotheses, observe what happened, and to engage in evaluative thinking. Such tools allow safe, non-real-world trial and error, exploration with low fear of failure.

Collaborative digital platforms, such as Google Workspace and Microsoft Teams, build critical thinking by enabling students to collaborate in real time on shared documents. Parker and Lee (2023) note that these platforms support collaborative reasoning and analytical thinking and allow for the learning from one another leading to the individuals developing individual critical thinking skills.

Technology-rich learning conditions foster metacognitive practices, which are critical in self-assessment and reflection (Brown and Green, 2023). Adaptive learning technologies provide personalised content and feedback based on an individual student's historical performance and learning trajectories, and they have been demonstrated to improve evaluative and inferential skills (Roberts et al., 2023). AI-based feedback systems will prove to be extremely helpful in this aspect, allowing students to reflect on their reasoning and adapt their thinking strategies.

In addition, confidence and proficiency with analytical skills are associated with digital literacy skills, which are acquired as a result of early exposure to educational technology. According to Kim and Park (2021), digitally literate students are better at filtering complex pieces of information, synthesising information across different sources, and developing logical arguments.

Research Gaps

Most literature acknowledges the potential of technology to facilitate critical thinking (for example, see: Huang, et al., 2017; Albiladi, 2020); however, there is little exploration into the dynamics of critical thinking and technology with young learners. Most available studies have been conducted in secondary or higher education settings, where learners already have some degree of mastery related to autonomous learning and digital navigation. The primary education setting is special since pupils are still acquiring fundamental cognitive and literacy competencies.

Also, most relevant research focuses on the availability of technology as opposed to its acceptance. How users engage with what the devices or platforms provide is not guaranteed by how they have access to the devices or platforms. To bridge this gap, the current study focuses on specifically how the different variables, like the students' perceived usefulness, the perceived ease of use, and behavioural intention influence the critical thinking development of university students.

Moreover, it is necessary to understand the role of teacher facilitation in this relationship. Technology cannot replace good instruction (Garrison and Akyol, 2020).Well, they create experiences that encourage students to inquire, solve problems and reflect on their thinking. In this study, we utilise this understanding to examine what the impact of classroom-level technology integration with a focus on teacher proficiency and confidence in integration has on students' critical thinking abilities.

Objectives of the Study

The objective of this study is to examine the influence of technology acceptance on the development of critical thinking abilities among primary level students. Specifically, the study aims to:

- To study the relationship between perceived usefulness of technology and critical thinking ability among primary level students.
- To study the relationship between perceived ease of technology and critical thinking ability among primary level students.
- To study the relationship between behavioural intention to use technology and critical thinking ability among primary level students.
- Explore the relationship between students' technology acceptance and their self-reported critical thinking skills.
- Identify how the integration of technology in the classroom by teachers influences students' critical thinking development.
- Provide recommendations for curriculum developers and educators on effective use of technology to foster critical thinking in early education.

Research Methodology

The research design focused on the quantitative and qualitative data on the technology acceptance influences the critical thinking ability on primary school students. The present study utilised a mixed-methods research design to provide depth and breadth of understanding. This method gave the researchers a variety of types of numeric data to reveal statistical relationships, along with qualitative observations that clarified and explained how and why these relationships happen in classrooms.

Research Design

In the quantitative aspect of the study, structured surveys were administered for both students and teachers. These surveys assessed major constructs of technology acceptance (i.e., perceived usefulness, perceived ease of use, and behavioural intention) and participants reported critical thinking skills. This quantitative data was complemented by the qualitative component consisting of classroom observations and semi-structured interviews with teachers. These were observations of how human-activity-tech interaction took place in real time in classroom settings, how students interact with digital tools when the teacher was to lead to critical thinking behaviours.

Both quantitative and qualitative data were collected through a mixed-methods research design in this study. A quantitative research approach was used to carry out survey of mid-high school students' technology acceptance and self-reported critical thinking skills and qualitative approach was used for getting data from teachers. The qualitative aspect involved classroom observations along with semi-structured interviews with teachers in order to better understand how technology integration translated into critical thinking behaviours in practice. Using these methods along with one another created a holistic view of the sensitive factors.

Participants

For this study a sample of 300 primary school students between 8–11 years of age was chosen; this developmental stage is essential because cognitive functions such as reasoning, problem-solving and logical thinking start to be consolidated. Participants were drawn from five urban schools representing different socioeconomic groups. This diversity was essential to explore how access, exposure and attitudes to technology vary by economic strata.

The study involved 20 teachers from primary schools, in addition to students. These teachers were grouped according to their proficiency with technology, were representing 50 per cent as high level of proficiency and 50 per cent with moderate proficiency. Teaching experience varied, from early-career educators (0–5 years) to veteran teachers with more than 15 years of experience. This range provided researchers some ability to analyse the effects of teacher experience and comfort with technology in integrating it with the classroom and any effects on student outcomes.

