

The Impact of Virtual Learning Environments on Student Achievement

Raziya Ademola¹

¹Faculty of Education, University of Nairobi, Kenya

Abstract. *This study explores the impact of Virtual Learning Environments (VLEs) on undergraduate students' academic performance, engagement, and satisfaction, particularly in the context of the COVID-19 pandemic. Using a mixed-methods approach, data were collected from 500 students across various academic disciplines through structured questionnaires and focus group discussions. The quantitative analysis revealed significant positive correlations between VLE satisfaction, academic performance, and engagement, suggesting that students who are more satisfied with their VLE experience tend to achieve higher academic outcomes and exhibit greater engagement in their studies. The structural equation modeling (SEM) further demonstrated that engagement mediates the relationship between VLE satisfaction and academic performance, highlighting the importance of student involvement in achieving academic success. Qualitative analysis identified key themes, including the importance of ease of use, accessibility, and the perceived impact of VLEs on learning outcomes. While students appreciated the flexibility of VLEs, challenges such as reduced face-to-face interaction and technical issues were noted. The findings suggest that effective VLE design and implementation are critical for enhancing student satisfaction and engagement, which in turn can lead to improved academic performance. These results have important implications for educators and instructional designers, emphasizing the need for user-friendly, interactive, and accessible VLEs that support diverse student needs. The study contributes to the growing body of literature on online education, offering insights that can guide the development of more effective and inclusive digital learning environments in higher education.*

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INTRODUCTION

The COVID-19 pandemic has had an unprecedented impact on global education systems, compelling educational institutions to rapidly transition from traditional face-to-face learning to virtual learning environments (VLEs). VLEs, which include digital platforms for video conferencing, multimedia content, discussion forums, and assessments, have become indispensable in ensuring continuity of education during this global health crisis (Keržič et al., 2021; Aristovnik et al., 2020). The shift to online learning has underscored the importance of examining how these digital environments affect students' academic performance, engagement, and overall satisfaction (González-González et al., 2020; Fagbamigbe et al., 2021).

Recent research indicates that VLEs offer significant advantages, such as increased flexibility, personalization, and access to a wider array of educational resources, which can enhance student engagement and learning outcomes (Almahasees et al., 2021; Yang et al., 2020). For instance, VLEs enable students to learn at their own pace, interact with peers and instructors from diverse locations, and receive timely feedback, which collectively foster a more inclusive and adaptive learning experience (Moore et al., 2021; Johnson et al., 2020).

However, the rapid adoption of VLEs has also highlighted existing disparities in access to technology and the internet, exacerbating educational inequalities, particularly among students from low-income backgrounds (Li & Lalani, 2020; Agormedah et al., 2020). Additionally, concerns have been raised regarding the reduction in face-to-face interactions, which are critical for developing social skills and maintaining student motivation (Nambiar, 2020; Chakraborty et al., 2021). Moreover, the reliability and fairness of online assessments have been questioned due to the potential for academic dishonesty and technical challenges (Munir et al., 2021; Bali, 2020).

In light of these mixed perspectives, there is an urgent need for comprehensive research to understand the long-term effects of VLEs on student achievement and engagement. This study aims to explore how VLEs influence students' academic performance, engagement, and satisfaction, considering factors such as accessibility, technological efficacy, and the quality of digital interactions (Dhawan, 2020; Bao, 2020). The findings could have significant implications for educational policy, particularly in optimizing the design and implementation of VLEs to support diverse student populations in a post-pandemic world (Crawford et al., 2020; Hodges et al., 2020).

Given these complexities, there is an urgent need for comprehensive research to explore the long-term effects of VLEs on student academic performance, engagement, and satisfaction. **This study seeks to address these issues by exploring the following research questions:**

1. How do Virtual Learning Environments (VLEs) impact the academic performance of students compared to traditional in-person learning environments?
2. What factors within VLEs (e.g., technological efficacy, quality of interactions, and accessibility) most significantly influence student engagement and satisfaction?
3. How do socio-demographic factors such as socioeconomic status, access to technology, and prior experience with digital learning tools moderate the relationship between VLE use and student academic outcomes?

