

## RESEARCH ARTICLE

# Unlocking Success: Measuring Higher Education Students' Performance Through E-Books and M-Learning

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## ABSTRACT

Digital integration in higher education (HE) has made significant progress in the first quarter of the twenty-first century, paving the way for more significant strides in the future. The present study investigated the role of E-books and M-learning on the academic performance of university students in Pakistan. We selected 430 university students from 10 universities in Punjab province using multi-method and multi-stage sampling techniques. The study's research design was a descriptive survey with cross-sectional data collection using a self-developed questionnaire. For the data analysis, we used Jamovi software (Version 2.4.11). The results revealed that E-books ( $B = 1.635$ ,  $SE = .10$ ,  $t = 15.1$ ,  $p < .001$ ) significantly contribute to students M-learning behaviour, which ( $B = 1.149$ ,  $SE = .092$ ,  $t = -1.59$ ,  $p < .001$ ) significantly contribute to university students' academic performance. It was also found that M-learning was a significant mediator for the relationship between E-books and academic performance at ( $B = .421$ ,  $SE = .03$ , 95 % CI [.365, .502],  $Z = 12.6$ ,  $p < .001$ ), predicting 57.5 % of the total mediation. Based on the study's results, we suggested that university students should effectively use E-books and M-learning to enhance their academic performance, leading to academic success.

**Keywords:** academic performance; digital tools; e-books; higher education; m-learning

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## 1. Introduction

The origin of E-books can be traced back to the early 1990s <sup>[1]</sup>. E-books in higher education (HE) have become progressively prominent owing to their manifold benefits. E-books enhance learning by increasing interactivity and engagement, enabling students to study at any location and time and utilizing portable devices such as smartphones or laptops <sup>[2-3]</sup>. E-books have many implications and benefits, such as people reading them offline and finding the text using the search option. Students can annotate and highlight

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the content of their interest and can integrate pictures, audio, and videos to improve their learning experiences <sup>[4]</sup>. It has also been found in the literature that students, particularly in HE, prefer E-books because they reduce their bag loads, which enables them to have good physical and psychological health. Moreover, these are cost-effective, and students can easily share them with their peers, teachers, and family, leading to financial savings <sup>[5]</sup>. Considering the broader implications of E-books, we found that it has transformed the future of HE and fulfilled students' learning experiences <sup>[6]</sup>.

In the tech-driven era, technology is revolutionising HE dynamics <sup>[7-8]</sup>. Emerging technologies like mobile learning (M-learning) have become popular among HE students in the last two decades. Students use M-learning functions to access material and required information at any time of the day without being present on university campuses <sup>[9]</sup>. Due to the ease of use and flexibility of M-learning, students are seen to use it to fulfill their academic needs <sup>[10]</sup>. It contributes to students' motivation and knowledge acquisition without delay, leading to improved performance in the classroom. Students use it individually and in group forms for more interactive learning, accessing information online and offline, and access to updated resources <sup>[11]</sup>. Literature supports that M-learning usage can reduce students' stress by finding study resources, libraries, and online learning platforms on a single click. Studies revealed that, besides its widespread benefits, it may have some limitations, such as students overly relying on these gadgets and getting addicted to phone usage, leading to poor mental health <sup>[12-13]</sup>. However, the literature supports that these issues can be sorted by introducing integrated and interactive pedagogies <sup>[14]</sup>.

E-books and M-learning are essential for technologically driven classrooms <sup>[15]</sup>. We believe that merging both technologies can facilitate students' learning platforms in HE. E-books have the advantage of reduced cost, ease of access, and key features such as search options, and students who combine these features with M-learning may have better, student-centered learning experiences <sup>[16]</sup>. E-books contribute to students' performance by facilitating them to reach updated information integrated with image and video features for better concept clearance. M-learning enables students to get study material flexibly without restricting them to time and location. The fusion of both technologies may help students in several ways, such as having easy access to material and sources, improving students' cooperation and participation, and individualised learning <sup>[17]</sup>.

