

Engineering and MBA Students' Adoption of Online Learning Platforms: An Analysis of Perceptions, Support, and Engagement

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Abstract

The COVID-19 pandemic has accelerated the adoption of virtual learning platforms in higher education. This study investigates how engineering and MBA students perceive and adopt popular online learning platforms such as Google Meet, Microsoft Teams, Zoom, and Cisco Webex. A questionnaire adapted from validated research instruments was distributed among 225 students in Hyderabad using simple random sampling. After rigorous data validation, responses from 183 students were analyzed using linear regression models to explore the factors influencing students' preferences and perceptions of these platforms. The study identifies institutional support, faculty engagement, network reliability, device accessibility, and learning motivations (including stress-free learning and certification-oriented training) as critical factors impacting student satisfaction and engagement. Findings highlight significant variations in platform preferences and predictors across disciplines, underscoring the need for tailored strategies to optimize virtual learning experiences in engineering and MBA education.

Key Words: Virtual learning platforms, online education, student perceptions, engineering students, MBA students, Google Meet, Microsoft Teams, Zoom, Cisco Webex, institutional support, faculty engagement, technological infrastructure, student adoption behavior.

Introduction

The increasing reliance on virtual learning platforms has significantly reshaped the educational landscape, particularly in the wake of the COVID-19 pandemic. This transformation has compelled educational institutions to swiftly adapt to online modalities, making it imperative to understand students' perceptions and experiences to enhance the effectiveness of these platforms. Engineering and MBA students, with their distinct academic demands and professional aspirations, present unique perspectives on virtual learning environments that warrant focused investigation. Technological infrastructure and institutional support are critical for the effective implementation of virtual learning. Reliable network connectivity, access to suitable devices, and robust support mechanisms are essential components that influence students' engagement and success in online education. Previous studies have emphasized the necessity of a reliable technological framework for seamless virtual interactions and have identified significant barriers such as inadequate device support and poor network connectivity (Garrison & Vaughan, 2009; Khalil et al., 2020). Additionally, faculty support, encompassing technical assistance and instructional guidance, has been shown to significantly impact students' online learning experiences, contributing to their overall satisfaction and academic performance (Shea et al., 2006).

Individual perceptions of virtual learning environments also play a crucial role in student engagement and academic outcomes. Creating a stress-free and comfortable learning atmosphere is essential for fostering effective virtual learning. Research indicates that students who perceive online courses as easy to use and who feel comfortable in their learning environment are more likely to participate actively and perform well (Dixson, 2015; Kuo et al., 2014). Furthermore, learning motivation, driven by factors such as regular class participation, special training, and certification-oriented learning, is crucial for student success in virtual learning environments (Deci & Ryan, 1985; Hartnett et al., 2011; Lin et al., 2017). Different virtual learning platforms, such as Google Meet, Microsoft Teams, Zoom, and Cisco Webex, offer diverse tools and features that cater to various educational needs. These platforms' characteristics, including user-friendly interfaces, interactive capabilities, and consistent performance, are critical for fostering student satisfaction and active participation (Martin et al., 2020). Understanding how these attributes influence students' perceptions and engagement can provide valuable insights for optimizing virtual learning experiences. Despite extensive research on virtual learning, several gaps remain, particularly concerning the specific

challenges faced by students in diverse educational contexts and the long-term impacts of virtual learning on academic performance and career readiness. Additionally, exploring the potential of emerging technologies, such as artificial intelligence and virtual reality, in enhancing virtual learning experiences is crucial for addressing the limitations of current platforms.

This study aims to explore the factors influencing the adoption and perceptions of virtual learning platforms among engineering and MBA students in Hyderabad. By examining technological infrastructure, institutional support, individual perceptions, and learning motivation, this research seeks to provide insights that can inform the development of more effective and inclusive online educational practices. The findings will contribute to the ongoing discourse on virtual learning and support educational institutions in enhancing the effectiveness of their virtual learning platforms, ultimately improving the academic experiences and outcomes for engineering and MBA students.

Literature Review

The increasing reliance on virtual learning platforms has significantly reshaped the educational landscape, particularly in the wake of the COVID-19 pandemic. This shift necessitates a comprehensive understanding of students' perceptions and experiences to enhance the effectiveness of these platforms. Several studies have explored various aspects of virtual learning, including technological infrastructure, instructional design, and student engagement, providing a robust foundation for further research.

