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The Influence of Digital Learning Environments on Academic Performance and Student Engagement Among Students

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Abstract

This research examines the impact of digital learning spaces on student performance and engagement among the students. It pays special attention to the internet access, access to educational resources, and tutoring support, taking into account behavioral and contextual variables. The study design used a quantitative, cross-sectional research design utilizing a secondary dataset of 6,607 students. Python was used to perform statistical analysis containing descriptive statistics, correlation analysis, and multiple linear regression to test the relationships between the factors of digital learning and student outcomes. Results show that factors of the digital learning environment play a significant role in academic performance. Resource access, internet access, and tutoring were identified as powerful predictors of exam scores. Nevertheless, the factors did not have statistically significant effects on student engagement. Engagement was more strongly related to behavioral variables like attendance, study hours, and motivation. The results show that although academic performance can be improved with the use of digital learning environments, more attention should be paid to motivational and behavioral aspects to increase student engagement. This research offers valuable information to teachers and policymakers to develop more effective digital learning plans.

Keywords: Digital learning environment, Academic performance, Student engagement, Internet access, Educational resources, Tutoring support, Educational technology

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1. Introduction

The fast growth of digital technologies has dramatically changed the nature of the educational system across the globe, and how students acquire knowledge, learn through the learning material, and how they perceive learning processes. Online learning environments, defined by the incorporation of web-based tools, online materials, and virtual support services, are now becoming more and more at the center of modern education. Such environments are flexible and accessible, as well as open new possibilities of improving academic performance and student engagement (Selwyn, 2016; Bates, 2019).

Academic performance is one of the most vital measures of educational success, and it is also determined by the broad scope of factors such as cognitive skills, socioeconomic status, institutional support, and learning conditions. Over the last few years, digital learning settings have become a significant predictor of student success as they allow access to information, facilitate interactive learning, and individualized learning (Means et al., 2014; Dhawan, 2020). Online access, access to educational materials, and other supplementary services, including tutoring sessions, are important factors that can greatly help students comprehend and memorize academic material.

Student engagement has been an issue that has received growing interest as a determinant of educational outcomes in addition to academic performance. Engagement involves behavioural, emotional, and cognitive participation in learning processes and is directly related to academic achievement and perseverance (Fredricks et al., 2004; Kahu, 2013). Online learning can be an engaging experience because it provides interactive learning environments, multimedia, and the ability to engage in collaborative learning. Nevertheless, the correlation between the factors of digital learning and engagement is not simple and can be changed by individual, contextual, and technological variables (Bond et al., 2020).

Although digital learning has been gaining momentum, current studies have inconclusive results on the effect of digital learning on student outcomes. According to some studies, digital technologies have a positive impact on academic performance and engagement due to the increased access to learning resources and increased interaction (Zhao et al., 2021; Al-Emran et al., 2020). On the contrary, other sources suggest that the advantages of digital learning can be scarce or skewed, especially in cases where students are under-resourced,

lack digital skills, or motivation (Selwyn, 2016; OECD, 2015). These discrepancies underscore the significance of the additional empirical research to determine the effects of individual elements of digital learning environments on the outcomes of students.

The main gap in the literature is a critical one since the analyses of academic performance and student engagement have not been integrated into one analytical framework. Although most studies have been conducted to study these constructs individually, few studies have been conducted to concomitantly determine the effect of factors in the digital learning environment on the two outcomes. In addition, the research conducted earlier tends to be based on small samples or institution-based samples, restricting the extrapolation of results. The studies, which use large datasets to quantitatively study the synergies between digital access, resource availability, and academic support and student outcomes, are also lacking.

The other significant gap is associated with the operationalization of student engagement. Self-reported survey data is often used to measure engagement and can be biased and restricted to objectivity (Kahu, 2013). The research needs to be conducted on the basis of the creation of the engagement indices based on observable behavioral indicators, including study time, attendance, and extracurricular activity participation, to have a more complex and data-driven view of engagement.

To address these gaps, the current study addresses the impact of digital learning environments on academic performance and student engagement using a big sample of students. The primary variables of digital learning considered in the study, such as internet access, the availability of learning materials, and tutoring support, and some of the most important control variables, such as family income, teacher quality, and past academic success, are also taken into consideration. This study will utilize a combined outcome variable by applying a single analytical model to offer a more detailed explanation of the effects that digital learning environments have on student success.

This research is important in that it will enable educators, policymakers, and institutions to understand the effectiveness of digital learning strategies. The comprehension of the degree to which digital resources play a role in academic performance and activity may be used to formulate specific interventions to enhance learning. Moreover, the results may also be used

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in the larger discussion of educational equity, as they may indicate the difference in access to digital learning opportunities.

The study is guided by several key objectives aimed at providing a comprehensive understanding of the role of digital learning environments in shaping student outcomes. First, it seeks to examine the impact of digital learning environment factors on academic performance, focusing on how elements such as internet access, access to resources, and tutoring support contribute to students' achievement levels. Second, the study aims to analyze the relationship between digital learning environment factors and student engagement, exploring whether digital access and support mechanisms influence students' involvement in learning activities. Additionally, the research assesses the role of behavioral and contextual variables, including study habits, attendance, motivation, and socioeconomic factors, in shaping both academic performance and engagement. Finally, the study endeavors to provide empirical evidence on the effectiveness of digital learning environments by utilizing a large dataset, thereby offering more generalizable and data-driven insights into the relationship between digital learning conditions and student outcomes.

