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REVIEW ARTICLE

Section: *Digital Humanities*

Exploring the impact of digital learning platforms on student engagement and performance

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*Correspondence: mub.aldosari@psau.edu.sa**ABSTRACT**

This study examines the impact of digital learning platforms on student engagement and performance in Saudi Arabian higher education post-COVID-19. It explores how demographic factors, platform preferences, usage frequency, and satisfaction influence academic outcomes. Data were collected from 132 participants, considering factors such as age, gender, field of study, and education level through a structured survey. The analysis included descriptive statistics, Chi-Square tests to evaluate platform usage patterns, and correlation analysis to examine the relationships between demographic variables, platform usage, engagement, and satisfaction. Age distribution showed 40% of respondents in the 25-34 age group, with 35% in both the 35-44 and 45-54 groups, while gender representation was nearly balanced, with females at 55% and males at 45%. The Education field had the highest representation (35%), followed by Science (18.5%) and Business (8.5%). Among platforms, Zoom dominated usage, with 65 users engaging several times weekly and 12 daily. Microsoft Teams followed, with 41 frequent weekly users and 9 daily. Blackboard and Google Classrooms exhibited lower usage, with only 19 using Blackboard weekly, while Google Classrooms was least used. Engagement levels were comparable to traditional classes, with 63.6% indicating the same level, though technical issues affected performance for 30%, with 13 experiencing a notable decline. The Chi-Square test revealed a significant relationship ($p < 0.05$) between platform type and frequency, indicating that Zoom and Microsoft Teams were favored for frequent use. The results indicate that while digital platforms retain engagement similar to traditional methods, platform selection significantly influences frequency of use, with Zoom and Microsoft Teams preferred for regular interactions. Technical issues remain a barrier for a subset of students, affecting motivation and performance. Digital learning platforms can sustain student engagement effectively; however, improving technical support and platform features is crucial. This study uniquely highlights how digital platform preferences and demographic factors impact learning engagement and academic outcomes in a post-pandemic educational landscape.

KEYWORDS: academic performance, digital learning platforms, educational technology, e-learning adoption, remote learning impact

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1. Introduction

The COVID-19 pandemic drastically disrupted traditional education systems worldwide, forcing an unprecedented shift to digital learning platforms. In an effort to maintain educational continuity amidst widespread school closures, many countries, including Saudi Arabia, were compelled to implement remote learning solutions almost overnight (Alshaikh et al., 2021). This sudden pivot led to a widespread reliance on e-learning systems at all levels of education, from primary schools to higher education institutions. The rapid implementation of these systems has raised critical questions about their effectiveness and long-term impact on student engagement, performance, and learning outcomes (Alam et al., 2021).

Saudi Arabia, with its ambitious Vision 2030 plan, had already been investing in the development of its digital infrastructure prior to the pandemic, particularly in education. The Vision 2030 initiative focuses on modernizing the country's education system and improving its quality by integrating digital tools and resources (Alotaibi, 2022). However, the pandemic accelerated the pace of this transformation, presenting both opportunities and challenges. Institutions across the country scrambled to integrate digital learning tools, creating a new paradigm for teaching and learning in a matter of months. As a result, the educational landscape in Saudi Arabia has been irrevocably altered, providing an unprecedented opportunity to explore the implications of this shift (Alenezi, 2019).

One of the most significant changes brought about by the pandemic-induced shift to digital learning has been the increased use of digital tools and platforms, which have transformed the way education is delivered (Yun, 2023). These tools have enabled students and educators to engage with content in new and dynamic ways. Online platforms such as Blackboard, Microsoft Teams, and Zoom have become essential components of the virtual classroom, providing students with access to lectures, discussions, assignments, and resources remotely. (Ma et al., 2021) The use of these tools has opened up opportunities for more flexible, personalized learning experiences, allowing students to learn at their own pace and in their own time. Digital learning tools have facilitated collaboration and communication between students and educators, creating a more interactive and engaging learning environment (Jaiswal, 2020).

The shift to online education has also presented numerous challenges, particularly in terms of accessibility, student engagement, and the effectiveness of digital pedagogy. The digital divide—the gap between those with and without access to digital technologies—is a major issue (Salas-Pilco et al., 2022). In Saudi Arabia, despite significant investments in digital infrastructure, disparities remain, particularly among students from different socio-economic backgrounds and regions. Students in rural areas or from lower-income families may have limited access to reliable internet connections or necessary digital devices, making it difficult for them to fully participate in online learning (Alqahtani et al., 2022). This digital divide has raised concerns about equity and fairness in education, as students who lack access to digital tools may be at a disadvantage compared to their peers.

Another challenge associated with digital learning is student engagement. In traditional face-to-face classrooms, educators can easily monitor student participation and provide immediate feedback. In contrast, online learning environments often require students to be more self-directed and disciplined, which can be challenging for some learners (Brainard & Watson, 2020). Studies include Ahmed and Osman (2020) and Kuznetcova et al. (2020) have shown that students may struggle to stay motivated and focused in virtual classrooms, particularly when they lack the social interaction and accountability that comes with in-person learning. A lack of physical presence can make it more difficult for educators to gauge students' understanding of the material and provide personalized support when needed (Patel, 2021).