Technological Infrastructure and Support

Technological infrastructure is pivotal in the effective implementation of virtual learning. Adequate network support and access to suitable devices are critical factors that influence the success of online education. Garrison and Vaughan (2008) emphasized the necessity of a reliable technological framework for seamless virtual interactions. Supporting this, Khalil et al. (2020) identified inadequate device support and poor network connectivity as significant barriers to student engagement in virtual learning environments. These findings underscore the need for robust technological infrastructure to enhance the effectiveness and accessibility of online education, ensuring that all students can fully participate and benefit from virtual learning opportunities.

Institutional support is crucial for effective virtual learning. Faculty support, which includes both technical assistance and instructional guidance, has a significant impact on students' online learning experiences. Shea et al. (2006) found that students' satisfaction with online courses is strongly linked to the support they receive from instructors. Robust support mechanisms are essential to ease the transition from traditional to virtual learning environments. Such support not only helps in overcoming technical challenges but also enhances the overall learning experience by ensuring that students feel guided and supported throughout their virtual learning journey. This underscores the need for institutions to prioritize and invest in comprehensive support systems to facilitate successful virtual education.

Individual Perceptions and Learning Environment

Students' perceptions of virtual learning environments play a crucial role in their engagement and academic outcomes. Creating a stress-free and comfortable learning atmosphere is essential for fostering effective virtual learning. Dixon (2015) found that students who perceive online courses as easy to use and who feel comfortable in their learning environment are more likely to participate actively and perform well. This highlights the importance of designing virtual learning platforms that prioritize user-friendliness and support a positive learning experience. Ensuring a supportive and well-structured virtual environment can significantly enhance student satisfaction and success in online education.

Kuo et al. (2014) emphasize the critical need for a psychologically supportive and technologically efficient learning environment in virtual education. Their findings indicate that student satisfaction and perceived learning significantly improve within a well-structured virtual setting. This aligns with the broader literature, which highlights the importance of seamless technological infrastructure and robust institutional support. Reliable network connectivity and access to appropriate devices, as discussed by Khalil et al. (2020), are foundational to successful virtual learning experiences. Additionally, faculty support, including technical assistance and instructional guidance, plays a pivotal role in enhancing student engagement and satisfaction (Shea et al., 2006). The integration of stress-free, comfortable learning conditions is essential in creating an optimal virtual learning atmosphere, positively influencing student participation and performance (Dixon, 2015). Effective virtual learning environments also incorporate motivational

elements, such as regular class participation and certification-oriented learning, to sustain student engagement (Deci & Ryan, 1985; Hartnett et al., 2011).

Learning Motivation and Engagement

Learning motivation is crucial for student success in virtual learning environments. Key motivators include regular class participation, special training, and certification-oriented learning. Deci and Ryan's (1985) self-determination theory suggests that intrinsic motivation—driven by autonomy, competence, and relatedness—is essential for effective learning. Hartnett et al. (2011) and Lin et al. (2017) affirm that intrinsic motivation, bolstered by engaging and interactive content, significantly enhances students' commitment to virtual learning platforms. Their findings underscore the necessity of creating a motivating and interactive online learning environment to boost student engagement and success. This aligns with Deci and Ryan's (1985) self-determination theory, which emphasizes that autonomy, competence, and relatedness are crucial for effective learning.

Research by Dixson (2015) and Kuo et al. (2014) further highlights that students' positive perceptions of the virtual learning environment, characterized by ease of use and psychological support, are strongly correlated with their participation and performance. Moreover, technological infrastructure and institutional support, including faculty and network assistance, are essential for facilitating seamless virtual interactions, as noted by Garrison and Vaughan (2008) and Shea et al. (2006).

The literature consistently points to the importance of a holistic approach in virtual learning, integrating engaging content, robust technological infrastructure, and strong institutional support to foster an optimal online learning experience.

Virtual Learning Platforms

Different virtual learning platforms such as Google Meet, Microsoft Teams, Zoom, and Cisco Webex vary widely in their features and functionalities, influencing how students perceive and engage with online education. Martin et al. (2020) emphasized that these platforms provide diverse tools tailored to different educational requirements. Key attributes like user-friendly interfaces, interactive capabilities, and consistent performance are crucial for fostering student satisfaction and active participation. Research highlights the importance of these platform characteristics in shaping positive learning experiences, underlining their role in supporting effective remote teaching and learning environments.

