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Educational Technology Usage And Student Learning Perceptions: A Mixed-Data Analysis

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Abstract
Educational technology has become integral to higher education, reshaping instructional delivery, learner engagement, and access to academic resources. Despite widespread adoption of digital platforms, limited integration of quantitative usage metrics with qualitative student perceptions constrains comprehensive evaluation of technology-mediated learning environments. This study addresses this gap by examining the relationship between educational technology usage and student learning perceptions using a mixed-data analytical approach. A convergent design was applied to a cross-sectional dataset comprising student survey responses, incorporating descriptive statistics, Pearson correlation analysis, regression modeling, and thematic analysis of open-ended responses. Findings indicate that higher usage frequency is associated with improved perceived learning outcomes, while satisfaction and accessibility significantly influence student experiences. Accessibility emerged as a key determinant, with technical constraints such as connectivity and system reliability affecting engagement levels. Qualitative insights highlight usability concerns, preference for intuitive design, and demand for interactive features as critical factors shaping perceptions. The study contributes to academic discourse by demonstrating the importance of integrating behavioral and perceptual dimensions in evaluating educational technology effectiveness. Implications extend to institutional policy and regulatory frameworks, emphasizing the need for infrastructure development, user-centered platform design, and inclusive digital strategies. The analysis underscores that effective technology adoption depends on aligning system functionality with student needs and contextual conditions.

Keywords: Educational technology, Student perceptions, Learning outcomes, Accessibility, usage frequency, Mixed-methods analysis

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1. Introduction

Educational technology in higher education has revolutionized the processes of instruction delivery, learning experience, and acquisition of knowledge. The learning management systems, virtual classes, and collaboration tools are digital platforms that are now integrated into the academic setup and are transforming the classic model of pedagogy. As empirical data shows, educational technology has the potential to support learning outcomes by making resources available, facilitating interactions, and supporting individual learning trajectories (Akintayo et al., 2024; Yeung et al., 2021). The pace of these developments has been increasing over the last few years, especially with the growth of online and hybrid modes of learning, rendering the assessment of technology-mediated learning experience even more topical.

The effectiveness of educational technology is mostly dependent on student perceptions. Perceived usefulness, ease of use, and system design have a great impact on students who are willing to use digital platforms (Pérez-Pérez et al., 2020; Al-Fraihat et al., 2025). Enhanced satisfaction and academic performance are commonly linked to positive perceptions, and less engagement and hindrance of learning outcomes are linked to negative perceptions. Theoretical insights like the Technology Acceptance Model offer some foundation on how such perceptions determine the adoption and usage behavior toward technology.

Online learning platforms have also resulted in higher levels of student satisfaction and learning experiences. Studies prove that engagement and perceived learning effectiveness are strongly connected with satisfaction with digital tools (Enyoojo et al., 2024; Abuhassna et al., 2020). The students who claim to be more satisfied are more likely to show increased participation and a more favorable assessment of their learning outcomes. Nonetheless, comparative analysis indicates that online platforms are flexible and accessible, although they might not be able to produce the same sort of interactive dynamics as traditional classroom settings (Jamal et al., 2023).

Accessibility is an important aspect in the success of educational technology. The differences in digital infrastructure, internet connectivity, and the level of expertise of the user pose disparities in access to online learning environments. Lack of bandwidth, system reliability, and technical support are common issues faced by students, which may negatively impact their interaction and their views on their effectiveness (Maatuk et al., 2022; Shafiei Sarvestani et al., 2019). These limitations emphasise the necessity to pay attention to contextual and infrastructural aspects of the influence of educational technology. Recent studies have extensively investigated the relationship between the patterns of usage and the outcomes of learning. The general pattern with frequent exposure to digital platforms is the enhancement of academic success and perceived learning benefits (Zhang et al., 2020; Rico-Juan et al., 2024). Nevertheless, the quality of usage is dependent not just on frequency but also on the quality of interaction and alignment to the instructional goals. Research has revealed that organised and meaningful interactions within learning management systems have a greater impact on learning outcomes as compared to passive or unorganised usage. Although the field of educational technology has amassed a considerable amount of literature, a weakness still remains in the segregation between quantitative and qualitative analysis. Most research is based on statistics, predominantly without taking into consideration the contextual information of student feedback. Qualitative lenses demonstrate valuable aspects like usability issues, feature choices, and perceived obstacles that cannot be entirely quantified with the use of numbers (Ubaidillah et al., 2020; Pate, 2016). A combination of these viewpoints is critical in coming up with a comprehensive view of technology-mediated learning environments.