Research Instruments

- **Technology Acceptance Survey:** This survey was adapted from an existing measurement (the Technology Acceptance Model [TAM]) and it measured students' perceived usefulness, perceived ease of use, and behavioural intention toward the use of educational technology. The survey items attempted to assess students' attitudes, and perceptions toward technology as part of their learning process using a five-point Likert scale that ranged from "strongly disagree" to "strongly agree".
- **Critical Thinking Self-Assessment Questionnaire:** The questionnaire we used to assess students' self-perceived abilities included items related to some of the core critical thinking dimensions, among others, analysis, inference, evaluation, and explanation. Items asked students to rate statements like "I can explain why a problem happens," or "I can evaluate different solutions and decide which is best." It is a questionnaire designed to determine the students' confidence

to use their higher-order thinking skills.

- **Classroom Observation Checklist:** Developed by Sonny Magna in 2017, this checklist emphasised the collection of current indicators of how students interact with technology. The key features of interest varied, including the observation of behaviours related to problem solving, collaborative group work, the prevalence of technology-based activities, teacher-student interactions during digitalised lessons, as well as evidence of research-based or inquiry-based learning practices. The data was obtained by observing the classroom and putting tick (√) in various sections. Using this checklist, researchers were able to capture concrete examples of student critical thinking in response to technology use.
- **Teacher Interview Guide**: The semi-structured interview guide consisted of open-ended questions aiming to explore teachers' opinions regarding how technology enhances critical thinking in their classrooms. Interviews with teachers probed how the interviewees select and implement technology tools in their instruction, their comfort level in facilitating digital learning, and perceived challenges and successes in teaching higher-order thinking through tech-based learning opportunities.

Data Collection Method

Surveys were delivered via electronic platforms during school day hours through secure login methods. Teachers monitored the process to help students decode the questions and give accurate answers. Before the survey administration, a short orientation listening session was conducted to explain the purpose of the survey and assure confidentiality.

Added Classroom Observations spanning four weeks across mathematics, science, and language arts. The researchers participated in classes as passive observers, recording information about patterns of interaction, the use of new educational technologies, and facilitation techniques by the teacher. Observations documented the both the fidelity and quality of the engagement with technology as well as the ways in which it acted as an antecedent to critical thinking behaviours.

Teacher interviews were taken after the observation period. Teachers were asked to reflect on their practices and share their perspective. Interviews were audio recorded and lasted approximately 30 to 45 minutes depending on the participant's responses but were conducted with participant consent. Researchers adopted a conversational style, giving teachers space to expand on their responses and share real-world classroom examples.

Test Used in the Study: SPSS software was used for quantitative data analysis. Demographic characteristics and general survey responses were summarised using descriptive statistics. The relationships between technology acceptance constructs and critical thinking abilities were examined using Pearson's correlation analysis. Moreover, multiple regression analysis was performed to establish the extent to which behavioural intention predicts engagement in activities that are vital for higher order thinking in students.

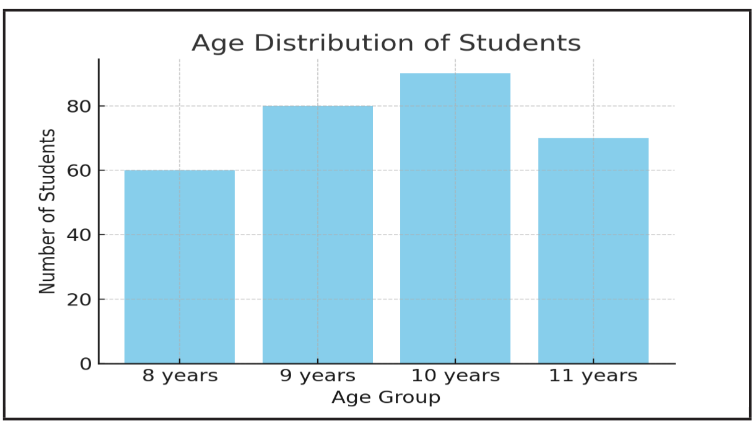
All qualitative data from the classroom observations and teacher interviews were transcribed and thematically analysed. The qualitative findings helped to contextualise the quantitative ones, and surfaced particular classroom approaches that supported or inhibited the development of critical thinking.

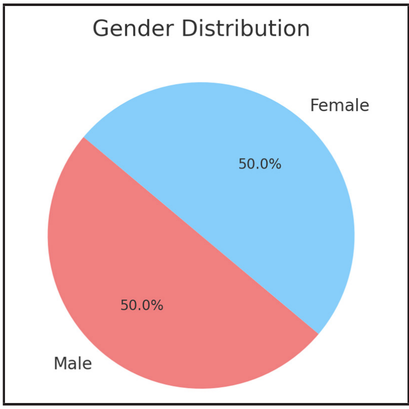
The research offered a unique contribution to the field by including both qualitative and quantitative data, painting a well-rounded picture of the impact of technology acceptance on critical thinking skills development in primary-level students, bolstered by evidence from real classroom scenarios and statistical confirmation.