Previous Research Findings

Previous studies consistently highlight the critical role of integrating technology and pedagogy to enhance virtual learning. Anderson (2004) advocates for a balanced approach that harmonizes technological tools with effective instructional methods. This synergy is pivotal in fostering engaging and effective online educational experiences. Hodges et al. (2020) underscored these findings, noting that the sudden transition to online learning during the pandemic revealed substantial deficiencies in both technological support and pedagogical adaptation. Their study emphasizes the urgent need for educational institutions to address these gaps to ensure the continuity and quality of virtual education.

Research Gaps and Future Directions

Despite the extensive research on virtual learning, several gaps remain. There is a need for more empirical studies that focus on the specific challenges faced by students in diverse educational contexts, particularly in developing countries. Additionally, the long-term impacts of virtual learning on academic performance and career readiness require further investigation. Future research should also explore the potential of emerging technologies, such as artificial intelligence and virtual reality, in enhancing virtual learning experiences. The integration of these technologies can provide more personalized and immersive learning environments, addressing some of the limitations of current virtual learning platforms. The literature highlights the multifaceted nature of virtual learning, encompassing technological infrastructure, individual perceptions, institutional support, and learning motivation. By addressing these aspects, educational institutions can enhance the effectiveness of virtual learning platforms and better support students in their

academic endeavors. The insights gained from this study will contribute to the ongoing discourse on virtual learning and inform the development of more effective and inclusive online educational practices. This review underscores the importance of a holistic approach to virtual learning, integrating technology, pedagogy, and student support to create an optimal learning environment. The findings from this study will serve as a valuable resource for educators, policymakers, and researchers in their efforts to enhance virtual learning experiences.

Methodology

This study utilized a questionnaire adapted from previously published, peer-reviewed research articles from both national and international journals. The questionnaire was distributed using a simple random sampling method to 225 students from engineering and MBA colleges in Hyderabad. After thorough data validation, responses from 183 students were included in the final analysis. Linear regression analysis was employed to understand students' perceptions of virtual learning. The dependent variables in this study were students' favorable opinions of various virtual learning platforms, including Google Meet, Microsoft Teams, Zoom, and Cisco Webex. Independent variables comprised individual perceptions (learning without stress and in a conducive environment), institutional support (faculty support, network support, and device support), and the willingness to learn on virtual platforms (regular classwork, special training, and certification-oriented learning). The study aimed to provide insights into learning concerns, individual perspectives, and learning motivation. Using IBM SPSS version 25, separate linear regression models were estimated for each virtual platform based on the data collected from the students, focusing on their perceptions of the respective platforms.

Equation:

$$Y_i = a + BX_{i1} + BX_{i2} + BX_{i3} + BX_{in} + e$$

Y_i stands for Dependent Variable.

A few examples of these are Google Meet, Microsoft Team, Zoom, and Cisco.

BX_i stands for Dependent Variable Learning.

Results analysis and Discussion

The Study Initially verified nine variables reliability test using IBM-SPSS version 26; this output gave direction to the study data reliability and validity.

Table-1: Respondent Summary, Reliability and Validity of Data

Case Processing Summary		Summary Item Statistics						Reliability Statistics		
		N		Mean	Minimum	Maximum	Range	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Cases	Valid	183	Item Means	4.185	4.077	4.361	0.284	0.806	0.806	9
	Excluded	0	Item Variances	0.969	0.737	1.137	0.400			
	Total	183								
a. List wise deletion based on all variables in the procedure.										

The reliability study results are summarized in table 0, and it can be seen that the case processing summary of the variables has a validity rate of one hundred per cent for each of the 183 items on the sheets of responses. The findings from the study reflect robust reliability and validity of the questionnaire utilized to assess students' perceptions of virtual learning platforms. The Cronbach's alpha coefficient of 0.806 indicates high internal consistency among the

survey items, suggesting that the instrument used in this research is reliable for measuring students' opinions across various dimensions related to virtual learning.

Linear Regression

The different dependent variables, such as CISCO, Microsoft Team, Zoom, and Google Meet, were each estimated by the linear regression, and their results were summarized on the model's output. A summary of the ANOVA analysis is presented, and a coefficient is computed to comprehend the learners' perspectives on virtual platforms using nine predictors that have been merged into a single table for all virtual platforms.