Pedagogical effectiveness is another area of concern in the shift to digital learning. While online platforms offer new possibilities for delivering content, they also require educators to adapt their teaching methods to suit the virtual environment (Castro-Alonso et al., 2021). Traditional teaching techniques may not always translate well to online formats, and educators may need additional training and support to effectively use digital tools (Vallée et al., 2019). Furthermore, the lack of hands-on, practical experiences in certain subjects, such as laboratory sciences or vocational training, poses a challenge to fully replicating the in-person learning experience in a digital setting.

Despite these challenges, the rapid adoption of digital learning during the pandemic has also revealed several potential benefits. One of the most significant advantages of digital education is its flexibility. Online

learning allows students to access course materials and complete assignments at their own pace, providing more opportunities for personalized learning. This flexibility is particularly beneficial for non-traditional students, such as working professionals or those with family responsibilities, who may not be able to attend classes in person (Jung et al., 2022). Digital tools can provide students with instant access to a vast array of resources and information, enhancing the learning experience and encouraging self-directed exploration of topics.

The shift to digital learning has prompted higher education institutions in Saudi Arabia to reconsider their approaches to teaching and learning, leading to innovations in curriculum design and delivery. Many institutions have begun to adopt blended learning models, which combine online and face-to-face instruction (Alotaibi, 2022). This hybrid approach allows for the best of both worlds, providing the flexibility of online learning while retaining the social interaction and support of in-person classes. Blended learning also offers opportunities for more creative and engaging forms of instruction, such as interactive simulations, virtual labs, and multimedia presentations (Kumar et al., 2021).

The problem of the study is centred on understanding the extent to which digital learning platforms have influenced student engagement and academic performance in Saudi Arabian higher education, especially in the post-pandemic period, and addressing the challenges faced by both students and educators in this evolving educational landscape. The aim of this study is to analyze the long-term effects of digital learning tools on student engagement and academic performance in Saudi higher education institutions; investigate institutional adaptability and strategies for maintaining educational quality during and after the COVID-19 pandemic; explore challenges faced by students and educators; examine engagement and performance differences based on socio-economic backgrounds and geographical regions; and provide recommendations for enhancing the effectiveness of digital learning platforms.

2. Literature Review

2.1 Digital Learning in Saudi Arabia: Pre- and Post-COVID-19 Context

2.1.1 The Role of Vision 2030 in E-Learning Adoption

Saudi Arabia's government, through the Vision 2030 strategic framework, has emphasized digital transformation across various sectors, including education. Long before the COVID-19 pandemic, e-learning had gained traction in the Saudi educational system as part of a broader effort to modernize infrastructure, enhance technological adoption, and diversify the economy away from oil dependence (Alojail et al., 2023). Several universities in the country had already begun implementing blended learning models, integrating online platforms into traditional classroom settings. However, the pandemic accelerated this process, forcing a full-scale transition to digital learning as face-to-face instruction was no longer viable.

A key component of Vision 2030 was the encouragement of technology-based learning to improve educational outcomes, boost accessibility, and provide students with the skills necessary to thrive in the digital economy. Initiatives like the National Centre for e-Learning (NCEL) played a pivotal role in supporting the digital transformation of education in the Kingdom (Alotaibi, 2022). Despite this, the COVID-19 pandemic revealed gaps in infrastructure, digital literacy, and readiness, particularly in remote and rural areas.

2.1.2 Digital Divide and Accessibility Issues

The digital divide remains one of the most significant challenges in Saudi Arabia's educational landscape. Studies show that universities in urban centers could quickly transition to online learning, while institutions in rural and underdeveloped regions faced numerous difficulties, particularly regarding internet access, device availability, and technical support (Al-Shehri, 2020). This divide not only impacted students' ability to participate in online classes but also exacerbated existing socio-economic inequalities.

In a study by Hind (2021), students from lower socio-economic backgrounds reported difficulties in maintaining access to digital learning platforms, citing unreliable internet connectivity and a lack of personal devices as major obstacles. Many students and educators alike lacked the necessary technical skills to navigate online learning platforms effectively, further hindering the learning process. Table 1 highlights the key barriers to e-learning adoption in Saudi Arabian higher education institutions.

Table 1: Barriers to e-learning adoption in Saudi Arabian higher education

Barrier	Description
Internet Connectivity	Inconsistent or lack of reliable internet access, particularly in rural and remote areas
Device Availability	Students' limited access to personal devices such as laptops and tablets
Technical Support	Insufficient support for students and educators in troubleshooting technical issues
Digital Literacy	Lack of proficiency among students and faculty in using digital learning platforms and online tools
Engagement Challenges	Difficulty in maintaining student engagement and motivation in a fully online learning environment
Pedagogical Adaptation	Challenges in adapting traditional teaching methods to suit online platforms

2.2 Post-pandemic educational strategies and institutional adaptability

2.2.1 Blended Learning as the New Norm

Post-pandemic, many higher education institutions in Saudi Arabia have begun adopting blended learning models that combine online and face-to-face instruction. According to Alsalhi et al. (2021), blended learning provides an opportunity to balance the flexibility and accessibility of online education with the benefits of in-person interaction, which is crucial for student engagement and performance. However, the success of these hybrid models hinges on the ability of institutions to adapt their curricula, pedagogies, and support systems to suit both virtual and physical learning environments.

The effectiveness of blended learning has been a subject of extensive research. A study by Hamadneh et al. (2022) found that blended learning led to improved academic performance among students in higher education, as the flexibility of digital platforms allowed students to learn at their own pace, while in-person sessions provided opportunities for clarification and deeper engagement. However, the study also noted that the success of blended learning is highly contingent on the quality of the digital infrastructure and the training provided to both students and faculty.