2. Methodology

2.1 Research Design

The research design used in this study was a quantitative, cross-sectional research design to investigate how the digital learning environment affects academic performance and student engagement among students. Quantitative methodology was found to be suitable since the purpose of the study is to measure the variables and to establish the relationships among them through the use of statistical methods. The cross-sectional character of the study indicates the usage of the data obtained at one point, and it is possible to identify the patterns and associations between variables regarding the learning environment and student outcomes.

This study builds on the existing data and aims to determine the relationship between the change in digital access and learning support variables and the change in academic performance and engagement. Such a design allows for an organized and objective assessment of the suggested relationships.

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2.2 Data Source

The data for this study were obtained from a publicly available dataset sourced from Kaggle, titled the Student Performance Factors dataset. The data was also given in CSV format and was directly utilized in the current analysis. It comprises 6,607 observations of students and contains 20 variables, that is, academic, behavioral, demographic, and environmental characteristics.

The dataset includes variables such as Hours_Studied, Attendance, Parental_Involvement, Access_to_Resources, Extracurricular_Activities, Sleep_Hours, Previous_Scores, Motivation_Level, Internet_Access, Tutoring_Sessions, Family_Income, Teacher_Quality, School_Type, Peer_Influence, Physical_Activity, Learning_Disabilities, Parental_Education_Level, Distance_from_Home, Gender, and Exam_Score. These variables provide a comprehensive overview of student learning conditions and outcomes, making the dataset suitable for examining the relationships proposed in this study.

2.3 Population and Sample

All the observations that were available in the dataset were used in the study, and the sample size was 6,607 students. The researcher did not engage in any direct sampling process since the dataset is secondary in nature. Rather, the sample frame of analysis was the dataset itself.

The entire dataset was used to ensure that as much information as possible was used and that the statistical analysis was strengthened. The variety of observations of the dataset also justifies the generalization of the findings in the context of student learning settings.

2.4 Variables and Operationalization

The research will have dependent and independent variables as well as control variables that have been chosen to enhance the accuracy of the analysis. The variable Exam_Score was used to measure academic performance, which is the level of achievement of students and is the primary outcome variable.

The variable student engagement was not directly represented in the dataset as a single variable. Thus, it was modelled as a composite variable that is based on various indicators that indicate that a student engages in learning activities. They are the indicators of Hours_Studied, Attendance, Motivation_Level, and Extracurricular_Activities. These

variables all define the behavioral, motivational, and participatory characteristics of engagement. The variables were converted into similar forms and aggregated to create an index showing the total engagement to build the engagement measure.

The independent variables were chosen to depict the online learning environment. These are Internet_Access, Access to Resources, and Tutoring Sessions. Internet access is a measure of the presence of digital connectivity, without which participation in contemporary learning settings is impossible. Access_to_Resources will be used to indicate the amount of educational resources that students have access to, and Tutoring_Sessions will be used to determine the kind of academic assistance that students receive.

In order to have a better estimation of the relationships, some control variables were incorporated in the analysis. These are Gender, Family income, Teacher quality, School type, Parental education level, and Previous scores. These have been known to affect academic results and interest and were thus adjusted in the regression models.

2.5 Data Preparation and Cleaning

The Python programming language was used to prepare and preprocess the data. The data was loaded into the analysis environment and studied in terms of structure, type of variables, and completeness. The data was a combination of both numerical and categorical variables, thus needed to be transformed properly to be analyzed.

At first glance, there were some missing values in some variables, such as in Teacher_Quality, Parental_Education_Level, and Distance_from_Home. Preprocessing took care of these missing values to guarantee the integrity of the analysis. Variables were thoroughly checked to make sure that there was consistency in coding and to remove any anomalies or errors.

Numerical forms of the categorical variables were created to be used in statistical analysis. Binary variables like Internet_Access and Gender were coded into dichotomous numbers, and ordinal variables like Motivation_Level and Access to Resources were encoded into ordered numerical scales. Where needed, regression modeling was done using dummy variable coding.

The construct student engagement was formed by merging the variables that were chosen after proper transformation. Continuous variables were standardized where necessary to make

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them comparable, and categorical variables were coded into numerical terms and aggregated. The data was also filtered on inconsistencies, duplication, and outliers to guarantee accuracy and reliability in further analysis.

2.6 Data Analysis Procedure

All the analyses were performed in Python, which offered a versatile and efficient environment to work with data and statistical modeling. Data manipulation and numerical computation were done in libraries like Pandas and NumPy, and statistical analysis was done in the form of suitable analytical packages.

It started by analyzing the dataset using descriptive statistics to give a summary of the data. The data on the distribution of the key variables were described by such measures as mean and standard deviation. This move gave a glimpse of student behavior, resource access, and their academic results.

After this, correlation analysis was performed to investigate the relationships among digital learning environment variables, student engagement indicators, and academic performance. This aided in determining the direction and strength of association between variables.

This was followed by multiple linear regression analysis to determine the effect of the factors of the digital learning environment on the dependent variables. There were two regression models that were developed. The initial model has analyzed the effect of the variables of the digital learning environment on academic performance in terms of Exam_Score. The second model assessed the impact of these variables on student engagement, measured using the created engagement index. In both designs, there were control variables to eliminate the possibility of confounding factors.