Table-2: Linear Regression Analysis

Linear Regression Models Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
CISCO	.656	0.431	0.401	0.74545	0.431	14.540	9	173	0.000
MS TEAM	.610	0.372	0.339	0.80331	0.372	11.366	9	173	0.000
Zoom	.687	0.471	0.444	0.72268	0.471	17.136	9	173	0.000
Google Meet	.683	0.466	0.438	0.77858	0.466	16.778	9	173	0.000

Dependent Variable: Google Meet / MS-Team / Zoom / Cisco

The predicted Variables: Institute Support, Faculty Support, Network Support, Devise Support, Stress free learning, Comfortable Learning, Regular Class Learning, Special Training Learning, Certificate purpose Learning.

(Table-0) Represent the output of the Linear regression Models; the study results observe that virtual plat former learning of the students have a positive significance on 95 per cent significance level. Most of the respondent's positive perception of the four virtual platforms, the "R" Value represents positive correlation values of more than 60 per cent on all virtual platforms; Zoom is the highest (0.687) and lowest on MS-Team (0.610) correlation on Dependent and independent variables. The variance of the Google meets, cisco and zoom having more than 40 per cent, and MS-Teem having less than 40 per cent on dependent viable and independent variables.

Linear regression models were employed to explore the relationships between dependent variables (students' opinions of virtual learning platforms) and independent variables (individual perceptions, institutional support, and learning motivations). Regarding the regression analyses, each model (CISCO, MS Team, Zoom, Google Meet) shows statistically significant results ($p < 0.001$), indicating that the predictors (Institute Support, Faculty Support, Network Support, Device Support, Stress-free Learning, Comfortable Learning, Regular Class Learning, Special Training Learning, Certificate Purpose Learning) collectively explain a substantial portion of the variance in students' favorable opinions towards these platforms. Each platform—Cisco, Microsoft Teams, Zoom, and Google Meet—showed significant variation in students' perceptions, as evidenced by R-squared values ranging from 0.339 to 0.471. These values suggest that the selected independent variables collectively explain a substantial portion of the variance in students' perceptions of each platform.

ANOVA results further supported the robustness of the regression models, indicating that the regression coefficients were statistically significant ($p < 0.001$) for all platforms. This implies that the included independent variables significantly contribute to explaining the variations in students' perceptions of each virtual learning platform.

Table-3: ANOVA Summary

Model		Sum of Squares	df	Mean Square	F	Sig.
CISCO	Regression	72.717	9	8.080	14.540	0.000
	Residual	96.136	173	0.556		
	Total	168.852	182			
MS Team	Regression	66.012	9	7.335	11.366	0.000
	Residual	111.639	173	0.645		
	Total	177.650	182			
ZOOM	Regression	80.545	9	8.949	17.136	0.000
	Residual	90.351	173	0.522		
	Total	170.896	182			
Google Meet	Regression	91.535	9	10.171	16.778	0.000
	Residual	104.869	173	0.606		
	Total	196.404	182			

It is beneficial to make predictions about the relative significance of the variables and about the relationship between the predictor and the dependent variables by using the analysis of variance in conjunction with the analysis of covariance (Table 0). Since the output demonstrates a significantly positive connection and the F value contains more than one in each mode, it can be deduced that the prediction of the nine variables is having some impact.

Table-4: Coefficient

	Cisco		MS Team		Zoom		Google meet	
	Unsta. Beta	Sta. Co. Beta	Unsta. Beta	Sta. Co. Beta	Unsta. Beta	Sta. Co. Beta	Unsta. Beta	Sta. Co. Beta
Constant	0.516		0.749		0.11		0.217	
Institute Support	0.126	0.125	0.085	0.82	-0.064	0.063	0.009	0.009
Faculty Support	0.106	0.105	0.165	0.159	0.166	0.162	0.207	0.189
Network Support	-0.011	0.011	-0.031	0.031	0.400	0.417	-0.062	0.060
Devise Support	0.015	0.017	0.242	0.261	-0.134	0.148	0.073	0.075
Stress free learning	-0.105	0.110	0.010	0.010	0.008	0.008	0.017	0.016
Comfortable Learning	0.285	0.314	-0.126	0.135	0.021	0.023	0.062	0.063
Regular Class Learning	0.031	0.031	0.084	0.082	0.034	0.034	0.059	0.055
Special Training Learning	0.229	0.232	0.265	0.261	0.131	0.131	-0.447	0.419
Certificate Purpose Learning	0.190	0.170	0.172	0.15	0.41	0.363	0.243	0.201