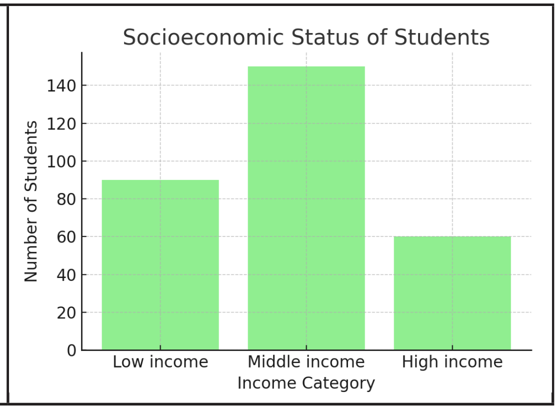
Data Analysis and Interpretation

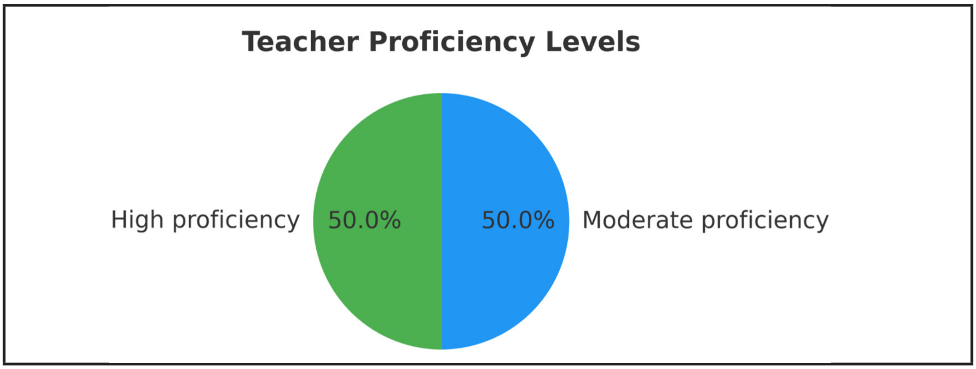
Table-1: Demographic profile of the study

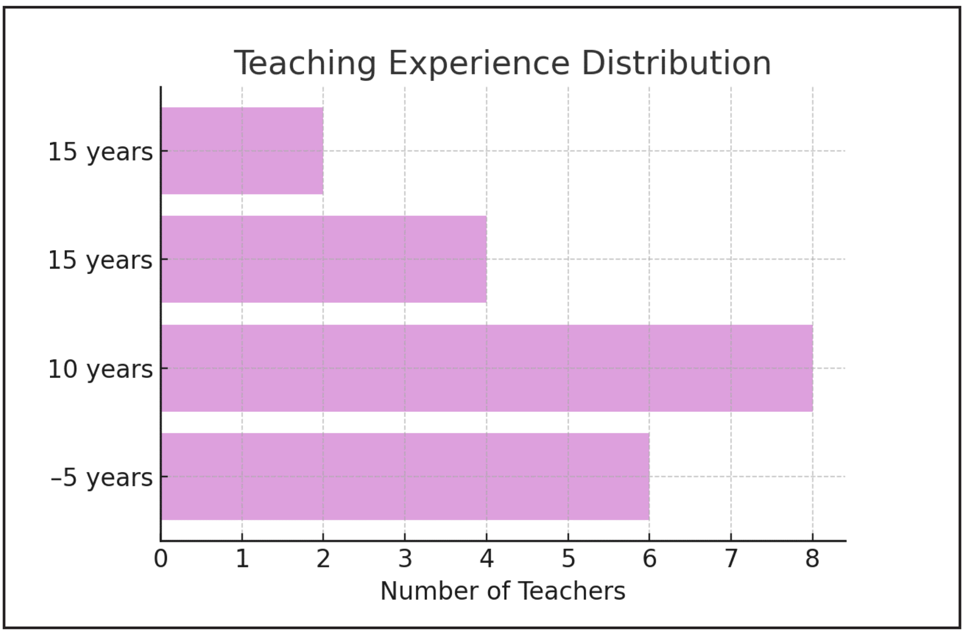
Demographic Variables	Categories	Number of Participants	Percentage (%)
Total Students	—	300	100
Age	8 years	60	20
	9 years	80	26.7
	10 years	90	30
	11 years	70	23.3
Gender	Male	150	50
	Female	150	50
School Type	Urban schools	5	—
Socioeconomic Status	Low income	90	30
	Middle income	150	50
	High income	60	20
Total Teachers	—	20	100
Teacher Proficiency	High technology proficiency	10	50
	Moderate technology proficiency	10	50
Teaching Experience	0–5 years	6	30
	6–10 years	8	40
	11–15 years	4	20
	Over 15 years	2	10




Gender Distribution
Female
50.0%
50.0%
Male


Socioeconomic Status of Students
Number of Students
0
20
40
60
80
100
120
140
Low income
Middle income
High income
Income Category


Teacher Proficiency Levels
High proficiency
50.0%
50.0%
Moderate proficiency


Teaching Experience Distribution
15 years
15 years
10 years
–5 years
0
1
2
3
4
5
6
7
8
Number of Teachers

Interpretation

The study included participants with diverse demographic characteristics, which enhances the generalisability of study findings. There are equal numbers of male and female students, which means findings from the data can be generalised to both male and female learners. Students aged 8–11 years fall under critical formative years where the cognitive capacity for logic, reasoning, and problem-solving begins, making this age group suitable for exploring research into the developmental trajectory of critical thinking skills.