2.7 Reliability and Validity Considerations

This was done to make sure that the variables employed in the study are a good measure of the underlying constructs. Exam_Score was directly used to measure academic performance, and student engagement was constructed with various indicators that are relevant to measure the multidimensional nature of student engagement.

This characteristic of engagement, through the use of a number of variables, enhances construct validity since it indicates various levels of student engagement in learning. The

reliability of the analysis was also enhanced by data cleaning and due care with the transformation of variables. The results are credible because of the consistency of the measurements across observations.

2.8 Ethical Considerations

The research used a dataset that was publicly available and did not entail communication with human subjects. The dataset does not contain personally identifiable information, ensuring that privacy and confidentiality were maintained. The information was applied to a purely scholarly application, and all analyses were done in line with the normal ethical research application.

3. Results

3.1 Descriptive Statistics

Table 1 presents the descriptive statistics of the variables in the study. The findings show that academic performance in terms of exam scores has a mean of 67.24 and a standard deviation of 3.89, which is relatively low, indicating that the majority of the students have scores that are close to the mean with minimal spread. The standardized student engagement index has a mean that is near zero (M = 0.00) with a standard deviation of 0.50, showing moderate variability in the level of engagement between students.

Behavioral indicators indicate that the average number of hours that the students studied is 19.98 hours, with a rather wide range of 1-44 hours, indicating that there are large variations in the study habits. The attendance rates were average, with an average of 79.98%, meaning that there was an overall consistency in the attendance of academic activities. Regarding factors of the digital learning environment, the mean of internet access is high (0.924), which means that most students have access to digital connectivity. On the same note, the mean of access to resources is 2.10 on a three-point scale, which denotes that the majority of students have moderate to high access to learning resources.

Academic performance distribution is further demonstrated in Figure 1, where there is a slightly skewed right distribution of exam scores. The majority of students are clustered in the 60-75 score range, with fewer students scoring very high above 80. This trend shows that

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though most of the students are at an average level, a low percentage of students exhibit excellent academic performance.

Table 1: Descriptive Statistics of Study Variables

Variable	Mean	Std. Dev.	Minimum	Maximum
Exam Score	67.236	3.890	55.000	101.000
Student Engagement Index	0.000	0.498	-1.661	1.718
Hours Studied	19.975	5.991	1.000	44.000
Attendance	79.977	11.547	60.000	100.000
Internet Access	0.924	0.264	0.000	1.000
Access to Resources	2.100	0.698	1.000	3.000
Tutoring Sessions	1.494	1.231	0.000	8.000
Motivation Level	1.906	0.696	1.000	3.000
Previous Scores	75.071	14.400	50.000	100.000
Note: Internet Access was coded as 0 = No and 1 = Yes. Access to Resources and Motivation Level were coded on ordinal scales from 1 to 3. The Student Engagement Index was standardized and constructed from selected engagement-related indicators.				