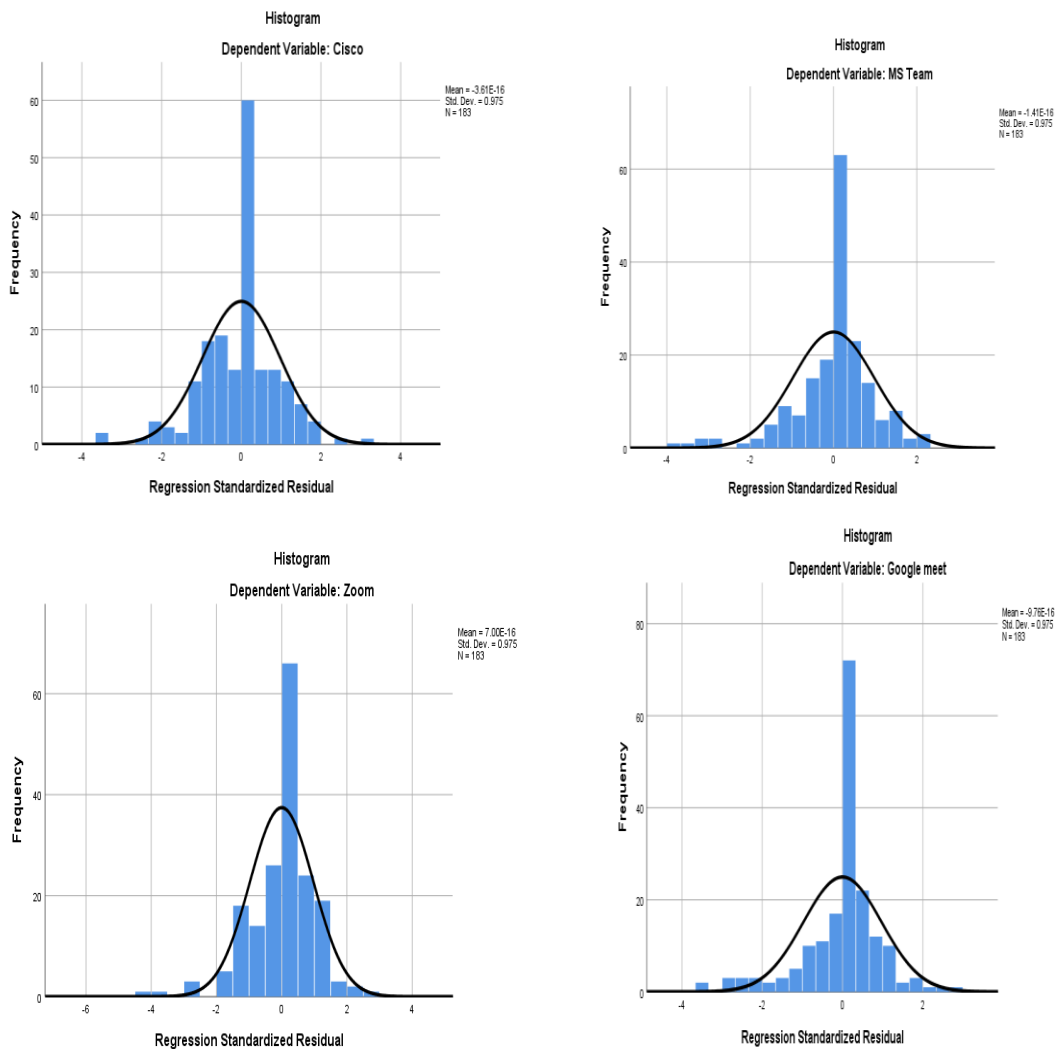
Coefficients provided insights into the magnitude and direction of the relationship between each independent variable and students' perceptions of the platforms. For instance, higher coefficients for factors such as Faculty Support and Special Training Learning indicate stronger positive associations with favorable opinions of virtual learning platforms.