Despite their broader use and advantages, very few studies have been conducted on their role in the context of Pakistani HE. We found minimal literature in local contexts, and we hope the present study will fill the literature gap by providing evidence of the effectiveness of such tools and technologies in developing countries like Pakistan. Baig and Jamil <sup>[18]</sup> studied the effectiveness of classroom technologies in a review study and found that they have mixed effects on students' learning. Amjad et al. <sup>[19]</sup> examined the effect of M-learning and related AI tools on HE students. As far as the researchers know, no study has been conducted to explore how the combination of E-books and M-learning influences students' academic performance in HE. Thus, we designed the present study with the following research question.

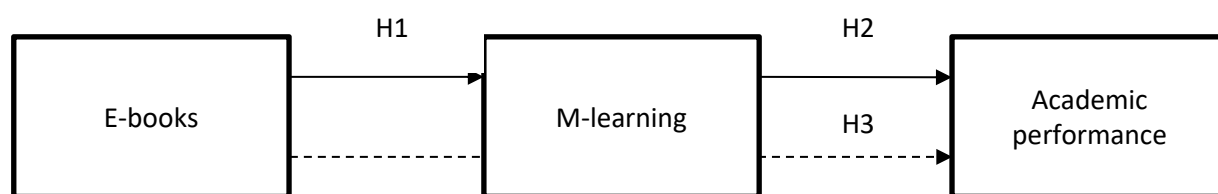
Can E-books and M-learning contribute to students' academic performance, and how does M-learning mediate the relationship between E-books and students' academic performance in Pakistani universities?

## **1.1 Theoretical background**

In the present study, students' performance in HE was measured by their involvement in preparing their assignments, quizzes, and presentations, as well as written and oral participation in course-related tasks and ultimately getting better grades in class. It is an empirical effort to explore how E-books and M-learning contribute to university students' academic performance in Pakistan, and it has roots in the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT is an extended form of various technology

acceptance models (TAM, TAM1, TAM2) and was presented by Venkatesh et al. [20] to thoroughly comprehend the factors that influence the acceptance and utilisation of technology

Using the UTAUT for E-books and M-learning in HE, we examined how these digital learning tools' perceived utility (performance expectancy) and ease of use (effort expectancy) influence students' willingness to engage with academic material. Considering the utility and implications of the UTAUT, we integrated its social impact, which narrates how students and teachers can follow it while using technologies and tools like E-books and M-learning. UTAUT focuses on access and technical assistance for using technological tools, which helped us understand E-books and M-learning's role in the tech-infused era. Furthermore, the implications of UTAUT in the current study's context will help teachers and students and how these tools influence HE students' performance. By applying UTAUT, we intended to provide a broader picture of how these tools enhanced students' performance in developing countries facing several challenges in purchasing and using technology in typically conservative cultures. Aligned with the principles of UTAUT, the current study's model is presented in **Figure 1**.



**Figure 1.** Research Model.

## 2. Literature review

### 2.1. E-books and M-learning

Technology has significantly impacted the education system in the past twenty years. The emergence of new technologies (such as E-books and M-learning) and their use in the teaching and learning process have gained academic attention. After COVID-19, technological tools have changed the course of traditional education in general and e-learning in particular. M-learning emerged after introducing innovative technological tools in e-learning [13]. M-learning, in literature, is described as part of e-learning, which empowers students to access data without the restriction of time and place [21]. In another study, E-books and M-learning are reported as the leading factors enhancing students' performance in an online classroom environment and a step ahead towards digital transformation [22]. This argument was further reinforced by the narrative of Viberg et al. [23], who mentioned that M-learning is strengthening the introduction of digital tools in formal and traditional education.