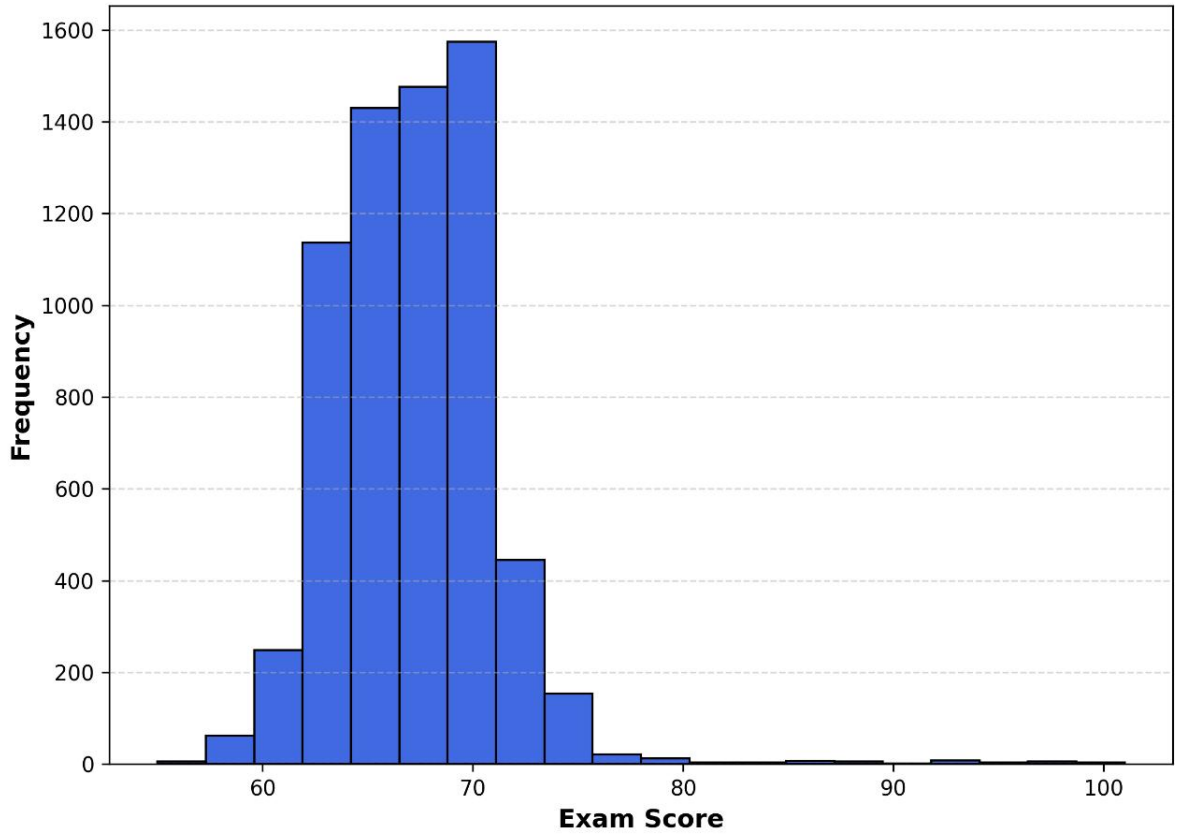

Figure 1: Distribution of Exam Scores

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3.2 Frequency Distribution of Key Variables

Table 2 shows the frequency distribution of the categorical variables. The results show that a substantial majority of students (92.45%) have access to internet facilities, while only 7.55% lack such access. This implies that the sample is well-digitally connected.

When it comes to access to educational resources, 50.23% of students indicated medium access, 29.89% high access, and 19.87% low access. Extracurricular activities are also fairly high, with 59.60% of students reporting participation as opposed to 40.40% who do not participate.

On the motivation level, 50.72% of the students indicated medium level of motivation, 29.32% and 19.96% indicated low and high levels, respectively. Further, most learners were in the public institutions (69.59%), and 30.41% in the private institutions. Such distributions emphasize the variance on both student attributes and learning environments and such are significant in identifying variations in academic performance and engagement.

Table 2: Frequency Distribution of Key Categorical Variables

Variable	Category	Frequency	Percentage (%)
Internet Access	Yes (1)	6108	92.45
	No (0)	499	7.55
Access to Resources	Medium (2)	3319	50.23
	High (3)	1975	29.89
	Low (1)	1313	19.87
Extracurricular Activities	Yes (1)	3938	59.60
	No (0)	2669	40.40
Motivation Level	Medium (2)	3351	50.72
	Low (1)	1937	29.32
	High (3)	1319	19.96
School Type	Public	4598	69.59
	Private	2009	30.41
Note: *Values in parentheses indicate coded categories used in the analysis.*			

3.3 Correlation Analysis

Table 3 shows the correlation between the most important variables. The findings show that academic performance has a moderate and positive correlation with the student engagement

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index (r = 0.592), which implies that an increase in student engagement correlates with the improved academic performance.

The behavioral variables exhibit high positive correlation with exam scores (r = 0.581) and the hours studied (r = 0.445), which means that a regular attendance and hours spent studying are significant in academic achievement. Academic performance also has a positive, but less strong, correlation with motivation level (r = 0.087).

There is a relatively weaker correlation between digital learning environment variables and academic performance. The relationship between access to resources is moderate (r = 0.170), and the same applies to tutoring sessions (r = 0.157). There is a weak positive relationship between internet access (r = 0.051), which shows that although digital access has a performance effect, its direct impact is weaker at the bivariate level.

The engagement index is closely related to the level of motivation (r = 0.503), attendance (r = 0.494), and hours studied (r = 0.489), which proves that the constructed engagement variable is a successful measure of behavioral and motivational aspects of student engagement. Generally, these results indicate that behavioral factors are more dominant in academic performance compared to digital environment factors at the correlation level.

Table 3: Correlation Matrix of Study Variables

Variable	1	2	3	4	5	6	7	8	9
1. Exam Score	1.000	0.592	0.051	0.170	0.157	0.445	0.581	0.087	0.175
2. Student Engagement Index	0.592	1.000	0.000	-0.010	0.002	0.489	0.494	0.503	0.008
3. Internet Access	0.051	0.000	1.000	-0.014	-0.010	0.005	-0.018	0.019	0.004
4. Access to Resources	0.170	-0.010	-0.014	1.000	-0.012	-0.005	-0.012	0.006	0.024
5. Tutoring Sessions	0.157	0.002	-0.010	-0.012	1.000	-0.014	0.014	0.001	-0.013
6. Hours Studied	0.445	0.489	0.005	-0.005	-0.014	1.000	-0.010	-0.010	0.025
7. Attendance	0.581	0.494	-0.018	-0.012	0.014	-0.010	1.000	-0.005	-0.020

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8. Motivation Level	0.087	0.503	0.019	0.006	0.001	-0.010	-0.005	1.000	0.006
9. Previous Scores	0.175	0.008	0.004	0.024	-0.013	0.025	-0.020	0.006	1.000
Note: Values represent Pearson correlation coefficients.									

3.4 Academic Performance Across Access to Resources

The relationship between access to resources and academic performance is illustrated in Figure 2. The findings indicate that there is an evident positive trend in academic performance with the increase in access to resources. The low access to students has lower median exam scores and more variance, whereas the medium and high access students have higher median scores with increasingly high consistency.

The existence of the high-value outliers of the medium and high categories points to more affluent students having a stronger chance of obtaining high academic performance. This trend provides a visual support to the statistical results and the significance of resource availability in determining student achievement.