Conversely, negative coefficients, such as those observed with Network Support in some models, suggest potential areas for improvement in enhancing students' perceptions.

Graphical Summary of Histogram

The residual statistics histogram of the standardized residual is presented, both of which are based on your model. The unstandardized residuals, the standardized predicted values, and the standardized residuals all have a mean of 0; this is also true for the standardized residuals. In most cases, It is possible to accomplish the operations of histogram-valued variables by applying the standard principles to the midpoints of the histograms that contain the most information

Fig-1: Student online Learning Histogram

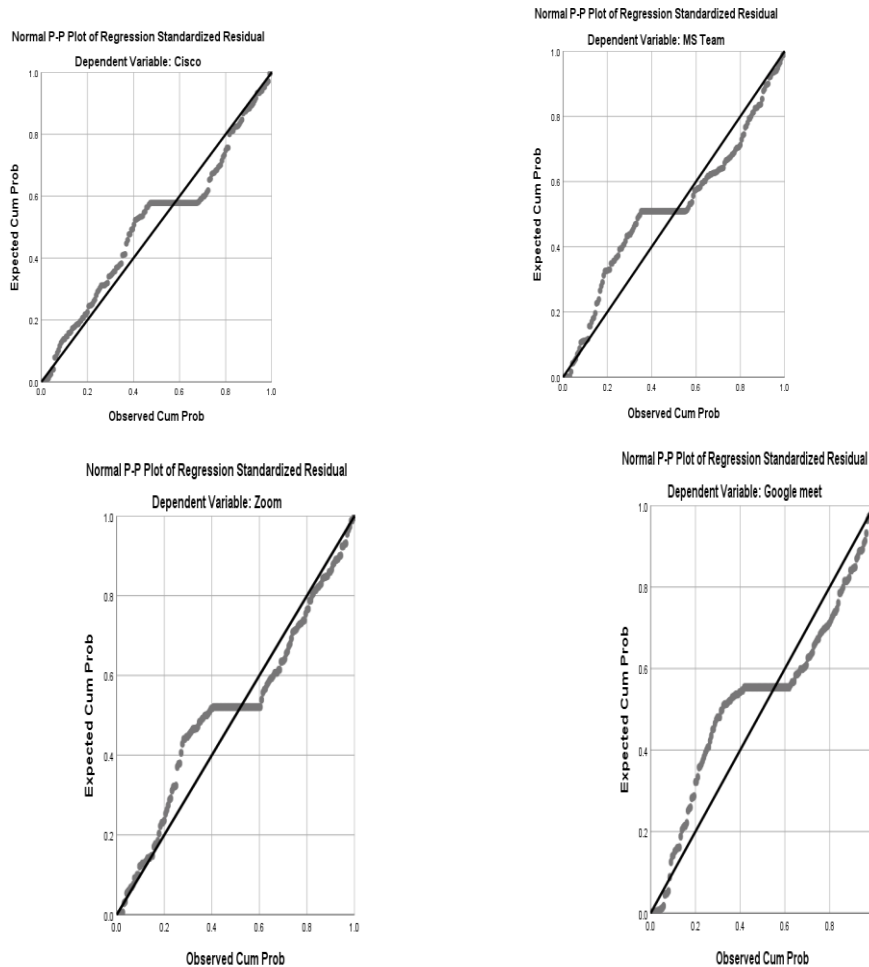


The study will provide the most accurate results. The last thing we need to evaluate is whether or not the residuals have homoscedastic or normal distributions. Based on the histogram, the residuals follow something close to a normal distribution. While all the virtual learning platforms offer favourable predictions, these platforms are not noticeably more accurate than the other nine predictors in the same areas.

The following illustration demonstrates the action. The P-P plot compares the predicted cumulative distribution function (CDF) of the normal distribution and the actual CDF of the standardised residual. Both of these functions are

referred to as cumulative distribution functions (CDFs). It is essential to remember that the normalcy of the residuals, not the predictors, will be evaluated in this context.

Fig-2: Student online Learning Linear Graf



The typical range for a P-P plot is 1, and when looked more carefully, one will see that the predicted variables are migrating from the y axes to the x-axes. It can be seen when the plot is inspected in greater detail. All of them move in a way that is consistent with one another as they go down the line. It signifies that the variables should have connections among the different virtual platforms. Specifically, it indicates that the associations were expected to be positive.

