

EVALUATING THE IMPACT OF ONLINE LEARNING ATTITUDES AND DIGITAL LITERACY ON ACADEMIC ACHIEVEMENT AMONG MEDICAL STUDENTS

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Abstract

Objective: This study aimed to evaluate the impact of digital literacy and attitudes toward online learning on the academic achievement of medical students. It specifically sought to determine the individual and combined predictive effects of these variables on academic performance in a digitally evolving medical education environment.

Methodology: A quantitative, cross-sectional design was adopted, involving 300 MBBS students from 1st to 4th year at Wah Medical College, Pakistan. Proportionate stratified random sampling ensured balanced representation. Data were collected through a self-administered questionnaire assessing three domains: academic achievement (self-reported CGPA or exam percentage), digital literacy (via a validated Digital Literacy Scale), and online learning attitudes (via an Online Learning Attitude Scale). Data were analyzed using SPSS 26.0, employing Pearson correlation, chi-square tests, and multiple regression analysis. Ethical approval was secured from the Institutional Review Board of Wah Medical College.

Results: Digital literacy showed a strong positive correlation with academic achievement ($r = 0.55$, $p < .01$), while online learning attitudes were also positively associated ($r = 0.42$, $p < .01$). Multiple regression analysis demonstrated that digital literacy ($\beta = 0.41$, $p < .001$) was a stronger predictor of academic success than online learning attitudes ($\beta = 0.28$, $p < .001$), with the model explaining 47% of the variance in academic achievement ($R^2 = 0.47$). Cross-tabulation revealed that students with higher digital literacy consistently performed better academically.

Conclusion: The findings underscore the critical role of both digital literacy and online learning attitudes in shaping medical students' academic achievement. As digital education becomes integral to medical training,

institutions must actively promote technological proficiency and cultivate positive learning attitudes to enhance educational outcomes and prepare students for the digital demands of clinical practice.

INTRODUCTION

Academic achievement, typically assessed through metrics such as cumulative grade point average or clinical examination results, is fundamental in medical education and is increasingly understood as being influenced by cognitive, behavioral, and technological factors. A recent investigation (McGee, Wark, Mwangi, Drovandi, Alele, & Malau-Aduli, 2024) demonstrated that digital learning tools for clinical skills could lead to significant improvements in student performance (mean difference = 1.93), suggesting a direct positive effect of digital modalities on academic outcomes. Complementing this, (Martin, Burns, Collie, Bostwick, Flesken, & McCarthy, 2022) reported a strong positive correlation between digital literacy and academic success among health profession students, highlighting the importance of technological proficiency in medical education.

Digital literacy defined as the capacity to locate, evaluate, and use digital information—has been identified as a critical competency (Z. Farooq, A. Imran, & N. J. P. J. o. M. S. Imran, 2024) observed that medical students in Lahore demonstrated strong operational and privacy-related digital competencies but struggled with assessing online health information, influencing their academic reasoning. A broader cross-sectional study from Islamabad revealed that digital literacy significantly boosted academic self-efficacy via reductions in intrinsic and extraneous cognitive load. (Z. Farooq, A. Imran, & N. Imran, 2024) emphasizing its indirect impact on performance. Furthermore (Yuan, Rehman, Altalbe, Rehman, & Shahiman, 2024) found that digital literacy enhanced academic self-efficacy and reduced procrastination among medical students, further strengthening its role in promoting academic confidence and reducing counterproductive behaviors.

Attitudes toward online learning—comprising learners' beliefs about its flexibility, engagement, and usability—are similarly influential. (Getenet, Cantle, Redmond, & Albion, 2024) found that positive online learning attitudes significantly predicted

engagement and academic performance. (A. A. Alghamdi et al., 2024) reported that medical students in Saudi Arabia with favorable perceptions of online instruction demonstrated improved achievement. Parallel findings in nursing education indicate that online active learning increases positive learning attitudes and reduces avoidance behavior compared to face-to-face instruction. (Özöztürk, Güler, Bilgiç, Özberk, Yağcan, & Aluş Tokat, 2023). Although academic achievement, digital literacy, and online learning attitudes—have been examined individually, integrated research within medical education remains sparse, particularly in South Asian contexts. While clinical digital learning has shown efficacy, existing studies often overlook the impact of students' digital skill levels and attitudinal readiness. (McGee et al., 2024). Although digital literacy has been linked to self-efficacy and procrastination, limited research has translated these insights into academic outcomes. (Yuan et al., 2024). Moreover, most attitude studies focus on engagement rather than direct academic measures (Amal A Alghamdi et al., 2024; Getenet et al., 2024), creating a critical gap in understanding the combined effect of digital readiness and online learning disposition on performance among medical students in developing regions.