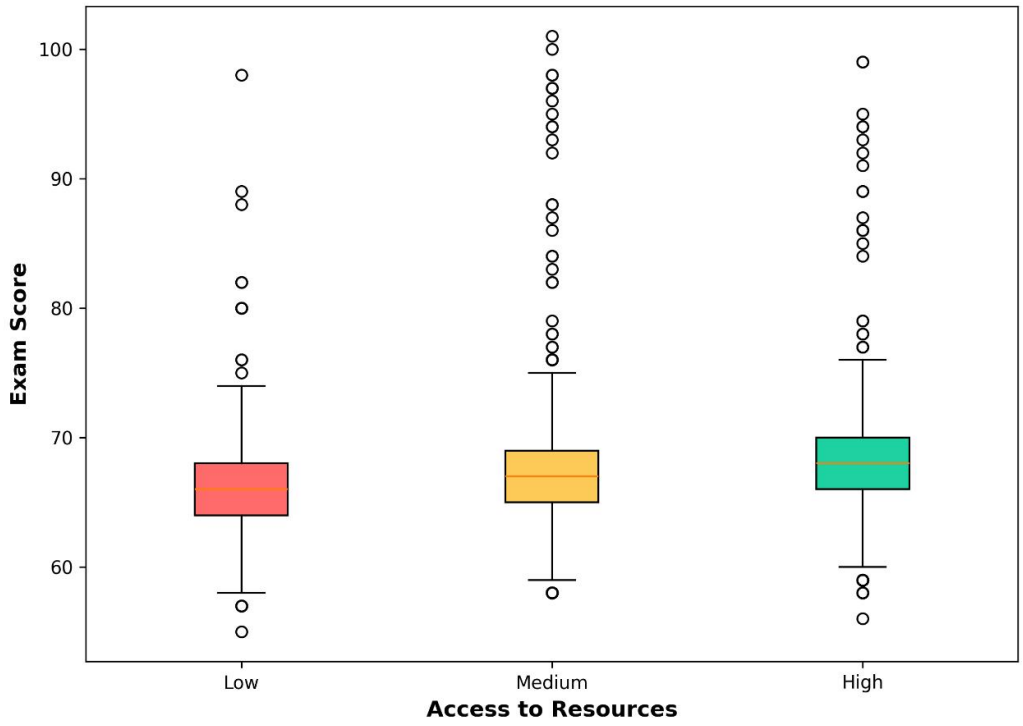

Figure 2: Academic Performance Across Levels of Access to Resources

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3.5 Academic Performance by Internet Access

Figure 3 gives a comparison between academic performance depending on access to the internet. The findings show that students who have access to the internet are more likely to perform better compared to those who do not have internet access. In particular, the median score on the exam of students with internet access is a little higher, and the distribution is broader in terms of the upper range than that of students without internet access.

Students with no internet access have poorer overall performance and fewer observations of high scores, implying that digital access can be a beneficial factor in academic performance. This conclusion aligns with the descriptive and regression studies, which put an emphasis on the importance of digital access in contemporary learning settings.

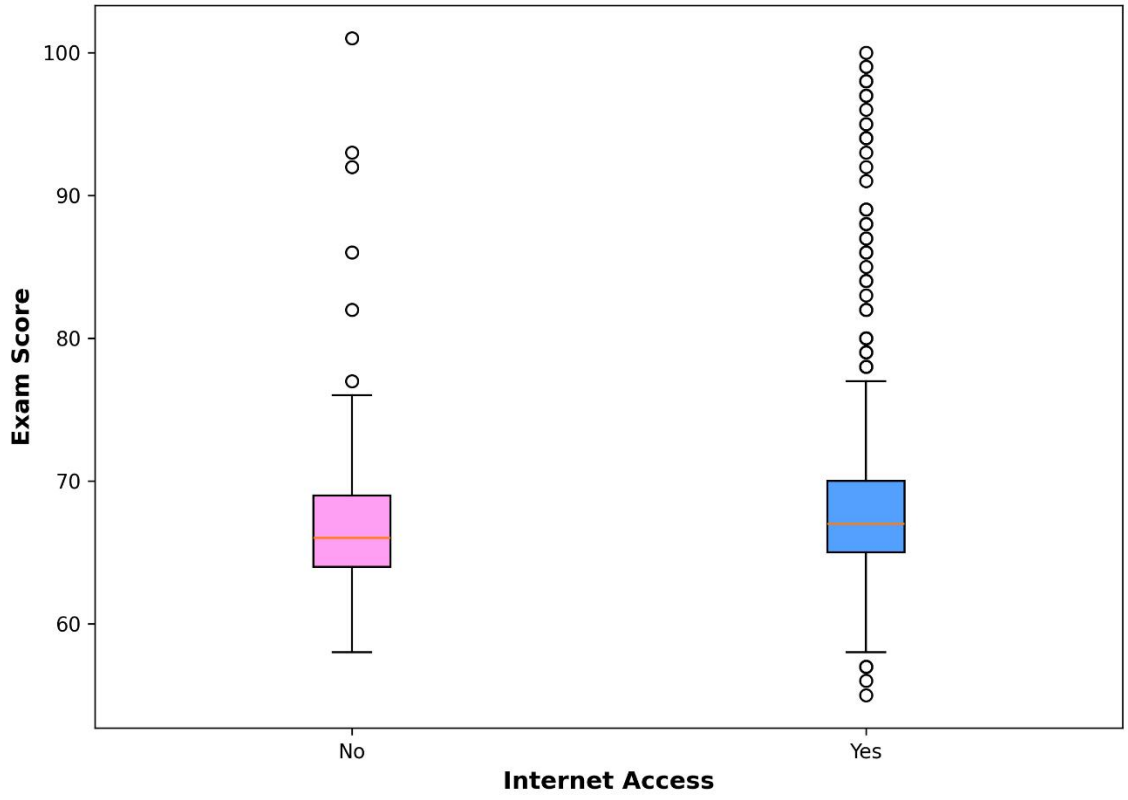

Figure 3: Exam Score by Internet Access

3.6 Relationship Between Study Behavior and Academic Performance

The correlation between study behavior and academic performance is demonstrated in Figure 4, which gives a scatter plot of hours studied and exam scores at various levels of motivation. The findings demonstrate that there is a positive correlation between time spent studying and