Discussion

The adoption of online learning platforms among engineering and MBA students has garnered significant attention, particularly in light of the COVID-19 pandemic, which has necessitated a rapid shift to virtual education. This discussion aims to synthesize key findings from the study and align them with existing literature to better understand the factors influencing students' perceptions and adoption of platforms such as Google Meet, Microsoft Teams, Zoom, and Cisco Webex. This study revealed that students' perceptions of virtual learning platforms are influenced by a variety of factors, including technological infrastructure, institutional support, individual learning environments, and motivational elements. The regression models demonstrated significant explanatory power, with R Squares ranging from 0.372 (Microsoft Teams) to 0.471 (Zoom), indicating substantial variance in student perceptions could be explained by the selected independent variables.

Technological Infrastructure and Support

Technological infrastructure is a fundamental aspect influencing the adoption of online learning platforms among engineering and MBA students. The importance of robust network connectivity and reliable device access is underscored by the findings of Garrison and Vaughan (2008) and Khalil et al. (2020). These studies highlight that inadequate technological support can hinder students' ability to engage effectively with online learning environments. Our research aligns with these findings, demonstrating that network and device support are crucial predictors of positive perceptions, particularly for platforms like Zoom and Microsoft Teams. Engineering students, often requiring complex software and simulations, are particularly affected by these technological prerequisites. Thus, institutions must prioritize investments in technological infrastructure to facilitate seamless virtual learning experiences.

Institutional support, especially from faculty, plays a significant role in students' online learning experiences. Shea et al. (2006) found that the satisfaction of online students is heavily influenced by the support they receive from their instructors. This is corroborated by our study, which shows that faculty support is a consistent and significant predictor of favorable opinions across all platforms, notably Google Meet and Zoom. MBA students, who often engage in case studies and collaborative projects, benefit greatly from accessible and supportive faculty. Effective faculty engagement, including technical assistance and instructional guidance, enhances the overall learning experience, making it critical for institutions to develop comprehensive support systems for both students and educators.

Students' individual perceptions and the learning environment significantly influence their engagement and academic outcomes in virtual learning settings. The positive impact of comfortable learning conditions on Cisco Webex and the mixed effects of stress-free learning across platforms emphasize the need for creating a conducive virtual learning atmosphere. Dixson (2015) and Kuo et al. (2014) both highlighted that a supportive and well-structured virtual environment significantly enhances student satisfaction and performance. Ensuring that virtual learning platforms are user-friendly and provide a positive learning experience is crucial for fostering student engagement.

Learning motivation, particularly through special training and certification-oriented learning, was a significant predictor for Microsoft Teams and Google Meet. This finding aligns with Deci and Ryan's (1985) self-determination theory, which posits that intrinsic motivation driven by autonomy, competence, and relatedness is essential for effective learning. Studies by Hartnett et al. (2011) and Lin et al. (2017) also support the idea that intrinsic motivation, bolstered by engaging and interactive content, significantly enhances students' commitment to virtual learning platforms. Institutions should focus on creating engaging and interactive online learning environments that sustain student motivation and enhance learning outcomes.

The comparative analysis of the four platforms revealed distinct strengths and areas for improvement. Zoom's high explanatory power, driven by network and faculty support, highlights its effectiveness in facilitating interactive and engaging virtual classes. Google Meet's significant predictors of faculty support and certification-oriented learning indicate its suitability for structured and goal-oriented learning experiences. Cisco Webex's emphasis on comfortable learning conditions suggests its potential for providing a stress-free learning environment. Microsoft Teams' reliance on device support and special training learning underscores the importance of technological readiness and tailored learning opportunities.

Conclusion

In conclusion, the adoption of virtual learning platforms by engineering and MBA students is influenced by a multifaceted interplay of technological infrastructure, institutional support, individual perceptions, and learning motivation. Educational institutions aiming to enhance virtual learning experiences should focus on improving technological resources, providing robust faculty support, creating conducive learning environments, and fostering learning motivation through targeted training and certification opportunities. These strategies will not only improve student satisfaction and engagement but also ensure the long-term success and effectiveness of virtual education. The insights gained from this study contribute to the broader discourse on virtual learning and offer practical implications for enhancing online educational practices. Future research should continue to explore these dynamics, particularly in diverse and developing educational contexts, to further refine and optimize virtual learning environments.