In a review study, Pedro et al. [16] presented M-learning as an influential tool for digital transformation and to impact students' learning habits in HE. Nielit and Thanuskodi [15] reported that M-learning impacts students' performance by focusing on their mobility in association with portable technologies. Literature also supports that students are becoming interested in using e-platforms due to their widespread utility in integrating them into modern pedagogies [24]. E-books and M-learning are changing study patterns and habits in HE regarding finding updated and relevant study material for formative and summative assessments [25]. Yan et al. [2] state that e-books with text-to-speech narrations improve students' understanding of reading difficulties, as seen by their ability to repeat the information orally. This is likely because the text-to-speech functionality in e-books supports readers and enables them to work within their levels of learning effectively. E-books retain the characteristics of conventional books, including the ability for readers to flip over pages, insert bookmarks, and make annotations. These arguments suggest using E-books and M-learning platforms

to improve students' performance in HE. Based on the above-mentioned literature review, we designed the following directional hypothesis.

H1: E-books contribute positively to the M-learning habits of students in higher education.

## **2.2. M-learning and academic performance**

Nuseir et al. [26] conducted a study to explore the impact of M-learning on students' performance. They collected data from students using a questionnaire and, after analysis, found that M-learning significantly contributes to their academic performance. García-Martínez et al. [27] conducted a study and found that M-learning and students' academic performance had a strong relationship. Aremu and Adeoluwa [28] conducted a study to examine students' learning attitudes and academic performance using M-learning. They collected data from college students and found that M-learning was associated with their academic performance. Thus, they suggested integrating M-learning into curricula. Ehsanpur and Razavi [21] conducted a study to compare M-learning-infused and traditional classrooms in an experimental study. After analysis, they found that M-learning contributes to students' interest and motivation to learn better than the conventional classroom.

Manzoor et al. [29] conducted a study in the Pakistani context to examine the effect of M-learning on business students' academic performance. The results indicated that M-learning is associated with students' performance, but there was no significant difference in performance for the case of gender. Lebedeva et al. [30] conducted a study to examine the effect of mobile apps usage on students' learning. They collected data from 320 students and found that mobile apps significantly contribute to their learning and cognitive motivation. Güler et al. [31] conducted a meta-analysis to see the effect of M-learning on students' mathematical achievements. Their results were based on 22 studies, and they concluded that M-learning has a medium positive impact on students' achievements in mathematics. These arguments present that academia has a conflicted opinion about using M-learning to improve students' performance. This provides one of the bases for our study to examine and get a clear picture of the effect of M-learning on HE students' academic performance. Based on the arguments presented above, we formulated the second directional hypothesis.

H2: M-learning contributes significantly to students' academic performance in higher education.

## **2.3. E-books, M-learning, and academic performance**

Although the topic is of significant attention, the causal relationships between E-books, M-learning, and academic performance in HE have been studied in isolation. E-books have transformed the conventional educational landscape by offering students digital materials to expand their learning options [32]. Wen et al. [33] investigated how E-books readers enhance learning opportunities for remote work-based learners, emphasising E-books' revolutionary educational potential. Concurrently, the incorporation of M-learning has transformed educational processes by providing students with access to learning resources via mobile devices. Wu et al. [34] conducted research into the impact of e-education on teaching and learning, highlighting the role of technology in determining academic performance.

The impact of M-learning on *HE* students' academic performance has been the focus of research in the past few years. Lebedeva et al. [30] found that M-learning improved student engagement and academic performance, emphasising the significance of mobile devices in promoting learning processes. Furthermore, a study conducted by Wijaya et al. [35] has highlighted the effectiveness of M-learning in education, demonstrating its ability to improve students' views and academic performance. The relationship between E-books, M-learning, and academic performance shows a dynamic educational landscape in which digital resources and mobile technologies play critical roles in molding students' learning experiences and performance.

Incorporating E-books and M-learning into HE contexts has positively enhanced student academic performance. Naveed et al. [9] reviewed the literature on M-learning in HE, resulting in ambiguous findings about the relationship between M-learning and academic performance. Despite this, Masa'deh et al. [36] found that using e-resources, such as E-books and mobile devices, can considerably improve students' academic success compared to traditional learning techniques. The changing educational landscape, driven by digital technology, emphasises investigating the interconnectedness of E-books, M-learning, and academic performance in HE settings to improve student learning experiences [19]. With the literature support provided above, we designed the following directional hypothesis.

H3: M-learning positively mediates the relationship between E-books and students' academic performance in higher education.