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academic performance, meaning that students who spend more time studying are likely to score higher.

Nonetheless, the data became different, which makes us assume that academic results cannot be completely determined by the study time. Students who may have a similar duration of study show varying levels of performance, which is a point of insight into the fact that other factors may have played a role. Motivation seems to be a significant factor, with more motivated students being clustered around relatively larger ranges of scores with similar amounts of study effort. It implies that motivation increases the quality of study behavior in relation to academic achievements.

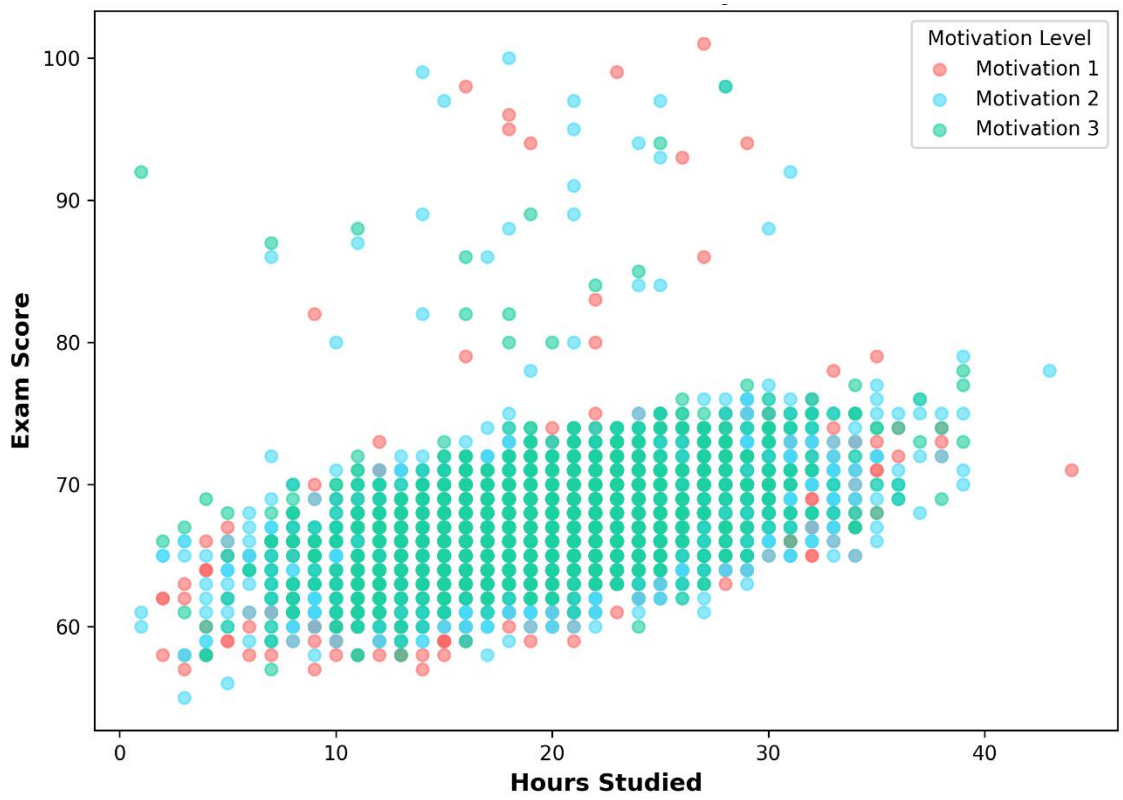

Figure 4: Hours Studied and Exam Score by Motivation Level

3.7 Regression Analysis

Table 4 contains the results of the regression process and includes two models to investigate how factors in the digital learning environment affect academic performance and student engagement.

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Model 1, which is a regression model of academic performance as the dependent variable, has a statistically significant result (R2 = 0.114, F = 94.25, p < 0.001), which shows that the independent variables, as a combination, will explain the variance in exam scores of about 11.4 percent. Among the predictors, access to resources has the strongest positive effect (β = 0.946, p < 0.001), followed by internet access (β = 0.812, p < 0.001) and tutoring sessions (β = 0.507, p < 0.001).

Control variables such as family income (β = 0.510, p < 0.001), teacher quality (β = 0.518, p < 0.001), parental education level (β = 0.530, p < 0.001), and previous scores (β = 0.047, p < 0.001) also show significant positive effects on academic performance. In contrast, gender (β = -0.009, p = 0.924) and school type (β = -0.072, p = 0.464) are not statistically significant predictors.