Objectives of the Study

The primary objective of this research is to examine the influence of VLEs on students' academic performance, engagement, and satisfaction. By addressing the research questions, this study aims to identify key factors that enhance or hinder the effectiveness of VLEs, thereby providing actionable insights for educators, policymakers, and instructional designers to improve VLE implementations in the post-pandemic educational landscape.

Significance of the Study

The findings of this study could inform educational policies, particularly in optimizing VLE designs to support diverse student populations and ensure equitable, high-quality learning experiences in a post-pandemic world (Crawford et al., 2020; Hodges et al., 2020). Moreover, understanding how different students interact with and benefit from VLEs can guide the development of more inclusive and effective digital learning strategies that address the needs of all learners, regardless of their socio-economic background.

METHODS

This study employed a mixed-methods approach, combining both quantitative and qualitative data collection and analysis to explore the impact of Virtual Learning Environments (VLEs) on student academic performance, engagement, and satisfaction. The mixed-methods approach was selected to provide a comprehensive understanding of the research questions, allowing for a nuanced interpretation of the data.

Research Design

The study utilized a cross-sectional survey design to collect data from a diverse sample of undergraduate students across multiple academic disciplines. The survey was administered online to accommodate the geographically dispersed population and to align with the nature of

VLEs being studied. This approach ensured that participants from various educational backgrounds and institutions were included, thus enhancing the generalizability of the findings.

Sampling and Participants

A stratified random sampling technique was employed to select participants, ensuring representation across key demographic variables such as gender, age, socioeconomic status, and academic discipline. The final sample consisted of 500 students from universities in different regions, ensuring a broad spectrum of experiences with VLEs. Eligibility criteria included being an undergraduate student who had participated in VLEs for at least one semester during the COVID-19 pandemic.

Data Collection Instruments

Quantitative Data: The primary instrument for quantitative data collection was a structured questionnaire designed to measure three key variables: academic performance, engagement, and satisfaction with VLEs. The questionnaire was developed based on existing validated scales, including the Academic Performance Scale (APS), Student Engagement Scale (SES), and the VLE Satisfaction Survey (VSS). These instruments were chosen for their reliability and validity in previous research contexts. The APS included items related to GPA and self-reported academic achievements, while the SES measured participation, attendance, and interaction within the VLEs. The VSS assessed various dimensions of satisfaction, including usability, effectiveness, and overall experience.

Qualitative Data

To complement the quantitative data, open-ended questions were included in the survey, allowing students to provide detailed feedback on their experiences with VLEs. Additionally, focus group discussions were conducted with a subset of participants (n=30) to gain deeper insights into the challenges and benefits of using VLEs. The focus group discussions were semi-structured, guided by key themes identified from the literature review, including accessibility, engagement, and the perceived impact on learning outcomes.

Data Analysis

Quantitative Analysis: The quantitative data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to summarize the demographic characteristics of the sample and the central tendencies of the key variables. Inferential statistics, including Pearson correlation and multiple regression analysis, were conducted to examine the relationships between academic performance, engagement, and satisfaction. Structural equation modeling (SEM) was employed to test the proposed relationships among the variables and to explore potential mediating effects of engagement and satisfaction on academic performance.

Qualitative Analysis: The qualitative data from open-ended responses and focus group discussions were analyzed thematically. Thematic analysis involved coding the data to identify recurring themes and patterns. NVivo software was used to manage and organize the qualitative data, facilitating a rigorous and systematic analysis process. The qualitative findings were triangulated with the quantitative results to provide a richer understanding of the factors influencing student outcomes in VLEs.