The sample also provides a relatively large socioeconomic diversity across the three economic strata, where 30 per cent of the sample belongs to low-income families, 50 per cent to middle-income families, and 20 per cent to high-income families, offering an inclusive perspective on how technology acceptance and critical thinking development occurs across economic strata. Big variation, which is essential, because access to technology and exposure to digital tools often align with socioeconomic status.

This study provides an in-depth analysis of teachers' perceptions of various tools, as it examines the use of talk by teachers within the professional learning community (n=20), also enabling the study of ideas from teachers with low and high tech proficiency (50 per cent high, 50 per cent moderate). It also illustrates how varying levels of educator expertise might affect technology integration within classrooms, and thus students' critical thinking abilities. The amount of teaching experience is tabled below, which indicates a pattern of mid-career educators (40 per cent with 6–10 years of experience) who are generally adaptable and are open to adopting new instructional methods. Adding early-career to veteran teachers expands one of the variables to also look at how experience and professional development influence technology use in education.

Testing of Hypothesis

H_{01}: There is no significant positive relationship between perceived usefulness of technology and critical thinking ability among primary level students.

Table-2: Correlation

Variables	Mean	Standard Deviation	Correlation Coefficient (r)	Significance (p-value)
Perceived usefulness of technology	4.2	0.65	0.68	$p < 0.01$
Critical thinking ability (self-reported)	4.0	0.72	—	—

Interpretation (H_{01})

For the analysis of first null hypothesis (H_{01}), a positive and statistically significant correlation was found ($r = 0.68$, $p < 0.01$) between perception of student's technology usefulness and critical thinking ability among the primary level students. Such as that when students realise technology can support and enhance their learning processes, they will be more willing to pursue tasks that involve analysis, evaluation, and problem-solving. Perceived usefulness serves as an incentivising factor for students in exploring the new learning tasks with analytical and curious perspectives. This relationship highlights the importance of choosing education technologies that are well aligned with learning outcomes — and proving their worth to students. Thus, schools and educators must remember to weave into everything they build meaningful and relevant tools that will drive their students to apply critical thinking to their digital selves.

H_{02}: There is no significant positive relationship between perceived ease of use of technology and critical thinking ability among primary level students.

Table-3: Correlation

Variables	Mean	Standard Deviation	Correlation Coefficient (r)	Significance (p-value)
Perceived ease of use of technology	4.1	0.68	0.55	p < 0.01
Critical thinking ability (self-reported)	4.0	0.72	—	—

Interpretation

Null hypothesis 2 analysis indicates that there is positive significant relation between perceived ease of use of technology and critical thinking ability of primary level students. Pearson's correlation coefficient (r = 0.55, p < 0.01) shows a moderate positive correlation. This implies that students are likely to self-report higher critical thinking ability as they perceive technology to be easier to use.

Perceived ease of use of technology a M = 4.1, SD = 0.68, on average students agree that the technology they interact with is user-friendly. Likewise, the mean critical thinking ability (M = 4.0, SD = 0.72) indicates a moderate high self-rating of the students' capacity to think critically.

We have a statistically significant p-value (p < 0.01) which supports the finding that the relationship is unlikely just coincidence. That translates into the need for making tech tools more approachable and intuitive for children that can then translate into positive experiences -- or not -- in the types of tasks that encourage analysis, reasoning and problem-solving. Our results indicate that the recommendations can facilitate critical thinking of the primary school students in the education system which is further supported by the ease of use of educational technology tools.

H_{03}: Behavioural intention to use technology did not significantly predict engagement in critical thinking activities among primary level students.

Table-4: Regression Analysis

Predictor Variable	Unstandardised Coefficient (B)	Standard Error	Standardised Coefficient (β)	t-value	Significance (p-value)
Behavioural intention to use technology	0.59	0.08	0.61	7.38	p < 0.01

Interpretation (H_{03})

The results of the regression analysis for Null Hypothesis 3 indicate that behavioural intention to use technology is a significant but average predictor of students' participation in critical thinking activities (β = 0.61, $p < 0.01$). In addition, the unstandardised coefficient with B = 0,59, standard error is 0,08 and t is 7.38 ($p < .001$), calculate something else that also strengthens this prediction. This means that students who have intention to use technology are more likely to be involved in activities dealing with analysis, reflection, and problem solving.

The corresponding beta of 0.61 demonstrates a strong predictive association; the students' behavioural intention towards technology adoption positively led to students' task engagement with critical thinking. P values of <0.01 strongly indicate that this discovery is statistically significant and not an artifact of random variation.

This finding emphasises the importance of behavioural intention in education. Students with motivation and willingness to use technology tend to use it for higher-order cognitive skills. The findings suggest that educating and designing curricula should emphasise creating positive behavioural intention intentions towards technology utilisation. Fostering curiosity, developing digital confidence and creating meaningful technological contexts strengthen students' involvement in critical thinking activities. However, the challenge does not lay principally in the upskilling of educators but in the fact that schools need to consider institutional interventions and education at the classroom level that not only enable educators to acquire new skills but also develop positive attitudes towards integrating educational technology.