### **3. Methodology**

The study was designed to investigate the influence of E-books and m-learning on HE students' academic performance in Pakistan. We adopted the quantitative approach, followed by the positivist philosophy, to examine the phenomena under study. McFadden [37] argued that the large sample is easily handled with quantitative methods. As quantitative approaches allow the quantification of data and its presentation with numbers, they help to present the results in numerical form. The positivism philosophy focuses on objectivity, evidence-based research, and phenomenal explanation [38]. In this study, by combining the quantitative methodology and positivist philosophical approach, we investigated the contribution of M-learning and E-books on HE student's performance in Pakistan.

#### **3.1. Research design**

The study examined how M-learning and E-books can influence students' academic attainment in HE. To collect data, we used a cross-sectional design. With the help of this research design, a comprehensive picture of the students' perspectives at a given time offers a thorough understanding of the impact of digital learning tools on academic performance. The data were collected from a diverse sample of HE students. This design streamlined identifying potential relationships between E-books and M-learning and offered significant insights to guide pedagogical practices to maximize students' HE performance.

#### **3.2. Participants**

We designed the present study to investigate the effect of E-books and M-learning on HE students in Pakistan. The first author generated the idea and wrote the first draft. The second and third authors collected data and analysed it. The rest of the authors proofread it and contributed intellectually to the present study. The current study's participants were university students. The study's sample was selected from the ten public and private sector universities in Punjab. The selection criteria encompassed undergraduate and graduate students who have utilised E-books and M-learning avenues for at least one semester as part of their academics. A sample of 430 university students was selected using the multi-method and multi-stage sampling techniques. The demographic information of the participants is presented in **Table 1**.

#### **3.3. Measure**

The data were collected using a questionnaire. We reviewed the literature for a suitable scale to measure the current study variables and context. However, we found no appropriate tool fitting into the current study's context. Then, after an extensive literature review on E-books [1-5-32], M-learning [13-39-40], and student's academic performance [4,34,41-44], the researchers developed a questionnaire. It had two parts: the first was about the demographic information, and the second had three sub-scales developed on the five-point Likert scale with options 1 (strongly disagree) to 5 (strongly agree). After development, the

questionnaire was sent to three experts (PhDs) to provide expert opinions on the language, structure of the sentences, and items' relevance to the study's objective. The questionnaire was revised based on the experts' feedback; then, it was piloted to get participants' opinions about the questions' format, language, and familiarity with the terms used in the scale. The scale items were again modified on their responses. Initially, the questionnaire had 34 items, but after expert opinion and pilot testing, it was reduced to 30.

**Table 1.** Participants' Information (N = 430)

Variables	Categories	Frequency	Percentage (%)
Gender	Male	194	45
	Female	236	55
University	Public sector	191	44
	Private sector	239	56
Discipline	Natural sciences	244	57
	Social sciences	186	43

**Table 1** indicates that female participants (55 %) showed more interest than male respondents (45 %) to be part of the present study. Moreover, students from private universities were leading (56 %) in numbers to public sector universities (44 %). It also reveals that students from natural sciences (57 %) were more inclined to respond to the questionnaire than those from social sciences (43 %), which may happen due to their growing interest in natural sciences.

Students' responses to E-books were measured with items like, "The search functionality in E-books helps me save time when reviewing for exams or quizzes." "E-books facilitate my annotating and taking notes directly on the digital text.", and "I believe E-books offer a cost-effective solution for obtaining my academic material." Participants' responses on M-learning were measured with items like, "I engage more deeply with course content when I use mobile learning tools." and "I rely on M-learning apps to manage my study schedule and academic deadlines." Moreover, university students' academic performance was measured with items like, "Digital learning tools have enhanced the quality of my written assignments." "Incorporating E-books and M-learning into my studies has enhanced my critical thinking skills." and "My academic performance has significantly benefited from integrating E-books and M-learning into my study habits." The researchers also ensured the reliability of the questionnaire. Cronbach's alpha values for the sub-scales ranged between .70 to .84. The values of Cronbach's were higher than the desired value of .70 for the suitability of the questionnaire as per the defined criteria by Orçan [45]. Furthermore, we carried out exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to ensure the questionnaire's construct and convergent validity. The assumptions of Bartlett's Sphericity and KMO for sampling adequacy were adequate, and the questionnaire's model fit measures are presented in **Table 2**.