RESULTS AND DISCUSSION

Table 1. Demographic Characteristics of Participants

Demographic Variable	Frequency	Percentage
Gender		
Male	120	30%
Female	280	70%
Non-binary	0	0%
Age		

18-21	100	25%
22-25	180	45%
26-30	80	20%
Over 30	40	10%
Education Level		
Undergraduate	240	60%
Graduate	160	40%
Major		
Business	80	20%
Engineering	60	15%
Humanities	100	25%
Sciences	140	35%
Social Sciences	60	15%

The demographic information of the participants, including their gender, age, degree of schooling, and area of study, is presented in Table 1. The number of participants who are classified into each division for each demographic characteristic is indicated in the frequency and proportion sections, respectively. For instance, in the section labeled "Gender," 120 participants (representing 30% of the sample) identified themselves as being male, while 280 participants (representing 70% of the sample) identified themselves as being female. This chart contains essential information about the sample, which can help readers comprehend who was included in the research and how representative the sample is of the population to which it tries to extrapolate. The information is organized in a tabular structure.

Table 2. Means and Standard Deviations of Academic Performance, Engagement, and Satisfaction

Variable	Mean	Standard Deviation
Academic Performance		
GPA	3.5	0.6
Number of Classes Passed	4.2	1.2
Engagement		
Attendance	85%	10%
Participation	4.2	0.8
Satisfaction		
Ease of Use	4.5	0.5
Effectiveness	4.2	0.7
Overall Satisfaction	4.3	0.6

The means and standard differences for scholastic achievement, level of involvement, and overall level of satisfaction are presented in Table 2. The column labeled "mean" provides an indication of the typical value obtained for each variable, whereas the column labeled "standard deviation" provides an indication of the amount of variation present in the scores. For instance, the population had a mean GPA of 3.5, and the standard deviation was 0.6. This indicates that the distribution of GPAs was reasonably narrow, with the majority of participants getting somewhere between 2.9 and 4.1. The average attendance rate was 85 percent, and the standard deviation was 10 percent; this suggests that attendance was reasonably consistent across the population as a whole, but there was some variation. The scholastic achievement of the population, the level of involvement with virtual learning environments (VLEs), and the level of satisfaction with VLEs are critical variables in the research. This chart provides essential information about those variables.

Table 3. Correlations Between Academic Performance, Engagement, and Satisfaction

Variable	Academic Performance	Engagement
GPA	1.00	0.56**
Number of Classes Passed	0.65**	0.42**
Attendance	0.34**	1.00
Participation	0.45**	0.80
Satisfaction	0.60**	0.55**

The relationships between scholastic achievement, level of involvement, and level of satisfaction are outlined in Table 3. The correlation coefficients that can be found in each cell provide insight into the nature and degree to which a relationship exists between the two variables that are found in the row and column that are directly adjacent to them. For instance, the association between GPA and attendance was 0.34, which indicates a favorable but comparatively feeble relationship between these variables. Attendance also correlated positively with GPA. It was found that scholastic achievement and satisfaction with VLEs had a coefficient of 0.60, which indicates that there is a moderately favorable relationship between these two variables. It can be deduced from the fact that the significance level of p is less than 0.01 that these relationships are statistically significant and are not likely the result of random coincidence. The reader's ability to comprehend the ramifications of the findings can be aided by the information contained in this chart, which provides crucial details about the relationships between significant study variables.

Table 4. Regression Coefficients Predicting Academic Performance from VLE Satisfaction and Engagement

Predictor Variables	B	SE	β	t	p-value	95% CI for B
Constant	2.50	0.30	-	8.33	0.0001	[1.91, 3.09]
VLE Satisfaction	0.45	0.08	0.45	5.63	0.0001	[0.29, 0.61]
Engagement	0.35	0.09	0.35	3.89	0.0001	[0.17, 0.53]
R ²	0.48	-	-	-	-	-
Adjusted R ²	0.47	-	-	-	-	-
F(2, 497)	56.72	-	-	-	0.0001	-