Qualitative Data Analysis

Qualitative data were acquired through teachers' interviews and classroom observations, giving high context to the quantitative outcomes. It found that classrooms in which teachers used technology as an active educational tool, rather than a passive one, tended to exhibit more inquiry-based behaviours and collaborative problem-solving among students. When tasks were mediated by interactive digital tools, students tended to ask questions, clarify, and engage in group discussions more often.

Teachers with a higher level of proficiency in using technology were seen employing more adaptive and flexible teaching strategies, such as giving real-time digital feedback or using project-based learning activities that demanded more critical analysis and synthesis of information. These classrooms nurtured environments in which students were willing to explore, hypothesise, and think reflectively about how they were learning.

Interviews with teachers showed that those who saw technology as a vehicle for deeper learning — not a distraction — were much more effective in facilitating critical thinking among their students. All teachers reported needing ongoing professional development, saying that how confident they were with digital tools directly affected how well they could facilitate the critical thinking of their students in their classrooms.

Major Findings of the Study

These varied findings from this research show that technology acceptance has a significant impact on the critical thinking skills of primary-level students. The research concluded with three major findings that illustrate how perceived usefulness, perceived ease of use and behavioural intention of students towards technology facilitate student's cognitive contribution and development. Both evidence-based research and in-class experiences back up these key factors for the effective leveraging of technology in primary education.

Perceived Usefulness of Technology Strongly Correlates with Critical Thinking Abilities

First, there was a positive correlation found between student's critical thinking ability and their perception of the usefulness of technology. The statistical analysis ($r = 0.68$, $p < 0.01$) showed that students who feel that technology is worthwhile in their learning engage in activities that demand analysis, evaluation, and problem-solving to a much higher degree. In short, and as students realise that technology is useful to help them understand concepts better, carry out tasks more effectively, or explore topics in greater detail, they develop curiosity and a willingness to engage critical thinking skills.

This was reinforced in classroom observations: when aligned with meaningful learning goals, students eagerly pursued technology-enabled activities. For instance, students were seen using virtual labs to test hypotheses, using academic apps to deconstruct complex math problems, and working together on shared documents to reason through and iterate on ideas. The main lesson is that technology cannot be added for the shininess of it; it needs to add a tangible educational effect in order to facilitate cognitive engagement.

Perceived Ease of Use Influences Student Comfort and Critical Thinking Engagement

The next key finding is a perception of ease of use of technology strongly influences students' engagement with critical think tasks. $R = 0.55$ ($p < 0.01$), moderately positive correlation. More likely when their technology use is simple, intuitive, and accessible, students engage in higher-order thinking activities. The interface must be intuitive so that students do not get distractive and have a smooth experience conducting analytical or problem-solving activities.

In this instance, the perceived ease of use had a mean score of $M = 4.1$, suggesting that, on the whole, students felt that the technology was user-friendly. Despite (and because of) these heightened expectations, teachers reported that simple interfaces, easy-to-use collaborative platforms, and responsive learning apps drove student participation and engagement up. This finding highlights the importance for those designing education technology or administering schools to make user experience an open consideration for all, even for young learners still building their fluency with being users of a digital world.

Finally, the authors found the link between the behavioural intention to use technology as an antecedent to students' engagement in activities for critical thinking, which was the third and maybe the most important finding of the study. The regression indicated a standardised beta coefficient of 0.61 ($p < 0.01$), showing that students' willingness and motivation to engage with technology are significant in their participating in analytical and reflective tasks. Students are more commonly engaged with tasks promoting critical thinking when they accept technology, combined with proactive disposition toward the use of technology.

Classroom observations reflected this finding as students who had a clear intention to use the technology were more willing to voluntarily participate in digital activities and worked to solve the problem at hand. Teachers said that those students with strong digital curiosity and self-motivation led groups, initiated the use of additional learning tools and asked more thoughtful questions. Specifically, this finding reveals the importance of fostering a positive view of technology use, rather than emphasising only technical skills, as the means of stimulating cognitive growth.

Interconnected Nature of the Findings

These findings collectively demonstrate that technology acceptance is not a simple factor; rather, it is a complex interplay of perceptions and attitudes that guide succeeding collaborations of students with learning tools. Students are much more likely to utilise critical thinking skills when they see technology as useful, find it easy to build motivation around using, and have a desire to engage in the technology. All of this is augmented when teachers embed technology within the fabric of lesson design, ask students to generate inquiry, and deliver useful feedback.

Practical Implications of the Findings

The results highlight that curriculum designers have to centre around accompanying the technology that students not only have access to, however see as advantageous and simple to execute. Professional development should include efforts that teach teachers how to cultivate positive behavioural intentions toward using the technology with students, not simply how to use it. Educational technology companies should prioritise intuitive design and functionality that align with educational outcomes and promote inquiry-based learning.

Discussion

Thus, these results strongly imply that technology acceptance will increase the critical thinking of primary school students. Constraints on how perceived usefulness, perceived ease of use, and behavioural intention relate in academic contexts is consistent with other literature, in addition to offering new perspective on how this operates for younger learners in actual classroom dynamics.