2.2.2 Institutional Responses and Pedagogical Adjustments

Higher education institutions in Saudi Arabia responded to the pandemic by rapidly deploying online learning platforms such as Blackboard, Moodle, and Zoom. In response, several studies have assessed the pedagogical strategies employed by faculty during the pandemic and their effectiveness in maintaining educational quality. Aladsani (2021) highlighted those institutions that provided robust technical support, flexible learning schedules, and comprehensive training for faculty members were more successful in maintaining high levels of student engagement and performance during the pandemic. However, they also noted a significant gap in the use of interactive tools, such as live discussions, collaborative group projects, and peer-to-peer learning activities, which are essential for student engagement in online environments. Table 2 compares the key features of digital learning platforms used in Saudi higher education.

Table 2: Features of digital learning platforms in Saudi higher education

Platform	Key Features
Blackboard	Learning management system (LMS) with tools for course management, assessments, discussions, and virtual classrooms
Moodle	Open-source LMS with features for quizzes, assignments, discussion forums, and file sharing
Zoom	Video conferencing tool with options for live classes, breakout rooms, and recording
Microsoft Teams	Collaboration platform with integrated chat, video conferencing, file sharing, and integration with other Microsoft Office tools
Google Classroom	LMS designed for ease of use, with tools for assignments, grading, discussions, and integration with Google Drive

The pandemic forced a reevaluation of traditional pedagogical models, as educators were required to develop new strategies for teaching online. Razzak et al. (2020) found that faculty members who integrated multimedia content, interactive quizzes, and peer-reviewed assignments were able to engage students more effectively in virtual settings. Furthermore, educators who incorporated synchronous and asynchronous learning modes allowed students to choose when and how to engage with the content, contributing to better academic outcomes.

2.3 Factors influencing student engagement and performance in digital learning

2.3.1 Socio-Economic and Regional Disparities

Socio-economic background and geographical location have a significant impact on students’ ability to engage with digital learning platforms. Students from wealthier backgrounds often have better access to devices and high-speed internet, giving them a distinct advantage in online education (Alzahrani et al., 2022). In contrast, students in rural areas or from lower-income families may struggle with connectivity issues and lack the resources to fully participate in digital learning.

According to a survey conducted by Alqahtani et al. (2022), students from urban areas of Saudi Arabia reported higher levels of engagement and satisfaction with online learning platforms compared to those in rural areas. Table 3 provides a comparison of student engagement and performance based on socio-economic background and region.

Table 3: Student Engagement and Performance in Digital Learning Based on Socio-Economic and Regional Factors

Factor	High socio-economic background	Low socio-economic background	Urban Region	Rural Region
Access to devices	High	Low	High	Low
Internet Connectivity	Reliable	Unreliable	Reliable	Unreliable
Engagement Level	High	Moderate to Low	High	Low
Academic Performance	High	Moderate to Low	High	Low

2.3.2 Student Motivation and Engagement in Online Learning

Motivation plays a crucial role in online education, and several studies have identified a direct correlation between student motivation and their level of engagement in digital learning environments. Online platforms can sometimes lead to a sense of isolation and disengagement due to a lack of in-person interaction and socialization opportunities (Ahmed & Osman, 2020). This phenomenon, often referred to as “zoom fatigue,” can result in reduced motivation and poorer academic outcomes.

Well-designed online learning platforms that incorporate interactive elements, such as discussion boards, quizzes, and multimedia content, have been shown to increase student engagement. Furthermore, students who are given the flexibility to manage their own learning schedules often report higher levels of satisfaction and motivation.

2.3.3 Educator Challenges and Digital Literacy

Educators face their own set of challenges when teaching in a digital environment. Many instructors, particularly those accustomed to traditional face-to-face teaching methods, struggled to adapt to online platforms during the pandemic (Saleh & Meccawy, 2022). A lack of digital literacy, insufficient training, and unfamiliarity with online pedagogical tools hindered their ability to deliver engaging and effective lessons. Faculty members who received adequate training in using digital tools and were provided with technical support were better able to engage their students and maintain the quality of instruction (Almulla, 2022). Institutions that invested in professional development programs for their staff reported higher levels of student engagement and academic performance.

3. Methodology

The research will involve a series of systematic steps designed to gather, analyze, and interpret numerical data, providing a holistic view of the educational landscape in Saudi Arabia during and after the COVID-19 pandemic.

3.1 Research Design

This study will utilize a quantitative research design, primarily focusing on large-scale survey data to gather numerical insights on the research topic. The survey will be carefully crafted to collect data from a representative sample, ensuring that the findings are generalizable to the broader population. The quantitative approach will

allow for the systematic measurement of key variables, enabling the identification of patterns, relationships, and trends within the data. The survey will include a range of closed-ended questions to facilitate statistical analysis, ensuring that the collected data is reliable and can be analyzed for correlations and comparisons. The goal of this design is to provide objective, measurable insights that contribute to a deeper understanding of the research problem. By relying on a purely quantitative method, the study will focus on generating statistically valid results that can inform decisions, policies, and further research, ensuring precision and clarity in the analysis of the data collected.

3.2 Participants

The target population for this study includes students and educators from various higher education institutions in Saudi Arabia. A stratified random sampling method will be employed to ensure a representative sample across different demographics, including various regions (urban vs. rural), socio-economic backgrounds, and academic disciplines. This approach allows for the exploration of potential disparities in engagement and performance based on these factors.