The model in Model 2, where the dependent variable is student engagement, is not significant (R2 = 0.000, F = 0.315, p = 0.970). None of the independent and control variables has a statistically significant effect on engagement. This shows that digital learning environment aspects incorporated in the model fail to explain variation in the created engagement index.

Table 4: Multiple Regression Results for Academic Performance and Student Engagement

Variable	**Model 1: Academic Performance (β)**	**p-value**	**Model 2: Student Engagement (β)**	**p-value**
Access to Resources	0.946	0.000	-0.007	0.433
Family Income	0.510	0.000	-0.003	0.688
Gender	-0.009	0.924	0.013	0.293
Internet Access	0.812	0.000	0.000	1.000
Parental Education Level	0.530	0.000	0.006	0.472
Previous Scores	0.047	0.000	0.000	0.514
School Type (Public)	-0.072	0.464	0.001	0.967
Teacher Quality	0.518	0.000	0.000	0.993
Tutoring Sessions	0.507	0.000	0.001	0.851
Constant	57.283	0.000	-0.020	0.720
Model 1 statistics: *R^2 = 0.114; F = 94.25; p < 0.001.*				
Model 2 statistics: R^2 = 0.000; F = 0.315; p = 0.970.				

Note: Coefficients are unstandardized beta values. P-values below 0.05 indicate statistical significance.

3.8 Summary of Findings

All in all, the findings reveal that the factors of digital learning environment, especially resource access, availability of the internet, and tutoring support, positively influence the academic performance at a significant rate. The findings are always backed up by descriptive statistics, correlation analysis, regression findings, and graphical evidence.

Nonetheless, the findings fail to validate the strong relationship between the factors of the digital learning environment and student engagement. This implies that there are other factors that might affect engagement that were not included in the dataset, such as psychological, social, or institutional factors.

4. Discussion

The current paper looked at the impact of online learning platforms on the academic performance and student engagement of students. The results offer valuable information on the role of digital accessibility, resource provision, and support mechanisms in student outcomes. In general, the findings suggest that the factors of the digital learning environment affect academic performance with a significant, but not statistically significant, impact on student engagement. This difference emphasizes the multidimensionality of the educational processes and indicates the possibility of various mechanisms that can explain the outcome of performance and engagement.

The regression findings indicate that the availability of resources, access to the internet, and tutoring sessions are great predictors of academic performance. Of these, the strongest predictor was access to resources, which demonstrates that access to learning materials is an important factor that supports student achievement. This result is consistent with the literature that highlights the significance of resource accessibility in improving the learning outcomes (Hattie, 2009; Schindler et al., 2017). Whenever students have sufficient access to textbooks, digital material, and learning environments, they will be in a better position to master academic content and excel in examinations.

Internet access is also positively related to academic performance and seems to underpin the notion that digital access improves learning opportunities. The availability of online materials, educational videos, and interactive platforms can enable students to complement traditional teaching, thus enhancing their comprehension and memory of the information (Sun et al., 2008; Johnson et al., 2016). Nevertheless, the comparatively lesser strength of the correlation between internet access and academic achievements indicates that the simple access to technology might not be enough; it is also crucial to use digital tools effectively.

It was also shown that tutoring sessions positively affected academic performance, which is why individual academic support is crucial. The result is in line with previous studies that have suggested that extra instructional help, including tutoring, can close achievement gaps and enhance student performance (Bloom, 1984; Kraft and Falken, 2021). Tutoring is focused and enhances learning, hence leading to an increase in academic performance.

Conversely, the findings show that the factors of the digital learning environment do not have any significant impact on student engagement. The given discovery is especially curious, given that the theoretical expectations are that digital tools should inherently increase the level of engagement (Henrie et al., 2015; Dixson, 2015). A possibility is that engagement is a multidimensional concept that is affected by psychological, social, and contextual dimensions that go beyond the presence of digital resources. Although digital tools could help in accessing learning, they cannot always motivate students and make them active.

The correlation analysis gives more understanding of this observation. Although there are positive correlations between student engagement and such behavioral variables as attendance, time spent studying, and motivation, the correlation between student engagement and digital learning variables is low. This is an indication that the engagement is more directly correlated with intrinsic and behavioral aspects as opposed to external technological circumstances. The same has been cited in research that has focused on the importance of motivation, self-regulation, and interaction in the classroom in influencing engagement (Reeve, 2012; Skinner et al., 2009).

The other significant finding is that engagement and academic performance are strongly correlated at the correlation level, although they are not significant in the regression model. This implies that engagement has an indirect impact on performance, which may be mediated

by other factors like effort and persistence. Nevertheless, the index of engagement created in this research might not be a complete measure of engagement, which also involves emotional and cognitive aspects, not reflected in the dataset.

Another important point raised by the findings is that socioeconomic and contextual factors are important contributors to academic performance. Family income, quality of teachers, and parental education level were all variables that were identified as having significant impacts on student outcomes. These findings are also in line with the existing literature that showed that students with more advantaged backgrounds are more likely to have higher academic success as they have more access to resources and support (Sirin, 2005; Coleman et al., 1966). This highlights the significance of combating the educational disparities in designing digital learning policies.

Although it has its contributions, the study has a number of limitations. To begin with, the application of a secondary dataset restricts the possibility of controlling all the relevant variables, especially those connected with psychological and emotional engagement. Second, the cross-sectional design does not allow one to determine causal relationships between variables. Third, study time and attendance are proxy indicators of operationalizing student engagement, and as a result, they might not adequately capture the multidimensionality of engagement. Also, no specifics on the quality of the use of digital resources are provided in the dataset, which can affect the efficiency of digital learning environments.