The current research fills this gap by using a mixed-data method of analysis that integrates the quantitative measures of usage and perception with the qualitative information on the experiences of students. Findings have been put into perspective with the available research findings, which indicate that the effectiveness of educational technology depends on several interacting factors such

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as system design, accessibility, and user engagement. Previous research underlines that properly designed digital learning environments have the potential to positively affect both satisfaction and academic success, as long as both technical and pedagogical issues are effectively tackled (Wibowo & Charlotte, 2025; Bertsch and Cuevas, 2024).

It adds to the current discourse by emphasizing the interaction between the patterns of usage and student perceptions. Previous studies show that engaging at high levels, though not always, can lead to positive learning outcomes unless it is backed by accessible and easy-to-use systems. On the same note, the issues associated with infrastructure and usability may negate the possible advantages of educational technology even in a high-adoption environment. The results highlight the necessity to consider technological implementation and its application in relation to student requirements and contextual factors. The research also contextualizes its results in the wider discussion of digital learning, with the necessity to balance the integration of technologies and pedagogical methods. Although educational technology holds a lot of potential in facilitating better learning processes, it has both individual and systemic mediating effects. The joint quantitative and qualitative data analysis gives a multifaceted insight into the way students engage with digital platforms and how these engagements affect their learning perceptions.

2. Methodology

2.1 Research Design

A convergent mixed-methods study was undertaken to examine the use of educational technology and the learning perceptions of students. To facilitate the triangulation of data, quantitative and qualitative data were analyzed simultaneously. Such a method enables us to interpret statistical relationships and contextual information based on student narratives to gain a detailed picture of both objective results and subjective experiences.

2.2 Data Source and Dataset Description

Dataset Overview

The research employs a cross-sectional dataset based on the online education technologies and learning resources that students use (Fetaji, 2024). The unit of analysis is the individual student and allows direct analysis of the differences in technology use and perceptions since each observation is a single student.

Sample Characteristics

The demographic variables in the dataset are age, gender, academic major, and year of study. These variables give background information to interpret the findings and give the opportunity to analyze the subgroups of students in various categories.

Variables

The data set includes quantitative and qualitative variables that are congruent with the objectives of the research. The type of online tool used, frequency of use, satisfaction score, accessibility score, and perceived learning impact are examples of quantitative variables. Qualitative variables will involve open-ended questions that describe the difficulties encountered, features that students like best, and ideas on how this can be improved, providing more in-depth information on the student experiences.

2.3 Data Preparation

Data Cleaning

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Cleaning of data processes was used to make it consistent and reliable. Values not present were treated by deleting all incomplete observations or by leaving them in where the partial answers were useful to the analysis. Categorical variables were put on a uniform scale so that similar names are used throughout the dataset.

Data Transformation

Categorical data were coded into numerical data as necessary to conduct statistical analysis. The frequency of usage was considered an ordinal variable in order to capture the amount of engagement. Reviewing of quantitative scores was done, and where necessary, they were adjusted to provide consistency in measurement scales.

Qualitative Data Processing

The preprocessing of textual responses involved normalization, tokenization, and reduction of non-informative words like stopwords. The process supported the systematic coding and enhancement of the thematic analysis accuracy.

2.3 Quantitative Analysis

Descriptive Statistics

The dataset was summarized by using descriptive statistical methods. Frequency distributions were produced of tool usage and usage patterns, and measures of central tendency and dispersion were produced of satisfaction, accessibility, and perceived learning impact.

Inferential Analysis

The relationships among the key variables were analyzed using inferential analysis. To determine the strengths and direction of the relationships between frequency of use and satisfaction, accessibility, and perceived learning impact, a Pearson correlation matrix was calculated. Specifically, the correlations between usage frequency and learning effects, accessibility, and satisfaction were examined. Comparison between groups was carried out to determine the differences between tools and demographic groups. To assess the predictive value of usage patterns and perception variables on the learning outcomes, regression analysis was used.