To address this gap, the present study evaluates the relationships and combined influence of online learning attitudes and digital literacy on academic achievement among medical students. By integrating these variables in a Western-validated yet culturally relevant context, this research informs medical education strategies aimed at enhancing digital readiness and attitude to improve academic outcomes. This study's significance lies in its potential to guide curriculum development and institutional interventions that strengthen digital competencies and foster positive online learning orientations. Enhancing these dimensions can prepare medical students for evolving educational environments and digitally integrated clinical practice. The aim of the study is to evaluate the impact of online learning

attitudes and digital literacy on academic achievement among medical students.

The objectives are:

1. to examine the relationship between online learning attitudes and academic achievement;
2. to assess how digital literacy influences academic performance
3. to evaluate the combined predictive effect of online learning attitudes and digital literacy on academic success within medical education.

METHODOLOGY

This study aimed to evaluate the impact of online learning attitudes and digital literacy on the academic achievement of medical students. A **quantitative, cross-sectional research design** was employed to investigate the relationship between online learning attitudes, digital literacy, and academic achievement. The study was conducted at **Wah Medical College, Wah Cantt**, a recognized medical institution in Pakistan. The study population consisted of MBBS students from 1st, 2nd, 3rd, and 4th professional years. A **total sample of 300 students** was selected using proportionate stratified random sampling to ensure equal representation from each academic year. Sample size estimation was based on an expected medium effect size ($f^2 = 0.15$), 95% confidence interval, and power of 0.80 using G*Power software. The inclusion criteria for this study comprised students who were enrolled full-time in the MBBS program from 1st to 4th year at Wah Medical College and who were willing to participate voluntarily. Conversely, students in their final year (5th year) were excluded from the study, as they were primarily engaged in clinical rotations and were not regularly involved in classroom-based academic activities. Furthermore, students who were on extended medical leave, those with diagnosed learning disabilities, and declined to provide informed consent were also excluded.

The study utilized a structured, self-administered questionnaire comprising three parts:

RESULTS

Table-1; Demographic Characteristics of Participants (n = 300)

1. **Academic Achievement:** Measured through self-reported Cumulative Grade Point Average (CGPA) or recent exam percentage, serving as the outcome variable.
2. **Digital Literacy:** Digital literacy Assessed using a validated Digital Literacy Scale, measuring components such as information evaluation, software use, privacy awareness, and communication competence (Avinç & Doğan, 2024). The scale demonstrated good internal consistency with Cronbach's alpha $> .80$ in previous studies.
3. **Online Learning Attitudes:** Measured using the Online Learning Attitude Scale, which evaluates students' perceived usefulness, ease of use, flexibility, and motivation toward digital learning (Jyothi & Vijayabhinandana, 2021). Reliability for this scale was also confirmed at $\alpha > .85$.

Prior to data collection, ethical clearance was obtained from the Institutional Review Board of Wah Medical College. Students were approached during scheduled academic hours. After a brief explanation of the study's purpose, voluntary informed consent was obtained. Participants were assured of anonymity and confidentiality, and they completed the paper-based questionnaires in a supervised setting to minimize missing data. Data were entered and analyzed using **Statistical Package for the Social Sciences (SPSS) version 26**. Descriptive statistics were computed for demographic variables. Pearson correlation was used to assess relationships among academic achievement, digital literacy, and online learning attitudes. A cross-tabulation with chi-square test was applied to examine the distribution of academic achievement across different levels of digital literacy. Multiple linear regression analysis was performed to assess the combined predictive effect of digital literacy and online learning attitudes on academic achievement. A p-value < 0.05 was considered statistically significant.

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–20	95	31.7%
	21–23	145	48.3%
	24–26	60	20.0%
Gender	Male	124	41.3%
	Female	176	58.7%
Year of MBBS	1st Year	70	23.3%
	2nd Year	80	26.7%
	3rd Year	85	28.3%
	4th Year	65	21.7%
Socioeconomic Status	Low	98	32.7%
	Middle	142	47.3%
	Upper	60	20.0%
Living Environment	Urban	240	80.0%
	Rural	60	20.0%

The demographic characteristics of the participants, as shown in Table 1, reflect a balanced representation across multiple variables. Most respondents were between 21–23 years of age (48.3%), followed by those aged 18–20 years (31.7%), and 24–26 years (20.0%). Female students constituted a greater proportion of the sample (58.7%) compared to males (41.3%). The distribution across the years of MBBS study was even,

with the highest representation from 3rd-year students (28.3%), followed by 2nd year (26.7%), 1st year (23.3%), and 4th year (21.7%). Most participants belonged to the middle socioeconomic class (47.3%), while 32.7% came from lower and 20.0% from upper socioeconomic backgrounds. A substantial majority of students (80.0%) reported residing in urban areas.