The limitations of this research should be overcome in the future by using primary means of data collection (surveys and interviews) to obtain a more detailed picture of student engagement. Longitudinal studies would also be desirable in exploring the effects of digital learning environments on student outcomes in the long run. Moreover, the mediating and moderating variables, including motivation, self-efficacy, and digital literacy, should be examined in future studies to gain a better insight into the mechanisms by which digital learning environments have an influence on academic performance and engagement.

The other potential area of future study is the qualitative study of digital learning: the effectiveness of particular technologies, instructional methods, and/or student-instructor relationships in online courses. Also, comparative research within various learning

environments and locales might yield further understanding of the functioning of digital learning environments within a variety of learning settings.

To sum up, this paper has shown that the factors of the digital learning environment significantly contribute to the improvement of student academic performance, but have a minimal effect on student engagement. The results indicate that, though access to the digital resources and support systems is critical to academic achievement, to promote student engagement, a more thorough emphasis on motivational, behavioral, and contextual aspects is necessary. The implications of these insights on education are significant to educators and policymakers who would like to maximize the use of digital technologies in education.

5. Conclusion

This study examined the influence of digital learning environments on academic performance and student engagement among students using a large dataset. The results show that digital learning variables, especially resource access, access to the internet, and tutoring services, are critical in enhancing academic success. These findings emphasize the need to make digital tools and academic support systems equally available to both students and teachers to improve student achievement. Nevertheless, the paper also shows that the factors of a digital learning environment do not play a significant role in student engagement. This implies that engagement is a more multifaceted construct that depends on behavioral, motivational, and contextual factors and not just on access to technology. Although digital tools offer a chance to learn, they cannot necessarily lead to an increased degree of student engagement. The research adds to the body of existing literature since it is both thorough in evaluating academic performance and engagement. It also highlights how a balanced approach that incorporates both digital access and strategies to improve student motivation and participation is important. Finally, enhancing academic performance in digital learning spaces needs to be supplemented by technological infrastructure, as well as understanding student behavior and engagement. The results provide useful information to teachers, other institutions, and policymakers in an effort to maximize the potential of digital education systems.

6. References

1. Al-Emran, M., Mezhuyev, V., & Kamaludin, A. (2020). Technology acceptance model in m-learning context: A systematic review. Computers & Education, 125, 389–412.
2. Bates, A. W. (2019). Teaching in a digital age: Guidelines for designing teaching and learning. BCcampus.
3. Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., & Kerres, M. (2020). Mapping research in student engagement and educational technology. International Journal of Educational Technology in Higher Education, 17(2), 1–30.
4. Dhawan, S. (2020). Online learning: A panacea in the time of the COVID-19 crisis. Journal of Educational Technology Systems, 49(1), 5–22.
5. Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept. Review of Educational Research, 74(1), 59–109.
6. Kahu, E. R. (2013). Framing student engagement in higher education. Studies in Higher Education, 38(5), 758–773.
7. Means, B., Toyama, Y., Murphy, R., & Baki, M. (2014). The effectiveness of online and blended learning. Teachers College Record, 115(3), 1–47.
8. OECD. (2015). Students, computers, and learning: Making the connection. OECD Publishing.
9. Selwyn, N. (2016). Education and technology: Key issues and debates. Bloomsbury Publishing.
10. Zhao, Y., Lei, J., Yan, B., Lai, C., & Tan, H. S. (2021). What makes the difference? A practical analysis of research on the effectiveness of distance education. Teachers College Record, 107(8), 1836–1884.
11. Bloom, B. S. (1984). The 2 sigma problem: The search for methods of group instruction. Educational Researcher, 13(6), 4–16.
12. Coleman, J. S., et al. (1966). Equality of educational opportunity. U.S. Government Printing Office.
13. Dixson, M. D. (2015). Measuring student engagement in the online course. Online Learning Journal, 19(4), 1–15.
14. Hattie, J. (2009). Visible learning: A synthesis of over 800 meta-analyses. Routledge.
15. Henrie, C. R., Halverson, L. R., & Graham, C. R. (2015). Measuring student engagement in technology-mediated learning. Computers & Education, 90, 36–53.

16. Johnson, L., Adams Becker, S., Cummins, M., & Estrada, V. (2016). NMC horizon report: Higher education edition. The New Media Consortium.
17. Kraft, M. A., & Falken, G. T. (2021). A blueprint for scaling tutoring. Educational Researcher, 50(9), 615–619.
18. Reeve, J. (2012). A self-determination theory perspective on student engagement. Handbook of Research on Student Engagement, 149–172.
19. Schindler, L. A., Burkholder, G. J., Morad, O. A., & Marsh, C. (2017). Computer-based technology and student engagement. International Journal of Educational Technology in Higher Education, 14(7), 1–28.
20. Skinner, E. A., Kindermann, T. A., & Furrer, C. J. (2009). A motivational perspective on engagement. Educational and Psychological Measurement, 69(3), 493–525.
21. Sirin, S. R. (2005). Socioeconomic status and academic achievement. Review of Educational Research, 75(3), 417–453.
22. Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). What drives e-learning effectiveness? Computers & Education, 50(4), 1183–1202.