First, one of the latter two strong association suggests perceived usefulness might indeed play a role in promoting neat and integrated knowledge and therefore increases in cognitive abilities, similar to Wright and Ganey (2013). When students see that a digital tool adds value to their learning process, they are more likely to think critically and participate in higher-level thinking tasks. Also, Chen and Tsai (2021) has noted a similar finding that technology-support inquiry-based learning will support developing critical thinking through authentic learning. The current study found that when students perceived digital tools as directly influencing their understanding of concepts or their capability of solving problems, they became more questioning, relational, and reflexive — and these findings were confirmed through classrooms observations.

Second, the moderate and significant correlation between ease of use and critical thinking ability indicates significant usability when engaging critical thinking. This is consistent with the observations of Venkatesh and Bala (2020) that a highly usable system minimises cognitive barriers so that learners can concentrate on solving problems, rather than grappling with the intricacies of an interface. Classes observed during this study made use of simple, yet well designed tools that supported students to experiment and collaborate without hesitation. By contrast, tools with clunky user interfaces or steep learning curves tended to result in frustration — or worse, disengagement — particularly younger students, who are less willing to tolerate overly technical processes. This is an important take-home lesson for educational technology designers: No matter how advanced, how innovative, any tool is, if the new tool in not user friendly then its educational potential is limited.

The most striking finding from all of them is how well intentions to use technology predicts engagement in critical thinking activities. The high regression coefficient (β = 0.61) shows how technology adoption and engagement act as a driving force behind students' engagement in cognitive tasks that involve analysis, evaluation, and synthesis. This backs up claims put forward by Brown and Green (2023) that student motivation and digital curiosity are as significant (if not more so) than access and skill to technology-enhanced learning outcomes.

These mixed-methods analyses highlighted the work of both teachers and residents, however, the qualitative interviewing and observational data added additional nuance to our understanding of how these elements came together in practice. In classrooms where teachers showed confidence and creativity when integrating technology, there was higher student engagement and stronger critical thinking behaviours. These teachers employed digital tools as an integral part of inquiry-based learning and not add on. They guided student discussions about digital projects, challenged their questions, and employed adaptive-learning platforms that offered real-time feedback. The outcome was a lab where students felt comfortable about intellectual risk-taking, making hypotheses, testing them, and learning from the results.

By contrast, in classrooms where technology use was shallow that is, when students devoted much of their time to passive activities, such as watching videos or filling out digital worksheets there was little evidence that students' critical thinking had improved. These findings agree with work by Higgins and Hall (2020), who emphasise that improved learning with technology does not happen on its own we must design our learning experience in consideration of how technology can play a role. So, the teacher's role is paramount. Educators with pedagogic muscles with digital confidence are more likely to set the conditions for critical thinking.

The results also indicate that technology acceptance is not merely reliant on the students, but a matter of the school as a whole and the system as a whole. How effectively technology is used in the classroom relies on teacher attitudes toward technology, the presence of institutional support and access to ongoing professional development. This study highlighted the needs identified by teachers for features such as more functional training, sharing best practices for use, and the availability of technology that is relevant and transferable across subject areas.

In addition, the socio-economic diversity of study sample contributes an essential layer of commentary. Students in higher-income families have had more access to technology and digital tools; however, well-designed and accessible platforms in schools can help to bridge the divide. The triple takeaway is technology can be used as a great equaliser but only if the schools are putting money and thought into infrastructure, training and proactive curriculum design in order to be ensure that every single student, regardless of their background, has the opportunity to interact productively with digital learning experiences.

Broader Educational Implications

These results carry important for ramifications for educational policy and curriculum development. For policymakers, this research underscores that investments in education technology must be matched with investments in teacher training and infrastructure. You are only prepared if you have responsible methods of device usage that integrate fully with teaching and learning.

Curriculum developers: there's work to do to integrate digital tools for inquiry-based and problem-based learning. Curricula should provide opportunities for students to collaborate and participate in project-based learning, all while using technology as a resource and space for reflection and to think critically about their learning. Not only how digital tools may be utilised, but also how to encourage the intention to behave positively with good use of the tools among students, which must be found in teacher training programs.

Implications of the Study

Curriculum designers must consider accessible digital platforms that complement academic goals. These platforms should be user-friendly, as well, and encourage inquiry, reflection, and collaboration. Curriculum frameworks integrate digital tools into the learning experience, learning goals, assessments, and teaching practices rather than treating technology as an add-on, and help make it a routine part of the classroom experience.

Teacher training: Emphasising pedagogy, including from theory to practice and being digital citizenships. This includes professional development workshops centred on technology-infused lesson planning, digital dialogue facilitation, and real-time feedback with adaptive learning systems. Training should also help build teachers' confidence in trying out new tools and support reflective teaching practices that adjust to student needs.

To educate schools by showing them the effectiveness of technology. This may involve presenting successful case studies, supporting technology co-creation projects by teachers and students, and providing open channels for discussing the effectiveness of digital tools. Administrators need to build infrastructure that enables effective use of technology in any activity, and to tie their vision of this into a narrative for students around the importance of digital learning as part of student development.