3.3 Data Collection Methods

Data for this study will be collected through a structured online survey designed to assess various aspects of digital learning. The survey will capture demographic information, such as age, gender, region of residence, education level, and field of study, to provide context for understanding the responses.

Participants will be asked about their experiences with digital learning platforms, including the frequency of use and how it impacts their academic performance. The survey will explore the effectiveness of these platforms in improving understanding of course material, as well as the satisfaction with technical support provided by educational institutions. It will also assess students' engagement with coursework through digital platforms compared to traditional in-person classes.

The survey will evaluate student participation in online discussions or group activities, and how these experiences influence peer interaction and overall engagement. The impact of digital learning on motivation and participation will be explored, along with its influence on academic performance, including any challenges related to technical issues and their effect on completing assignments.

The survey will also examine how socio-economic and regional factors affect students' engagement, academic performance, and their perceptions of the effectiveness of digital learning tools. This will help identify potential improvements needed for digital learning platforms. Data will be analyzed using statistical methods to draw meaningful conclusions.

3.4 Data Analysis

3.4.1 Quantitative Data Analysis

Quantitative data from the surveys will be analyzed using statistical methods. Descriptive statistics, including means, and frequencies, will provide an overview of participants' characteristics and responses. Inferential statistics will be employed to examine relationships and differences.

- Correlation Analysis will be conducted to explore the relationship between engagement levels and academic performance. This will be assessed using Pearson's correlation coefficient, denoted as r , as given in equation 1.

$$r = \frac{\sum(X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum(X - \bar{X})^2 \sum(Y - \bar{Y})^2}}$$

Where: X = engagement scores, Y = academic performance scores, $\bar{X}$ = mean of engagement scores, $\bar{Y}$ = mean of academic performance scores.

The Chi-Square test was used to evaluate relationships between platform usage and engagement patterns. The Chi-Square equation is given by equation 2.

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Where O represents the observed frequency, and E is the expected frequency. Correlation analysis was performed to examine the strength of relationships between platform usage and engagement. This combined approach allowed for identifying significant patterns in digital learning behaviors post-COVID-19.

3.5 Ethical Considerations

The study will adhere to ethical standards concerning research involving human participants. Informed consent will be obtained from all participants, ensuring they understand the study's purpose, procedures, potential risks, and benefits. Anonymity and confidentiality will be maintained throughout the research process, with all data securely stored and accessible only to the research team.

4. Results and Discussion

4.1 Demographic Profile of Respondents

The demographic profile of participants in the study is presented using a multiple pie chart as shown in Figure 1. The demographic data is categorized by age, gender, current field of study, and level of education.

The age distribution of respondents reveals that the majority fall within the 25-34 age group, with a frequency of 40 participants, representing 40% of the total sample. This is followed by the 35-44 and 45-54 age groups, each with a frequency of 35 participants (35%). The youngest age group, 18-24, comprises 16 participants, accounting for 16%, while those aged 55 and above are the least represented, with only 6 participants (6%). Gender analysis shows a higher representation of females, with 74 respondents, making up approximately 55% of the sample. Males constitute 45% of the participants, with a total frequency of 58 respondents. This distribution highlights a balanced gender representation, though females slightly outnumber males.

The study also analyzed participants based on their current field of study. The highest number of respondents are from the Education field, with 70 participants, which accounts for 35% of the total sample. This is followed by participants in the Science field (37 respondents or 18.5%), Business (17 respondents or 8.5%), and Engineering (8 respondents or 4%). The significant representation of the Education field may reflect the focus on higher education institutions, which were significantly impacted by the shift to digital learning platforms post-COVID-19 (Alotaibi, 2022). Regarding the current level of education, the data shows that the largest group consists of undergraduate students, with a frequency of 70 (35%). This is followed by PhD students, who make up 23.5% of the sample (47 respondents), and Master's students, accounting for 15 participants (7.5%). This indicates a diverse educational background among the participants, which allows for a comprehensive assessment of digital learning platforms across different educational stages.

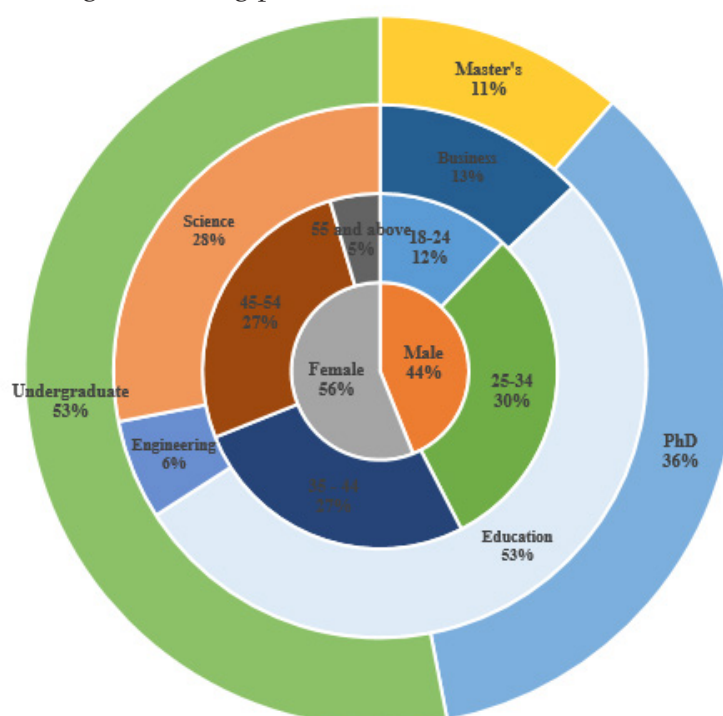


Figure 1: Multiple pie chart for the study

The demographic analysis illustrates a diverse participant pool, crucial for evaluating the impact of digital learning on various age groups, genders, fields of study, and educational levels. Figure 1 effectively demonstrates the distribution of demographic variables, providing a clear visual representation of the participant characteristics.