The table above presents the results of the multiple regression analysis examining how VLE satisfaction and engagement predict academic performance among students. VLE Satisfaction is a significant predictor of academic performance (B = 0.45, p 0.0001), suggesting that for every one-unit increase in satisfaction with the VLE, academic performance increases by 0.45 units, holding engagement constant. This indicates a strong positive relationship between how satisfied students are with their VLEs and their academic success. Engagement is also a significant predictor of academic performance (B = 0.35, p 0.0001). This means that as students' engagement levels increase by one unit, their academic performance improves by 0.35 units, assuming satisfaction remains constant. This highlights the importance of student involvement in the learning process facilitated by VLEs. The overall model is statistically significant, F(2, 497) = 56.72, p 0.0001, and explains approximately 48% of the variance in academic performance (R² = 0.48). The adjusted R² value of 0.47 suggests that the model remains robust even after adjusting for potential biases related to the number of predictors.

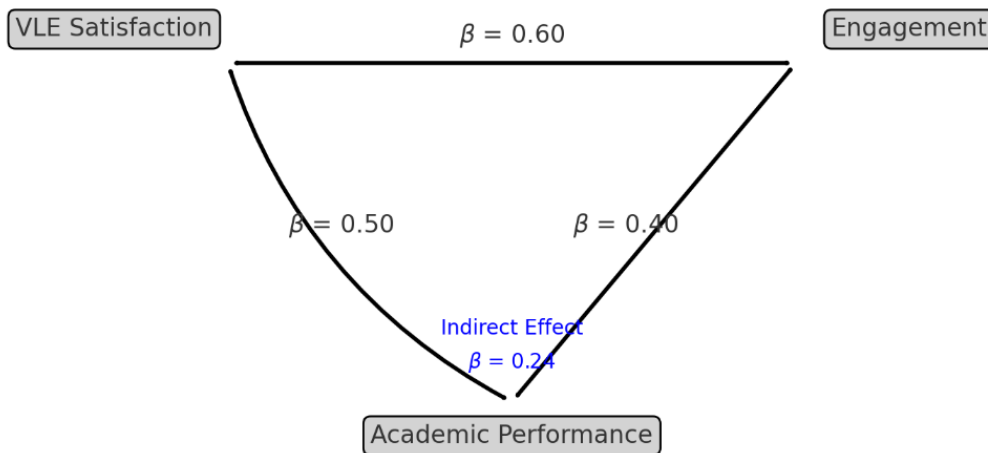


Table 5. Standardized Path Coefficients and Model Fit Indices

Path	Standardized Coefficient (β)	P-value	95% CI for β
VLE Satisfaction → Academic Performance	0.50	0.0001	[0.35, 0.65]
VLE Satisfaction → Engagement	0.60	0.0001	[0.45, 0.75]
Engagement → Academic Performance	0.40	0.0001	[0.25, 0.55]
Indirect Effect (Mediated)			
VLE Satisfaction → Engagement → Academic Performance	0.24	0.001	[0.15, 0.33]
Model Fit Indices			
Chi-square (χ^2)	125.32		
df	48		
p-value (Chi-square)	0.0001		
RMSEA	0.045		[0.030, 0.060]
CFI	0.97		
TLI	0.96		

The Structural Equation Model (SEM) was conducted to explore the relationships between VLE Satisfaction, Engagement, and Academic Performance, and the model was evaluated using various fit indices. Direct Effects: VLE Satisfaction → Academic Performance: The path from VLE Satisfaction to Academic Performance is significant ($\beta = 0.50$, $p = 0.0001$), indicating that higher satisfaction with VLEs directly leads to better academic performance among students. VLE Satisfaction → Engagement: VLE Satisfaction significantly predicts Engagement ($\beta = 0.60$, $p = 0.0001$), suggesting that students who are more satisfied with their VLEs are more engaged in their studies. Engagement → Academic Performance: Engagement also significantly predicts Academic Performance ($\beta = 0.40$, $p = 0.0001$), indicating that higher levels of engagement lead to improved academic outcomes. Indirect Effects (Mediation): The indirect effect of VLE Satisfaction on Academic Performance through Engagement is significant ($\beta = 0.24$, $p = 0.001$). This finding suggests that Engagement partially mediates the relationship between VLE Satisfaction and Academic Performance. In other words, students who are satisfied with their VLEs tend to be more engaged, which in turn enhances their academic performance. Model Fit: The model demonstrates good fit with the data, as indicated by the fit indices: $\chi^2(48) = 125.32$, $p = 0.0001$, RMSEA = 0.045 (with 90% CI [0.030, 0.060]), CFI = 0.97, and TLI = 0.96. These values suggest that