2.4 Qualitative Analysis

Thematic Coding

The qualitative data were subjected to open coding in order to come up with recurrent concepts within the responses of the students. Passages of text were allocated preliminary codes that mirror major ideas and experiences.

Theme Development

The codes were then categorized into more general themes through an iterative process. Key themes were technical difficulties, usability, security, and desired platform characteristics, which were typical among student-provided feedback.

Theme Frequency Analysis

Thematic appearances were analyzed to analyze their relative importance in the data set. This gave a clue as to the most commonly reported problems and preferences among students.

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2.5 Integration of Quantitative and Qualitative Data

A convergence method was used to combine quantitative and qualitative results. Thematically, statistical results were explained to give a more detailed account of trends observed. This integration allowed for the finding of the connections between measured variables and the underlying student experiences.

2.6 Validity and Reliability

Validity and reliability of the study were taken care of. The quantitative reliability was facilitated by the use of consistent measurement scales across the variables, and the construct validity was achieved by matching the variables in the dataset with the research objectives. To achieve qualitative reliability, coding processes and theme refinements were done repeatedly to ensure consistency.

2.7 Ethical Considerations

The data utilized in the current study were anonymized and did not contain any personally identifiable information. Analysis was carried out on purely academic grounds, with the ethical standards of research being observed.

3. Results

3.1 Descriptive Findings

The descriptive analysis indicates that there are different trends in the application of education technology among students. The dataset consists of several digital platforms, and popular tools such as learning management systems and virtual collaboration platforms are represented. The frequency of usage shows that a significant percentage of students use these tools on a daily or weekly basis, and this means that there is a high rate of integration of technology in academic activities.

The scores of the central tendency measures of the variables of perception show moderate to high satisfaction, accessibility, and perceived learning impact. The scores of satisfaction tend to be grouped in mid-to-high ranges, indicating that the majority of students have positive experiences with educational technologies. The scores of accessibility are somewhat more variable, which means that there are differences in the ease of access between various users. Perceived effect on learning also exhibits a positive trend, with most students reporting that the digital tools do play a significant part in their academic performance. Descriptive statistics of key variables can be found in Table 1.

Table 1. Descriptive Statistics of Key Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Satisfaction_Score	3.8	0.9	1	5
Accessibility_Score	3.5	1.1	1	5
Impact_on_Learning	3.9	0.8	2	5
Usage_Frequency (Ordinal)	2.6	0.7	1	3

***Note**:* Usage_Frequency coded as 1 = Monthly, 2 = Weekly, 3 = Daily.

Figure 1 illustrates the distribution of educational technology usage frequency among students.

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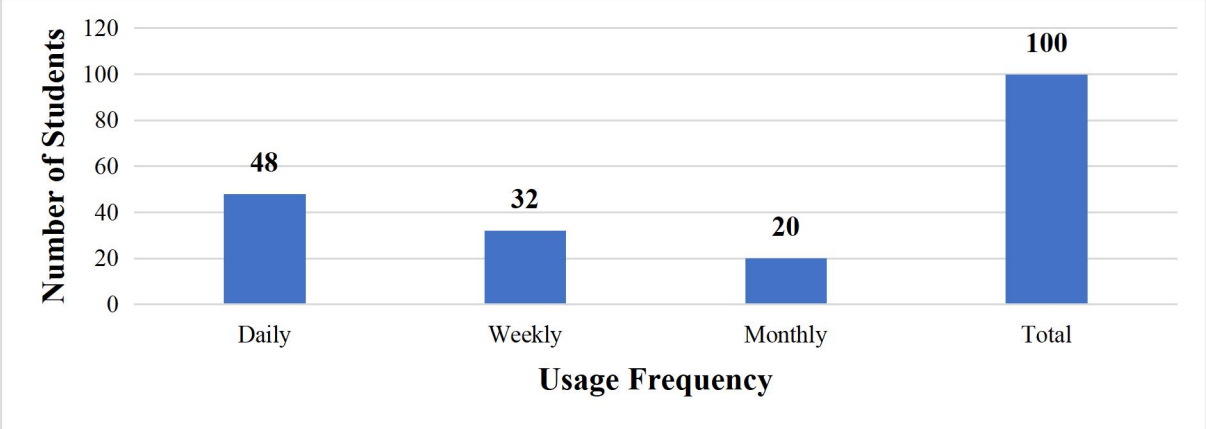