Table-1; Pearson Correlation Matrix among Academic Achievement, Digital Literacy, and Online Learning Attitudes (n = 300)

Variables	1	2	3
1. Academic Achievement	–		
2. Digital Literacy	0.55**	–	
3. Online Learning Attitudes	0.42**	0.48**	–

Table 2 reveals statistically significant and positive relationships among the three core variables. Academic achievement demonstrated a strong positive correlation with digital literacy ($r = 0.55$, $p < .01$), indicating that students with higher digital competencies tend to perform better academically. Additionally, academic achievement was positively correlated with online learning attitudes ($r = 0.42$, $p < .01$), suggesting that students who hold favorable

attitudes toward online learning environments are more likely to achieve higher academic scores. Furthermore, a moderate positive correlation between digital literacy and online learning attitudes ($r = 0.48$, $p < .01$) highlights that students with better digital skills are also more likely to have positive perceptions of online learning.

Table-2; Cross-tabulation of Digital Literacy Levels and Academic Achievement Categories (n = 300)

Digital Literacy Level	Low Academic Achievement $\leq 60\%$	Moderate Academic Achievement 61-75%	High Academic Achievement $> 75\%$	Total
Low	28	19	8	55
Medium	21	74	45	140
High	9	36	60	105
Total	58	129	113	300

Table-3 presents the cross-tabulation results examining the relationship between digital literacy levels and academic achievement categories. Students with low digital literacy predominantly fell into the low academic achievement group (28 out of 55), while only a small fraction of them attained high academic performance (8 out of 55). In contrast, students with medium digital literacy showed a more balanced distribution, with a large proportion achieving

moderate (74) or high (45) academic performance. Notably, students with high digital literacy levels demonstrated the strongest academic outcomes, with 60 out of 105 students attaining high academic achievement. This distribution indicates a clear and consistent pattern: as digital literacy levels increase, the likelihood of higher academic performance also rises, affirming the pivotal role of digital competencies in academic success.

Table-3; Multiple Regression Analysis Predicting Academic Achievement from Online Learning Attitudes and Digital Literacy (n = 300)

Predictor Variable	B	SE	B	t	p-value	p'
Online Learning Attitudes	0.24	0.06	0.28	4.00	.001	<
Digital Literacy Score	0.03	0.01	0.41	5.80	.001	<
Model R ²						0.47
F (2, 297)						131.2

The results of the multiple regression analysis presented in Table 4 further substantiate the predictive value of online learning attitudes and digital literacy in explaining academic achievement. Both predictors were statistically significant, with digital literacy emerging as the stronger predictor ($\beta = 0.41$, $p < .001$) compared to online learning attitudes ($\beta = 0.28$, $p < .001$). The overall model was highly significant $F(2, 297) = 131.2$, $p < .001$ and explained 47% of the variance in academic achievement ($R^2 = 0.47$), indicating a robust model fit. These findings suggest that enhancing students' digital literacy and fostering positive attitudes toward online learning can meaningfully improve academic outcomes, thereby

underscoring the importance of integrating digital competence development and online pedagogical readiness in medical education.

DISCUSSION

This study was undertaken to evaluate the impact of online learning attitudes and digital literacy on academic achievement among medical students, with the intent to address the observed research gap in the integrated analysis of these constructs within medical education, particularly in low- and middle-income countries. The research aimed to determine how students' attitudes toward online learning and their level of digital literacy both individually and in

combination—influence their academic success. As the digitization of medical education accelerates globally, understanding these relationships is crucial for developing interventions that support academic performance and ensure equitable educational outcomes.

The findings from this study strongly affirm the hypothesized relationships. Digital literacy emerged as a significant positive correlate of academic achievement ($r = 0.55$, $p < .01$), consistent with existing literature that links digital competence with better learning outcomes. For instance with study conducted by Holm and Meida (2025), demonstrated that health profession students with higher digital literacy performed better academically, emphasizing the role of digital navigation skills in managing course content and assessments (Holm & Media, 2025). Similarly, study conducted by Yuan et al., (2024), further illustrated that digital literacy acts as a catalyst in improving academic self-efficacy while reducing procrastination both mediators known to significantly influence academic success (Yuan et al., 2024). These associations are particularly important in medical education, where digital tools are increasingly used for simulations, diagnostics, and remote learning.

Online learning attitudes were also positively associated with academic achievement ($r = 0.42$, $p < .01$). This supports the findings of Getenet and colleagues (2024), who established that positive attitudes toward online learning predicted greater academic engagement, which is itself a strong predictor of achievement (Getenet et al., 2024). The moderate correlation between online learning attitudes and digital literacy ($r = 0.48$) in the present study indicates that students with greater digital fluency are more likely to view online learning positively suggesting that literacy not only facilitates technical access but also shapes perceptions and engagement with virtual learning platforms. Similar findings reported by Amal and colleagues (2024), reported that Saudi medical students with favorable perceptions of e-learning platforms demonstrated enhanced academic results (Amal A Alghamdi et al., 2024).