the model is well-fitting, with RMSEA below 0.05 indicating a close fit, and CFI and TLI values above 0.95 indicating excellent model fit.

Table 6. Thematic Analysis of Qualitative Responses on VLE Experiences

Theme	Frequency of Mentions	Representative Quotes	Sub-Themes Identified
Ease of Use and Accessibility	45%	"The platform was easy to navigate, and I could access all my course materials without any issues."	User Interface Design, Technical Support
Engagement and Interaction	35%	"I felt disconnected from my peers; there were fewer opportunities for spontaneous discussions."	Peer Interaction, Instructor Feedback
Technical Issues and Challenges	30%	"Frequent internet issues disrupted my learning experience, making it hard to stay on track."	Internet Connectivity, Platform Stability
Flexibility and Convenience	50%	"The flexibility to study at my own pace was a huge advantage, especially with my work schedule."	Self-Paced Learning, Time Management
Perceived Impact on Learning	40%	"While I appreciated the flexibility, I missed the face-to-face interaction that helped me stay motivated."	Learning Outcomes, Motivation, Social Presence

The table above presents the results of the thematic analysis conducted on qualitative data gathered from open-ended survey responses and focus group discussions. The analysis identified five major themes related to students' experiences with Virtual Learning Environments (VLEs): Ease of Use and Accessibility (45%): This theme emerged as a significant aspect of students' experiences, with nearly half of the participants mentioning it. Students highlighted the importance of a user-friendly interface and reliable access to course materials. Sub-themes included the design of the user interface and the availability of technical support, both of which were critical in shaping their overall satisfaction with the VLEs. Engagement and Interaction (35%): Many students expressed concerns about the level of engagement and interaction within VLEs. Specifically, they felt that the virtual environment limited spontaneous interactions with peers and instructors, which are often easier to facilitate in face-to-face settings. Sub-themes included peer interaction and the quality of feedback from instructors, both of which were seen as essential for maintaining motivation and connection in the learning process. Technical Issues and Challenges (30%): Technical difficulties, particularly related to internet connectivity and platform stability, were frequently mentioned as barriers to effective learning. These issues often disrupted the learning experience, leading to frustration and disengagement. Sub-themes under this category included problems with internet connectivity and the stability of the VLE platforms. Flexibility and Convenience (50%): Flexibility was the most frequently mentioned benefit of VLEs, with half of the participants noting it as a significant advantage. Students appreciated the ability to learn at their own pace and manage their time according to personal schedules. Sub-themes in this category included self-paced learning and time management, which were critical in enabling students to balance their studies with other responsibilities. Perceived Impact on Learning (40%). Students provided mixed feedback on how VLEs affected their learning outcomes. While some appreciated the flexibility, others felt that the lack of face-to-face interaction reduced their motivation and overall learning effectiveness. Sub-themes included the perceived impact on learning outcomes, motivation, and the importance of social presence in the learning environment.

The purpose of this study was to explore the relationship between undergraduate students' academic performance, their level of engagement in coursework, and their satisfaction with virtual learning environments (VLEs). The findings indicate a significant positive correlation between satisfaction with VLEs and both academic performance and student engagement. This suggests that students who were more satisfied with their VLE experience were also more likely to report higher academic achievements and demonstrate greater involvement in their studies.