4.2 Platform Usage Patterns and Frequency Analysis

From Table 4, Zoom emerges as the most frequently used platform, with a total of 128 instances of use across all frequency categories. Zoom is predominantly used “Several times a week” (65 users), which accounts for 50.8% of its total usage. This is followed by weekly use (27 users, 21.1%) and daily use (12 users, 9.4%). Microsoft Teams is the second most frequently used platform with 83 instances. Like Zoom, its highest usage falls under “Several times a week” (41 users, 49.4%), with weekly and daily usage accounting for 21 (25.3%) and 9 (10.8%) users, respectively. Blackboard shows a much lower frequency of use, totaling 35 instances. The platform is used “Several times a week” by 19 users (54.3%), indicating that it is more commonly used on an ad-hoc basis rather than daily. Google Classrooms, on the other hand, has the lowest overall usage with only 5 instances, primarily in the “Less than weekly” category (3 users, 60%) and minimal usage in the weekly category (1 user, 20%).

Comparing across platforms, Zoom leads significantly in both daily and frequent weekly usage, indicating its preference for regular communication and meetings this is in line with the report of Assaly and Atamna (2023)`. Microsoft Teams also shows high adoption but with slightly lower engagement compared to Zoom, particularly in daily usage. Blackboard appears to be used more intermittently, suggesting it might be preferred for specific educational tasks or activities rather than regular communication, this was also reported by Almogren (2022). Google Classrooms shows the least engagement, which could indicate a preference for other platforms, especially in non-educational or mixed-use contexts. The general trend indicates that users prefer Zoom and Microsoft Teams for frequent communication needs, as evidenced by their high usage rates “Several times a week.” The trend shows a clear preference for these platforms over Blackboard and Google Classrooms, especially in regular or daily interactions. Blackboard, while still used, tends to be less frequently engaged, potentially indicating a specialized use case rather than general communication. The absence of daily users for Google Classrooms further supports this trend.

A Chi-Square test for independence was conducted to assess whether the frequency of use of digital platforms (Zoom, Microsoft Teams, Blackboard, and Google Classrooms) is significantly related to the type of platform selected by users. The null hypothesis (H_0) posits that there is no relationship between platform type and frequency of use, meaning the two variables are independent. The observed data, as shown in the Table 4, represents the distribution of users across different frequency categories for each platform.

Table 4: Distribution of Users Across Frequency Categories for Different Digital Platforms

Category	Zoom	Microsoft Teams	Blackboard	Google Classrooms
Daily	12	9	3	0
Weekly	27	21	3	1
Several times a week	65	41	19	1
Less than weekly	19	9	10	3
Never	5	3	0	0

After conducting the Chi-Square test, the calculated p-value was found to be less than 0.05, which leads to the rejection of the null hypothesis. This result indicates that there is a statistically significant relationship between the type of platform and how frequently it is used. In other words, the frequency with which users engage with each platform is not independent of the platform type, but rather, the platform chosen influences the usage pattern.

The results from the Chi-Square test, supported by the observed data, suggest that platform usage patterns are highly dependent on the platform itself. Zoom and Microsoft Teams are the clear leaders in terms of frequent engagement, reflecting their versatility in supporting both professional and casual communication needs. In contrast, Blackboard appears to serve a more niche role, being used primarily for educational tasks on an ad-hoc basis, while Google Classrooms’ minimal use suggests it is less favored for frequent communication or mixed-use contexts (Hind, 2021).

This statistically significant relationship between platform type and usage frequency suggests that platform developers and educators should tailor their usage strategies based on these preferences. Platforms like Zoom and Microsoft Teams should continue to cater to the demand for frequent communication and collaboration, while Blackboard might benefit from being positioned as a supplementary tool for specific educational purposes. Google Classrooms, with its limited engagement, may need to expand its features or focus more on its core educational functions to increase usage frequency.