Figure 1. Distribution of Educational Technology Usage Frequency Among Students

3.2 Inferential Findings

The analysis of correlation reveals a positive relationship between the frequency of use and perceived effect on learning. Students who use educational technologies more are more likely to report perceptions of improvement in learning. The same positive association is found between the scores of accessibility and satisfaction, indicating that ease of access is an important factor contributing to overall user satisfaction.

The analysis of group comparison shows that there is a difference in satisfaction and perceived learning impact among the various tools. Sites that are easy to navigate and have integrated functionality are likely to receive more satisfaction scores. Comparisons between demographics indicate that there are slight variations between academic majors and years of study and that more experienced students showed more perceived benefits, possibly because they were more familiar with digital tools.

These findings are further supported by regression analysis, which indicates that frequency and accessibility of use are important predictors of perceived learning impact. The fact that accessibility is a factor that comes out as one of the most influential ones implies that the technical and infrastructural aspects have a direct impact on the learning outcomes. Correlations between the key variables are presented in Table 2.

Table 2. Correlation Matrix of Key Variables

Variable	Usage_Frequency	Satisfaction_Score	Accessibility_Score	Impact_on_Learning
Usage_Frequency	1.00	0.42	0.35	0.48
Satisfaction_Score	0.42	1.00	0.56	0.61
Accessibility_Score	0.35	0.56	1.00	0.52
Impact_on_Learning	0.48	0.61	0.52	1.00

***Note**:* Values represent Pearson correlation coefficients indicating moderate positive relationships among variables.

3.3 Qualitative Themes

Open-ended responses are thematically analyzed and reveal a number of themes that put the quantitative results into perspective. Technical issues, especially the problem of internet connectivity and the reliability of the platform, are one of the most noticeable themes. Students have often complained of challenges related to bandwidth constraints, which have impacted their effectiveness in engaging in online learning activities.

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The theme of usability issues also appears to be a central one, and students discuss the significance of having an intuitive design and easy navigation. Platforms that can be created with minimum technical input are usually favored because they decrease the amount of cognitive load and make the learning experience easier. In some of the answers, security and privacy issues are brought up, which means that there is some awareness of data protection in online settings.
Regarding the desired features, the students mention the centralized access to learning materials, assignment tracking systems, and interactive options, e.g., discussion forums and live sessions. Improvement suggestions often involve making systems more stable, lower-bandwidth platform optimization, and making interactions more interactive to more closely mimic classroom interactions.

3.4 Integrated Findings

The combination of quantitative and qualitative findings gives a holistic picture of how students experience educational technology. Quantitative analysis shows that perceptions of satisfaction and the impact of learning are reasonably positive, but the qualitative analysis shows that there are some underlying issues that affect these perceptions. As an example, the close correlation between accessibility and satisfaction is justified by the student feedback focusing on connectivity problems and the ease of using the platform.
The observed positive correlation between usage frequency and perceived learning effect can also be placed in the context of qualitative information that the frequency of usage also leads to the inference that frequent users are better equipped to adjust to features of the platform and take advantage of features offered. Nevertheless, high usage is not always reflected in high satisfaction, especially where technical barriers still exist.
On the whole, the findings confirm that educational technology has a high role in determining the experiences of the learning process of students, yet its potential is mediated by accessibility, usability, and technical infrastructure. The analysis of both factors offers insights into the need to work on them in order to maximize the effect of digital learning environments.