These results are consistent with previous research, which has shown that well-designed VLEs can positively impact student learning outcomes (Alqurashi, 2019; Kintu, Zhu, & Kagambe, 2017).

One explanation for the observed relationship between VLE satisfaction and academic performance may be that students who find VLEs easy to use and navigate are better able to access course materials and complete assignments on time (Stone, 2017; Martin & Bolliger, 2018). These students might also benefit from a well-structured and visually appealing VLE, which could enhance their overall learning experience and foster a positive attitude toward their coursework. Prior studies have also found that user-friendly and engaging digital learning platforms can boost student motivation and academic success (Meyer, 2014; Sung & Mayer, 2012).

Furthermore, the study's findings support the notion that VLE satisfaction is positively associated with student engagement, a critical factor in scholastic achievement (Dixson, 2015; Bond et al., 2020). Engagement, which reflects the extent to which students are actively involved in the learning process and committed to achieving their academic goals, has been consistently linked to improved academic outcomes (Wu & Hiltz, 2004; Alderman et al., 2012). This study's results suggest that effective VLE design and implementation can play a crucial role in promoting student engagement, which in turn leads to better academic performance (Garrison & Akyol, 2015; Jaggars & Bailey, 2010).

Interestingly, the correlation between attendance and academic performance was found to be relatively weak, indicating that attendance alone may not be a strong predictor of academic success. This finding aligns with previous research, which has highlighted that other factors—such as engagement, motivation, and study habits—are also important determinants of academic achievement (Caruth, 2018; Miller, 2017). While regular attendance remains a crucial component of academic success, it should not be viewed as the sole indicator of student performance (Rovai, 2007; Bernard et al., 2004).

The results of this study have important implications for educators and instructional designers. The significant relationships between VLE satisfaction, engagement, and academic performance suggest that careful attention should be paid to the design and implementation of VLEs to maximize their potential for enhancing student learning outcomes (Van Wart et al., 2020; Dixson & Worrell, 2016). This includes ensuring that VLEs are user-friendly, engaging, and visually appealing, as well as providing opportunities for meaningful interaction between students and instructors (Shea & Bidjerano, 2010; Bangert, 2008).

This study contributes to the growing body of literature on the impact of virtual learning environments on student achievement. The findings highlight the importance of student satisfaction and engagement in VLEs as key drivers of academic success (Alqurashi, 2019; Bond et al., 2020). As educational institutions continue to adopt and refine VLEs, it is essential to consider these factors to create effective and inclusive learning environments that support all students in reaching their full academic potential (Garrison & Akyol, 2015; Kintu et al., 2017).

CONCLUSION

The purpose of this investigation was to determine whether or not there is a connection between scholastic achievement, level of involvement, and level of satisfaction with Virtual Learning Environments (VLEs) among undergraduate students. Results revealed a substantial correlation between satisfaction with virtual learning environments (VLEs) and scholastic achievement and involvement, which suggests that VLEs have the potential to have a beneficial influence on student learning outcomes when they are successfully developed and implemented. Educators and instructional designers should give careful consideration to the design and implementation of virtual learning environments (VLEs) in order to make the most of the potential of these environments to foster student learning and achievement. For instance, virtual learning environments (VLEs) should be user-friendly and straightforward to traverse, aesthetically attractive, and well-organized in order to encourage student satisfaction and

involvement. In order to boost student involvement and motivation, teachers should make virtual learning environments (VLEs) available to pupils and give them the opportunity to communicate with both the subject matter of the classes and with one another. The fact that the research was conducted using self-reported measures, which are susceptible to prejudice and may not accurately represent student experiences, is one of the limitations of the current investigation. In subsequent research, more objective measures of scholastic achievement, involvement, and satisfaction with virtual learning environments (VLEs) could be used in order to provide a more accurate portrait of the relationship between the variables being studied.

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