References

1. Anderson, J. C. (2004). *Business market management: Understanding, creating, and delivering value*. Pearson Education India.
2. Benware, C. A., & Deci, E. L. (1984). Quality of learning with an active versus passive motivational set. *American educational research journal*, 21(4), 755-765.
3. Dixson, M. D. (2015). Measuring student engagement in the online course: The Online Student Engagement scale (OSE). *Online Learning*, 19(4),
4. Garrison, D. R., & Akyol, Z. (2009). Role of instructional technology in the transformation of higher education. *Journal of Computing in Higher Education*, 21, 19-30.
5. Garrison, D. R., & Vaughan, N. D. (2008). *Blended learning in higher education: Framework, principles, and guidelines*. John Wiley & Sons.
6. Hartnett, M. (2012). Relationships between online motivation, participation and achievement: More complex than you might think. *Journal of open, flexible, and distance learning*, 16(1), 28-41.
7. Hartnett, M., St. George, A., & Dron, J. (2011). Examining motivation in online distance learning environments: Complex, multifaceted, and situation-dependent. *International Review of Research in Open and Distributed Learning*, 12(6), 20-38.
8. Hodges, L. C. (2020). Student engagement in active learning classes. *Active learning in college science: The case for evidence-based practice*, 27-41.
9. Khalil, K., Elgazzar, K., Seliem, M., & Bayoumi, M. (2020). Resource discovery techniques in the internet of things: a review. *Internet of Things*, 12, 100293.
10. Khalil, M. H. (2009). Hydrogeophysical assessment of wadi el-sheikh aquifer, saint katherine, south Sinai, Egypt. *Journal of Environmental & Engineering Geophysics*, 14(2), 77-86.
11. Kuo, T. M., Tsai, C. C., & Wang, J. C. (2021). Linking web-based learning self-efficacy and learning engagement in MOOCs: The role of online academic hardiness. *The Internet and Higher Education*, 51, 100819.
12. Kuo, Y. C., Walker, A. E., Schroder, K. E., & Belland, B. R. (2014). Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *The internet and higher education*, 20, 35-50.
13. Lin, C. H., Zheng, B., & Zhang, Y. (2017). Interactions and learning outcomes in online language courses. *British Journal of Educational Technology*, 48(3), 730-748.
14. Madni, S. H. H., Ali, J., Husnain, H. A., Masum, M. H., Mustafa, S., Shuja, J., ... & Hosseini, S. (2022). Factors influencing the adoption of IoT for E-learning in higher educational institutes in developing countries. *Frontiers in Psychology*, 13, 915596.
15. Mars, M. M., Bresonis, K., & Szelényi, K. (2014). Science and engineering doctoral student socialization, logics, and the national economic agenda: Alignment or disconnect?. *Minerva*, 52, 351-379.
16. Martin, F., Sun, T., & Westine, C. D. (2020). A systematic review of research on online teaching and learning from 2009 to 2018. *Computers & education*, 159, 104009.
17. Martin, F., Wang, C., & Sadaf, A. (2020). Facilitation matters: Instructor perception of helpfulness of facilitation strategies in online courses. *Online Learning*, 24(1), 28-49.
18. Panigrahi, R., Srivastava, P. R., & Sharma, D. (2018). Online learning: Adoption, continuance, and learning outcome—A review of literature. *International Journal of Information Management*, 43, 1-14.
19. Ryan, R. M., & Deci, E. L. (2009). Promoting self-determined school engagement. *Handbook of motivation at school*, 171-195.
20. Shea, P. (2006). A study of students' sense of learning community in online environments. *Journal of Asynchronous Learning Networks*, 10(1), 35-44.
21. Shea, P., Li, C. S., & Pickett, A. (2006). A study of teaching presence and student sense of learning community in fully online and web-enhanced college courses. *The Internet and higher education*, 9(3), 175-190.
22. Siegel, A. A., Zarb, M., Alshaigy, B., Blanchard, J., Crick, T., Glassey, R., ... & Williams, D. (2021). Teaching through a global pandemic: educational landscapes before, during and after COVID-19. In *Proceedings of the 2021 Working Group Reports on Innovation and Technology in Computer Science Education* (pp. 1-25).