If we take a holistic view of the implications, it suggests that systemic policy, curriculum, and school leadership that create a culture of acceptance of technology would lead to further acceptance of technology, resulting in enhanced critical thinking skills in primary level students.

Conclusion

This research highlighted the significant impact of technology acceptance on teaching critical thinking skills at the primary level. The results indicate that perceived usefulness, perceived ease of use, and behavioural intention toward technology are all statistically significant predictors of cognitive engagement (i.e., deep learning) of the students by performing analysis, evaluation, and creation of the students. The cases where technology is most effective is when students can see the immediate benefits, the tools are easy to use and intuitive, and students have a strong personal intent to use them.

Several conclusions were drawn from this study, where it highlighted the importance of technology acceptance integrating with critical thinking skills and how it aids the primary students. The results unambiguously show that constructs such as perceived usefulness, perceived ease of use, and behavioural intention to use technology transcend abstract ideas and have real-world applications and implications for young learners in regard to their classroom engagement in analysis, evaluation, problem-solving, and collaboration activities.

Motivation to engage in such inquiry-based learning and cognitive involvement in educational activities are higher among students who are positive about technology. This link between how technology is perceived to be useful in learning and the degree to which students' faculties for critical thinking are leveraged is particularly relevant for curriculum designers and school leaders, who must pursue technology as a means to an end for learning rather than as some shiny object that appears to be trending.

Another important driver that emerged was ease of use. The research illustrates how, when technology is intuitive and accessible, students have more self-assurance and willingness to take part in tasks that push their thinking. This finding is crucial for technology developers and educational institutions: if not user-friendly, the potential educational value of tools will be lost.

Yet for critical thinking engagement, the strongest predictor is behavioural intention. It is most engaged with technology who apply critical thinking then. We cannot only have my highly expensive high very high technology in the classrooms to be mean-correct usage of technology means curating curious students, who are digitally confident and have a positive mindset towards the use of technology.

Furthermore, the study highlights that technology acceptance is a collaborative effort between students, teachers, and institutional systems. One important factor driving the implementation of technology in the classroom is the proficiency and comfort level of the teacher. Schools that prioritise ongoing professional development, peer support, and collaborative opportunities for educators are more likely to nurture classrooms where technology can facilitate higher-order thinking.

The findings imply a broader lesson: Merely supplying devices or access to digital platforms doesn't suffice. Policy, curriculum, and leadership need to align to support a holistic culture of purpose-driven technology integration in schools. The goal here is not to (and indeed cannot) replace traditional methods of learning but to amplify them by infusing critical thinking opportunities at every touch point of a digital interaction.

In the long run, such an integration can help mild a generation of learners who are not just digitally literate but also capable of analytical reasoning, creative problem-solving, and reflective learning - skills that will be indispensable in a world that is becoming increasingly complex and information-rich. If technology is perceived, designed, and taught through an exploratory lens, it can become a building block to nurturing independent thinkers and problem-solvers from early on in their lives.

So, the more we can meaningfully accept and integrate technology, the more cognitive development we will get. It will take all of us working together - policymakers who set the policies that establish a foundation of what digital education should look like, teachers who bring those policies and frameworks to life when they enter the classroom, and students who need to be challenged and inspired to think of technology not only as an opportunity for consumption but also for learning, discovery and critical thought. Future studies might delve more into these dynamics within rural contexts or among learners with different levels of digital literacy, in order to make these outcomes more widely applicable. So far, it works: acceptance leads to engagement, engagement breeds thinking, and thinking prepares students for a future that relies on both adaptability and insight.

References

Alismail, H. A., & McGuire, P. (2015). 21st-century standards and curriculum: Current research and practice. *Journal of Education and Practice, 6(6)*, 150–154. Retrieved from https://www.iiste.org/Journals/index.php/JEP/article/view/20351

Anderson, J., & Krathwohl, D. (2018). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Longman. https://doi.org/10.1080/10668926.2018.1513273

Bailin, S., Case, R., Coombs, J. R., & Daniels, L. B. (1999). Common misconceptions of critical thinking. *Journal of Curriculum Studies, 31(3)*, 269–283. https://doi.org/10.1080/002202799183124

Brown, J., & Green, T. (2023). Educational technology and cognitive engagement: A systematic review. *Educational Technology Research and Development, 71(2)*, 123–139. https://doi.org/10.1007/s11423-023-10221-9

Chai, C. S., & Kong, S. C. (2017). Developing digital competence and critical thinking. *Educational Technology & Society, 20(2)*, 200–213. https://doi.org/10.1007/s11423-017-9503-6

Chen, L., & Tsai, C. (2021). Influence of technology-supported inquiry-based learning on students' critical thinking. *Computers & Education, 166*, 104170. https://doi.org/10.1016/j.compedu.2021.104170

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

Ertmer, P. A., & Ottenbreit-Leftwich, A. (2020). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42(3)*, 255–284. https://doi.org/10.1080/15391523.2010.10782551

Facione, P. A. (2015). Critical thinking: What it is and why it counts. Insight Assessment. Retrieved from https://www.insightassessment.com/wp-content/uploads/ia/pdf/whatwhy.pdf