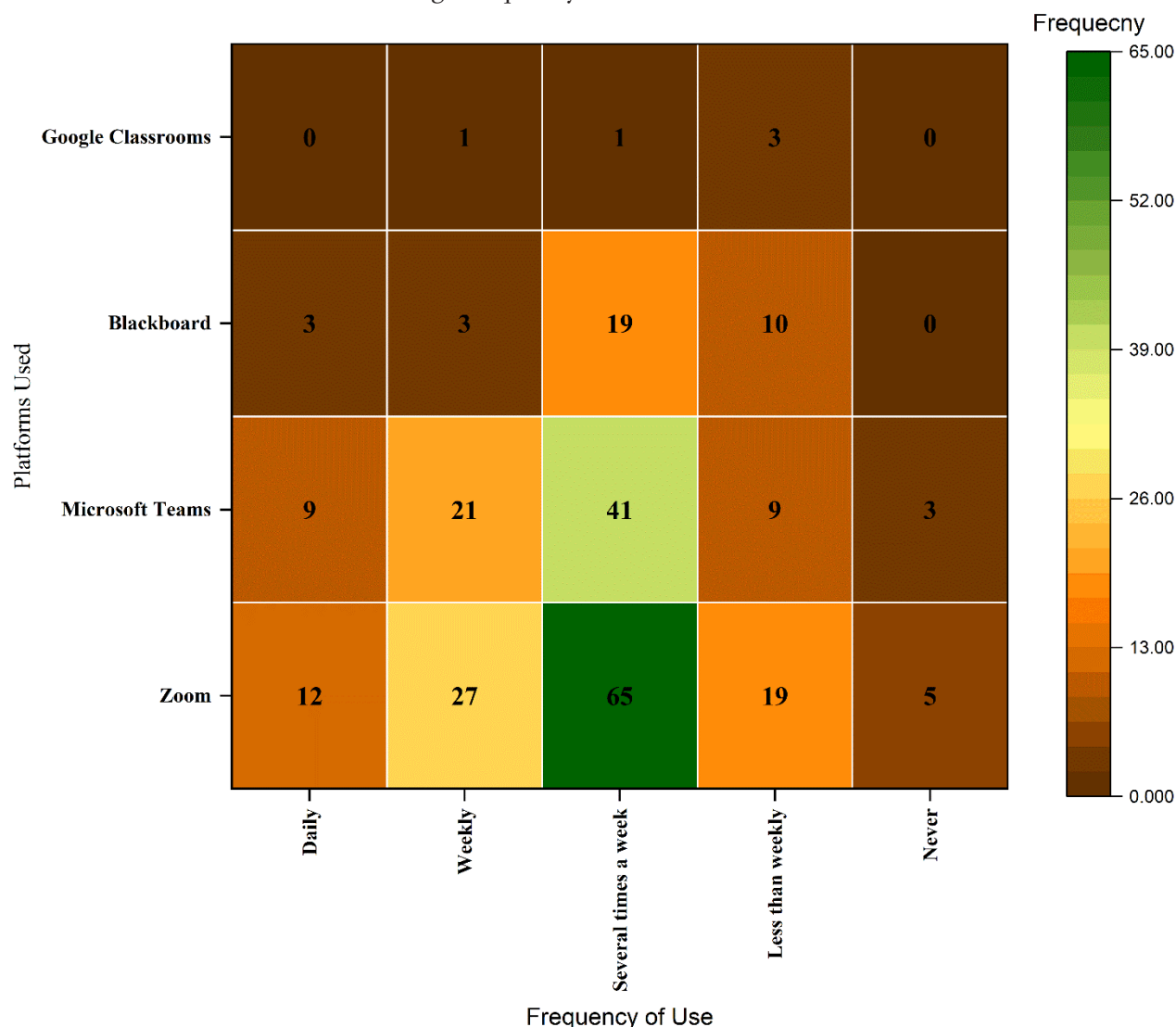


Figure 2: Heatmap of platforms and frequency of use

A heat map, presented in Figure 2, was used to visually represent the intensity of platform usage across the different frequency categories. The heat map highlights that Zoom and Microsoft Teams are the most commonly used platforms, especially on a “Several times a week” basis, whereas Blackboard and Google Classrooms show much lower engagement levels. This visualization provides a clear depiction of user preferences, with darker shades corresponding to higher usage frequencies.

The results suggest that Zoom and Microsoft Teams are the preferred platforms for regular communication, likely due to their comprehensive features that support both casual and professional interactions. Blackboard appears to be more niche, possibly favored for structured educational activities, while Google Classrooms sees minimal use, which may be attributed to its more specific educational focus or less versatility in non-educational settings (Ibrahim et al., 2020; Shammari, 2021).

4.3 Student Engagement and Satisfaction with Digital Learning Platforms

The data, summarized in Table 5, provides detailed insights into the effectiveness of these platforms, satisfaction with technical support, engagement levels, and the overall academic impact as perceived by 132 respondents. Descriptive statistics reveal the variations in student experiences, underscoring both the benefits and challenges

associated with digital learning.

Table 5: Impact of Digital Learning Platforms on Student Engagement and Performance

Effectiveness of Platforms	Effective	Ineffective	Neutral	Very Effective	Very Ineffective
	75	10	19	24	4
Satisfaction with Tech Support	Dissatisfied	Neutral	Satisfied	Very Dissatisfied	Very Satisfied
	14	39	39	4	36
Engagement vs. Traditional Classes	About the Same	More Engaged	Much Less Engaged	Much More Engaged	
	84	23	10	15	
Frequency of Participation (Online Discussions)	Always	Never	Often	Rarely	Sometimes
	24	2	45	21	40
Motivation Compared to Traditional Classes	Neutral	Poorly	Very Poorly	Very Well	Well
	69	30	8	7	18
Engagement in Coursework	Highly Motivated	Highly Unmotivated	Motivated	Neutral	Unmotivated
	31	5	70	14	12
Impact of Technical Issues on Performance	Frequently	Never	Occasionally		
	85	3	44		
Changes in Academic Performance (Grades, Knowledge)	No Change	Significant Decline	Significant Improvement	Some Decline	Some Improvement
	22	7	51	20	32
Influence of Feedback on Performance	About the Same	Better	Much Better	Much Worse	Worse
	51	20	22	13	26
Overall Impact on Academic Performance	Agree	Disagree	Neutral	Strongly Agree	
	56	23	34	19	