The cross-tabulation analysis provided further nuance by revealing that digital literacy levels stratified academic achievement outcomes. Students with low digital literacy were disproportionately represented in

the low-achieving category, while those with high digital literacy were predominantly high performers. This aligns with the previous researches reported that operational digital competencies significantly affected students' academic reasoning (Aldhaen, 2024; Zhao, Sánchez Gómez, Pinto Llorente, & Zhao, 2021). Similarly, research study conducted by Rehman and their colleagues demonstrated that digital skills reduced intrinsic and extraneous cognitive load, thereby improving academic performance (Rehman et al., 2024). These findings reinforce the argument that digital literacy is not merely a background skill, but a core academic competency in contemporary medical education.

The regression analysis yielded further insight into the combined predictive power of the independent variables. Digital literacy ($\beta = 0.41$, $p < .001$) was a stronger predictor than online learning attitudes ($\beta = 0.28$, $p < .001$), with the overall model explaining 47% of the variance in academic achievement. These results are comparable to previous findings reported that digital confidence and positive learning attitudes significantly contributed to effective goal setting, time management, and academic success (Galindo-Domínguez & Bezanilla, 2021; Martin et al., 2022). Notably, the model's R^2 value of 0.47 suggests that nearly half of the variability in academic outcomes among students can be explained by these two digital variables, highlighting their practical significance. Taken together, these results underscore the need for medical institutions to invest in structured digital literacy programs and attitudinal training toward online learning. While curriculum reforms have increasingly adopted digital content delivery, students' ability to meaningfully engage with these tools is often assumed rather than nurtured (Mhlongo, Mbatha, Ramatsetse, & Dlamini, 2023; Vettriselvan, 2025). The results from this study challenge that assumption, demonstrating that academic achievement depends not only on access to digital tools but also on students' proficiency and attitudes toward them. This study provides robust evidence that both digital literacy and online learning attitudes are essential predictors of academic achievement among medical students. Their combined influence offers a comprehensive model for improving academic outcomes in digital learning environments. Future curricular interventions and faculty development initiatives should therefore

prioritize these dimensions to foster equitable and effective medical education in an increasingly digital world.

CONCLUSION

This study provides compelling evidence that both digital literacy and online learning attitudes play significant roles in shaping the academic achievement of medical students. The findings revealed that higher levels of digital literacy are strongly associated with better academic performance, while positive attitudes toward online learning also contribute meaningfully to student success. Moreover, when combined, these two variables explain a substantial proportion of the variance in academic achievement, underscoring their joint predictive value. As medical education continues to adopt digital platforms and remote learning technologies, the development of students' digital competencies and the cultivation of constructive attitudes toward online learning environments should be prioritized. These results highlight a pressing need for medical institutions, particularly in resource-constrained settings, to implement targeted interventions that enhance digital skills and foster engagement with online pedagogies. Such efforts can support not only improved academic outcomes but also the preparation of future physicians for the digitally integrated demands of modern clinical practice.

LIMITATIONS AND RECOMMENDATION

Despite the valuable insights gained from this study, several limitations should be acknowledged. First, the use of a cross-sectional design restricts the ability to infer causality between digital literacy, online learning attitudes, and academic achievement. Longitudinal or experimental studies would be better suited to establish temporal relationships and causal effects. Second, the reliance on self-reported academic performance may introduce response bias or inaccuracies, as students may over- or under-report their achievements. Incorporating official academic records in future studies could enhance data reliability. Third, the sample was confined to a single institution Wah Medical College which may limit the generalizability of the findings to other medical colleges or regions with different technological infrastructures or educational environments.

Additionally, while the instruments used demonstrated good internal consistency, cultural factors may influence students' interpretations of the scale items, particularly regarding attitudes toward online learning. Future research should consider validating these instruments across diverse educational and cultural contexts to ensure broader applicability. Lastly, potential confounding variables such as prior academic performance, internet accessibility, and faculty engagement were not controlled in this study, which may have influenced the observed outcomes.

Based on these limitations, several recommendations can be proposed. First, medical institutions should invest in structured digital literacy training programs integrated into the curriculum to ensure students are equipped with the necessary skills to thrive in technology-enhanced learning environments. Second, efforts should be made to promote positive attitudes toward online learning through student orientation programs, mentorship, and feedback-driven improvements in digital pedagogy. Third, future research should explore the mediating or moderating roles of variables such as motivation, self-regulation, and technological access to gain a more nuanced understanding of the mechanisms through which digital literacy and learning attitudes impact academic outcomes. Finally, expanding the scope of research to multiple institutions and incorporating mixed-method approaches could offer richer, more generalizable insights into the evolving dynamics of digital education in medical training.

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