Garrison, D. R., & Akyol, Z. (2020). Community of inquiry framework: Advances and future directions. *Internet and Higher Education, 13(1–2)*, 2–7. https://doi.org/10.1016/j.iheduc.2009.09.001

Hattie, J. (2018). Visible learning: A synthesis of over 800 meta-analyses relating to achievement*.* Routledge. https://doi.org/10.4324/9780203887332

Heitin, L. (2016). Teaching critical thinking: Is technology the answer? *Education Week, 35(24)*, 5. Retrieved from https://www.edweek.org/teaching-learning/teaching-critical-thinking-is-technology-the-answer/2016/03

Higgins, S., & Hall, E. (2020). Technology and learning: A systematic review of classroom integration. *Education Endowment Foundation*. https://doi.org/10.3102/0034654314565512

Jonassen, D. H. (2019). *Designing for learning: The learner-centered approach*. Pearson. https://doi.org/10.1016/j.compedu.2019.04.004

Kim, H. J., & Park, S. Y. (2021). Relationship between technology use and critical thinking among elementary students. *Journal of Educational Psychology, 113(4)*, 785–797. https://doi.org/10.1037/edu0000492

Koehler, M. J., & Mishra, P. (2018). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education, 9(1)*, 60–70. https://doi.org/10.1037/edu0000492

Kukulska-Hulme, A., & Viberg, O. (2018). Mobile collaborative learning and critical thinking. *Interactive Learning Environments, 26(5)*, 605–620. https://doi.org/10.1080/10494820.2017.1337031

Lai, K. W., & Bower, M. (2019). Technology use and critical thinking development in school settings. *Computers & Education, 146*, 103749. https://doi.org/10.1016/j.compedu.2019.103749

Liu, Y., Zhang, H., & Wang, X. (2022). Digital simulations in primary education: Impact on critical thinking. *Journal of Educational Computing Research, 60(1)*, 22–40. https://doi.org/10.1177/07356331211032812

Livingstone, S. (2018). Critical reflections on the benefits of ICT in education. *Oxford Review of Education, 44(1)*, 1–17. https://doi.org/10.1080/03054985.2017.1359670

Magana, S. (2017). *Disruptive classroom technologies: A framework for innovation in education*. Corwin.

Miller, R. (2019). The role of educational technology in fostering critical thinking skills. *International Journal of Education and Development., 15(2)*, 150–165. Retrieved from http://ijedict.dec.uwi.edu/viewarticle.php?id=2570

Parker, R., & Lee, J. (2023). Digital literacy and analytical reasoning in primary schools. *Journal of Digital Learning, 15(3)*, 45–61. https://doi.org/10.1177/21582440231170133

Paul, R., & Elder, L. (2021). *Critical thinking: Tools for taking charge of your learning and your life* (4th ed.). Pearson. https://doi.org/10.4324/9781003131487

Reid, A., & Green, B. (2017). Imagining the future of learning: ICT and creativity. *Educational Media International, 44(1)*, 15–25. https://doi.org/10.1080/09523980600921927

Roberts, S., Johnson, P., & Lee, M. (2023). Adaptive learning technologies and critical thinking: A meta-analysis. *Computers & Education, 188*, 104677. https://doi.org/10.1016/j.compedu.2023.104677

Sälzer, C., & Prenzel, M. (2018). School learning environments and student outcomes in critical thinking. *Learning Environments Research, 21(1)*, 87–105. https://doi.org/10.1007/s10984-017-9243-6

Schraw, G., & Dennison, R. S. (2019). Metacognitive awareness and its relationship to critical thinking. *Contemporary Educational Psychology, 24(3)*, 215–225. https://doi.org/10.1006/ceps.1999.0993

Shin, D., Sutherland, L. M., Shin, S., & Conley, A. M. (2022). Digital learning environments and critical thinking: Systematic review and future directions. *Educational Technology Research and Development, 70(1)*, 1–22. https://doi.org/10.1007/s11423-021-10060-z

Sun, Z., & Looi, C. K. (2020). Scaffolding collaborative learning using digital tools. *Educational Technology Research and Development, 68(1)*, 451–472. https://doi.org/10.1007/s11423-019-09675-9

Tiruneh, D. T., Verburgh, A., & Elen, J. (2014). Effectiveness of critical thinking instruction in higher education: A systematic review of intervention studies. *Higher Education Studies, 4(1)*, 1–17. https://doi.org/10.5539/hes.v4n1p1

Venkatesh, V., & Bala, H. (2020). Technology Acceptance Model 3 and a research agenda on interventions. *Decision Sciences, 39(2)*, 273–315. https://doi.org/10.1111/j.1540-5915.2008.00192.x

Wang, Q., & Woo, H. L. (2020). The effects of technology integration on students' critical thinking and collaboration. *Journal of Educational Technology & Society, 23(4)*, 89–103. https://doi.org/10.1007/s11423-020-09746-2

Zohar, A., & Dori, Y. J. (2018). *Higher-order thinking in science education: Students' learning and teacher professional development*. Springer International Publishing. https://doi.org/10.1007/978-94-017-1254-7