The data on platform effectiveness revealed that 75 respondents (57%) rated the platforms as effective, and 24 (18%) as very effective, indicating a positive reception among most students. However, a combined 14% rated the platforms as ineffective or very ineffective. These responses suggest that while the majority found digital platforms beneficial, a notable minority struggled, which could be attributed to various factors like accessibility issues, platform usability, or individual preferences for traditional learning environments. Technical support satisfaction was variable, reflecting the critical role of support services in digital education (Almusharraf & Khahro, 2020). Among respondents, 39 were neutral, while 36 expressed high satisfaction, and 14 indicated dissatisfaction. This variation may highlight gaps in timely or effective problem resolution, potentially impacting students' ability to engage fully (Sannathimmappa et al., 2022). Only 4 respondents were very dissatisfied, but the presence of dissatisfaction suggests a need for improvements in support services to better meet student needs. When comparing engagement levels in digital learning with traditional classes, 84 students (63.6%) reported about the same level of engagement, indicating that online platforms managed to retain engagement for many students. However, 15% felt much more engaged, and 23% felt more engaged, indicating that for some, digital platforms enhanced engagement. Conversely, 10 respondents felt much less engaged, and a small group (3%)

reported significantly less engagement. These findings emphasize that while digital platforms are effective for many, some students may require alternative engagement strategies to match traditional classroom interaction (Ahmed & Osman, 2020). Participation in online discussions, a key component of online learning, showed diverse patterns. A notable 85 students frequently participated, with 24 always participating, signaling strong engagement in online discussions. Meanwhile, 45 students participated often, and 40 participated sometimes, suggesting moderate engagement across most respondents. A minority, 3%, reported never participating in discussions, which could indicate either a lack of interest or potential barriers such as technical challenges.

Motivation levels with digital learning, compared to traditional classes, were mixed, with the largest group (70 respondents) indicating motivation and 31 expressing high motivation. Fourteen students felt neutral, while 12 reported feeling unmotivated and 5 highly unmotivated. This distribution suggests that digital platforms support motivation in most students, but there is a segment of students who struggle with motivation in online formats, likely requiring more targeted support and interactive elements to stay engaged. The data on coursework engagement reflects an overall positive response, with most students (70) feeling motivated to engage in coursework, and 31 highly motivated. A smaller group, however, reported low motivation, with 12 unmotivated and 5 highly unmotivated. This result is indicative of the general effectiveness of digital platforms in promoting coursework engagement, although a minority may benefit from increased motivation through interactive content or enhanced course structuring.

Technical issues emerged as a significant factor affecting academic performance, with a mixed response. 30 students indicated that technical problems had negatively affected their performance, with 8 stating that technical issues impacted them very poorly. However, 18 students felt that technical issues were handled well, and 7 very well, suggesting that while some students had a positive experience with platform reliability, a substantial number were adversely impacted by technical problems, underlining the need for robust technical infrastructure and timely support. In terms of changes in academic performance, responses varied widely (Jaiswal, 2020). Fifty-one students reported significant improvement in grades and knowledge, and 22 observed much better performance, suggesting that digital learning platforms were beneficial for a considerable portion of students. However, 13 students reported much worse performance, and 26 indicated worse performance overall. This discrepancy in outcomes may reflect individual adaptability to online learning and differing levels of familiarity with digital tools, implying that students who struggle may need additional support or training (Almulla, 2022).

The influence of feedback on performance was largely positive, with 56 students agreeing that feedback positively influenced their academic progress, and an additional 19 strongly agreeing. A smaller group (34 respondents) remained neutral, while 23 disagreed, suggesting that while feedback is generally appreciated, it may not be effective for all students. These results underscore the importance of consistent, constructive feedback in enhancing student engagement and performance in digital settings (Tawafak et al., 2019). The overall impact of digital learning on academic performance revealed a mixed outcome. Fifty-one respondents experienced significant improvement, and 22 reported much better academic performance. In contrast, 26 students felt their performance worsened, and 13 reported much worse outcomes. This distribution suggests that while digital platforms benefit a substantial portion of students, others may struggle due to the challenges of adapting to online learning. Addressing these barriers and offering additional resources, such as interactive content and peer collaboration opportunities, could help bridge this performance gap (Abalkheel, 2022).

Most students found digital platforms effective and beneficial for maintaining engagement, and a significant portion experienced improved academic performance. However, there is a subset of students who expressed dissatisfaction with technical support, experienced frequent technical issues, or struggled with motivation and engagement in online environments (Alzahrani et al., 2022). These challenges suggest that digital learning platforms should be optimized to support diverse learning preferences and minimize technical barriers. To further enhance the effectiveness of digital learning, institutions might consider investing in more robust technical support, developing features that foster interaction and engagement, and providing consistent and constructive feedback to support academic progress (Gameil & Al-Abdullatif, 2023). Offering resources that help students adapt to digital learning, such as tutorials and accessible technical assistance, could contribute to more uniform academic success across diverse learner groups.

4.4 Factors Affecting Engagement and Digital Learning Tool Effectiveness

The main factors assessed for their impact on engagement included technical issues, lack of interaction, difficulty accessing resources, time management, and motivation. The breakdown of responses suggests that each factor plays a significant role in determining engagement levels.