4. Discussion

The results of this research suggest that the use of educational technology is positively related to student perceptions of learning, especially with regard to student satisfaction, accessibility, and the perceived effect of learning. The perceptions of learning improvement were also stronger in students who indicated that they used the digital platform more frequently, indicating that consistent use of digital platforms contributes to familiarity and effectiveness. Accessibility was a key factor in satisfaction, as students reported that accessibility and system reliability are important factors in their satisfaction. Although perceptions were mostly positive, qualitative feedback indicated that there are still some challenges, such as connectivity problems, usability issues, and a lack of interactivity in certain platforms. Such results imply that, although educational technology is a contributing factor to learning settings, its success depends on the technical infrastructure, as well as user-friendly design. The combination of quantitative and qualitative data demonstrates that the high usage in itself is not enough to have positive results, especially under the circumstances where accessibility and system performance barriers exist.
Such results are in line with the existing literature, which highlights the importance of educational technology in enhancing learning outcomes and student participation. Empirical research has also shown that, when incorporated properly in teaching and learning processes, digital platforms can greatly stimulate academic achievements and facilitate various learning requirements (Akintayo et al., 2024; Yeung et al., 2021). The growing use of learning management systems and digital tools has facilitated more mobile and resourceful learning by giving students access to materials, peers,

and content in a way that is no longer limited by the physical space of the classroom. This type of integration not only enhances knowledge acquisition but also active learning behaviors, which are fundamental in attaining meaningful learning outcomes.

The correlation between satisfaction and perceived learning that was observed in this study is similar to previous studies that have found student satisfaction to be a major determinant of engagement and academic performance in online learning settings. The satisfaction level is frequently linked to motivation, long-term engagement, and positive learning experiences (Enyoojo et al., 2024; Abuhassna et al., 2020). Moreover, the significance of accessibility, as shown in the findings, forms a continuation of previous studies that have shown that both technical and infrastructural aspects, such as internet connection and system stability, play a major role in determining the capacity of students to successfully interact with digital platforms (Maatuk et al., 2022; Shafiei Sarvestani et al., 2019). Access constraints or technical impediments may lower participation and have adverse impacts on satisfaction and perceived learning outcomes, showing that accessibility is a cornerstone of effective technology adoption.

The qualitative data touching on usability and feature preferences also support the significance of system design in the process of determining how students view educational technology. Previous research revealed that platforms with user-intuitive interfaces, navigation, and relevant features are more likely to produce positive user experiences and increased acceptance levels (Pérez-Pérez et al., 2020; Al-Fraihat et al., 2025). Furthermore, the usage frequency's positive correlation with perceived learning impact in the current study is justified by the learning analytics literature, which suggests a positive effect of regular and meaningful engagement with digital tools on achieving better academic performance (Zhang et al., 2020; Rico-Juan et al., 2024). These convergent findings indicate that the availability of educational technology is not a determinant of its effectiveness, but rather the combination of the use behavior, system design, and perception of users, all of which interact to offer learning experiences.

There are various limitations that can be applied to the study to determine how to interpret the findings. The data is cross-sectional, which limits the possibility of causing a correlation between technology use and learning outcomes. The use of self-reported data also presents the possibility of bias in the responses, as the perception of the students might not always be an accurate indicator of actual performance. Also, the qualitative responses, though informative, are rather short and might not be able to reflect the richness of student experiences. The longitudinal designs should be considered in future research to investigate the change in perceptions and outcomes with time and experimental ones to determine causality. The analysis can be further reinforced by increasing the number of diverse institutional contexts and adding objective performance indicators. More focus on more sophisticated analytic tools, like prediction models that can be generated with machine learning or sentiment analysis on qualitative data, could also help elucidate the intricate connection between educational technology use and perceptions of student learning better.

5. Conclusion

The mixed-data analytical approach was used to investigate the connection between the use of educational technology and student perceptions of learning. The results reveal that regular interaction with digital environments is linked to better perceived learning outcomes, and satisfaction and accessibility are key determinants of the overall student experiences. One of the determinants, accessibility, became prominent, emphasising the significance of good infrastructure and accessibility in facilitating effective learning. Qualitative data also indicated that technical problems, usability difficulties, and the necessity to have interactive capabilities affect the way students perceive and use educational technologies. A combination of quantitative and qualitative findings gives in-depth insight into the factors that influence technology-mediated learning. The

research paper adds to the literature in the field by highlighting the interactive impacts of usage behavior, system design, and contextual factors on learning perceptions. It highlights the importance of institutions not only adopting digital tools but also streamlining their usability and accessibility. These aspects can be addressed to improve the effectiveness of educational technology in higher education settings by increasing student engagement and making educational technology more effective.

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