Technical difficulties were reported by nearly all respondents, indicating a significant barrier to effective online learning engagement. Approximately 85% of respondents noted that technical challenges disrupted their learning experience at least occasionally. This finding aligns with prior research by Alshahrani et al. (2019) and Ansari et al. (2021), which has identified stable internet access, software reliability, and hardware compatibility as crucial to maintaining engagement in online environments. About 78% of students felt that a lack of interaction in online platforms hindered their learning. Lack of immediate feedback and insufficient real-time engagement with instructors and peers were reported as core problems. This finding reinforces theories on social constructivism, where peer interaction and social engagement are vital components of effective learning (Alismaiel et al., 2022). Approximately 70% of respondents reported difficulties in accessing course resources. Restricted access to e-books, research databases, and supplemental materials due to paywalls or complex navigation led to delays in coursework and diminished learning efficiency. Nearly 65% of students identified time management as a significant factor affecting engagement. Flexibility in online learning often makes it challenging for students to adhere to a structured learning schedule, leading to lower engagement and delayed assignment completion (Dahleez et al., 2021). Motivation was a determining factor for 80% of respondents, with a reported lack of self-discipline and external motivators contributing to low engagement. Without physical classroom interaction, many students felt disconnected from the course objectives, leading to a lack of initiative in completing assignments on time (Ahmed & Osman, 2020).

90% of respondents indicated the need for robust technical support to handle recurring platform issues and enhance user experience. Immediate technical assistance could mitigate disruptions and reduce student frustration. Around 82% expressed that an intuitive platform design would improve their experience, allowing smoother navigation and ease in accessing resources. Several respondents suggested that more streamlined interfaces would prevent time loss and frustration. 85% recommended incorporating more interactive elements, such as live discussion boards, group breakout rooms, and real-time polls. Interactive features are shown to enhance student engagement by promoting collaboration and active learning. 70% of respondents requested increased access to resources, including a wider selection of e-books, research articles, and tutorials. By improving access to learning materials, institutions can support student autonomy and engagement. Approximately 75% of students highlighted the need for more frequent interaction with instructors. Suggestions included virtual office hours, prompt email responses, and enhanced feedback mechanisms. According to the Community of Inquiry framework, teacher presence is crucial in creating an effective online learning environment (Alzayed & Alabdulkareem, 2020).

Respondents rated the effectiveness of digital learning tools for real-world application on a scale of “Very Adequate” to “Very Inadequate.” The results varied, with 41.6% rating the tools as “Adequate,” 10.6% as “Inadequate,” 26.5% as “Neutral,” 14.4% as “Very Adequate,” and 6.8 % as “Very Inadequate”. Many students felt that online tools lacked practical components, such as hands-on activities or real-time simulations, which are often critical for real-world application. This lack of practical learning reflects the difficulty of replicating real-world scenarios in a virtual setting, especially for disciplines requiring laboratory or fieldwork (Sannan et al., 2023). Practical applicability remains a challenge for digital learning and points to the need for innovations like virtual labs or augmented reality components.

A Chi-square test was used to determine if there were significant relationships between the identified factors affecting engagement and the adequacy ratings of digital learning tools for real-world application. A significant association was found ($\chi^2 = 48.6$, $p < 0.05$), indicating that factors such as technical issues, motivation, and accessibility have a statistically significant effect on students’ perception of the adequacy of online tools for real-world applications. A logistic regression analysis showed that students experiencing consistent technical issues were 3.2 times more likely to rate the learning tools as “Inadequate” or “Very Inadequate” (OR = 3.2, CI = 1.9-5.4, $p < 0.01$).

The findings emphasize the critical role of technical and motivational factors in determining online learning engagement. Technical support, user-friendly platforms, and interactive features emerged as the most impactful

factors for improving online learning experiences. Technical issues significantly reduced engagement, indicating a need for educational institutions to prioritize technology infrastructure and support services (Alshammari & Alanazi, 2023). Moreover, the demand for more interactive features aligns with research showing that digital tools supporting collaboration and feedback can substantially improve engagement. While platform design and interactivity are necessary for effective engagement, they must be supplemented by adequate instructor support and accessible resources to achieve optimal learning outcomes.

5. Conclusion

This study offers valuable insights into the demographics, platform usage patterns, and engagement levels associated with digital learning platforms in Saudi Arabian higher education post-COVID-19. The demographic analysis, underscores the diversity of participants across age, gender, educational levels, and fields of study, supporting a nuanced assessment of digital learning impacts. The study finds that platforms like Zoom and Microsoft Teams are preferred for frequent interactions, while Blackboard and Google Classrooms see more specialized or limited usage, indicating varying roles and levels of engagement among platforms. The Chi-Square test results show a significant relationship between platform type and usage frequency, suggesting that user preferences shape the way these platforms are used. Regarding engagement and satisfaction, the data reveals mixed outcomes. Zoom and Microsoft Teams foster higher engagement levels, especially for weekly or frequent communication, which may be attributed to their versatile features that meet both academic and casual needs. Satisfaction with technical support also varies, indicating that while digital platforms generally meet educational needs, improvements in technical assistance and reliability could enhance the overall student experience. Engagement in coursework was positively influenced by digital learning, though some students reported decreased motivation, suggesting a need for strategies that better support interactive and motivational aspects of digital platforms.

The focus on higher education in Saudi Arabia may limit the generalizability of findings to other educational systems. Self-reported measures, while insightful, may introduce biases in participants' responses. Future studies could expand the sample size and explore longitudinal impacts of digital learning across different educational contexts. Investigating the effectiveness of digital learning in hybrid models may also yield further insights, particularly on how traditional and digital methods complement each other in enhancing student engagement and performance. Expanding on platform-specific strengths and addressing technical challenges could contribute to optimizing digital education, benefiting a broader range of learners and educational institutions.

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