**Table 2.** Measure Fit Model.

RMSEA	RMSEA 90 % CI		TLI	BIC	Model Test		
	Lower	Upper			$\chi^2$	Df	p
.002	.740	.776	.930	980	4752	348	> .001

**Table 2** provides measure fit model statistics on CFA. The RMSEA value is .002, with a 90 % confidence interval ranging from .740 to .776. This value is below the conventional cutoff of .06, highlighting an adequate fit between the observed data and the hypothesised model. The TLI is .930, close to the recommended value of .95, signifying an appropriate model fit. The BIC is 980, another indicator of

good model fit, as lower values are generally preferred. The Chi-square test of model fit is insignificant ( $\chi^2 = 4752$ ,  $df = 348$ ,  $p > .001$ ), underscoring a good model fit.

### 3.4. Data collection

The data collection process was carried out using the Google Forms. Online platforms like WhatsApp groups, Facebook Messenger, and email were used to share the Google Forms link with the study's participants. The data collection process was completed in January and February 2024. After sharing the online links with participants, they were given the first reminder after a week and the second reminder after the second week. After collecting data, it was managed in the Excel sheet.

### 3.5. Data analysis

For data analysis, we used Jamovi software (Version 2.4.11). Descriptive and inferential statistics explored the trends and causal relationships among study variables. Pearson correlation, simple linear regression, and mediation analysis were conducted to test the hypotheses.

### 3.6. Research ethics

The data were collected using online sources, so no potential harm was involved in the current study. However, we ensured the following research ethics in the present study. The consent request was part of the questionnaire. Hence, the data were collected after obtaining the informed consent. The participants were ensured of their anonymity and confidentiality. Their personal information, like names, university names, and marital status, was not asked to hide their identity. They were also given the right to withdraw from the data collection process.

## 4. Results

After collecting the data, we tested the assumptions of parametric statistics. We found that the normality of data, equal variance, linearity, and independence of observation were appropriate for using parametric statistics. We deployed descriptive and inferential statics to analyse data in context to the current study. The correlation matrix for the study variables is presented in Table 3.

**Table 3.** Correlation Table (N = 430).

Variables	1	2	M	SD
E-books			3.78	.57
M-learning	.70**		3.79	.47
Academic performance		.92**	3.76	.52

\*\**. Correlation is significant at the .01 level (2-tailed)*

**Table 3** indicates the correlation among the study's variables. It shows that E-books and M-learning have a positive, strong, and statistically significant correlation ( $r = .70$ ,  $n = 430$ ,  $p < .01$ ). Besides this, M-learning and academic performance also have positive, linear, strong, and significant correlations ( $r = .92$ ,  $n = 430$ ,  $p < .01$ ).

#### 4.1. Contribution of E-books to M-learning

To explore the contribution of E-books to M-learning, we designed the first hypothesis and tested it using simple linear regression at the .001 level of Alpha. The results are presented in **Table 4**.

**Table 4.** Contribution of E-books to M-learning.

Predictor	Estimate	SE	t	P
Intercept	1.635	.10	15.1	<.001
E-books	.570	.03	20.1	<.001
R	.696			
R <sup>2</sup>	.485			
F(1,428)	403, p <.001			

Dependent Variable: M-learning

**Table 4** highlights that the relationship between E-books and M-learning is positive, linear, and significant ( $R = .696, p <.001$ ). The value of  $R^2$  (.485) advocates that approximately 48.5 % of the variance in M-learning is explained by E-books. It also shows the effect size of e-books and their contribution to M-learning, which is statistically significant, supporting the first hypothesis. It is also found that the model significantly predicts the M-learning at  $F(1,428) = 403, p <.001$ . The intercept has an estimate (Beta value) of 1.635, with  $SE = .10$ , at a  $t = 15.1, p <.001$ , indicating that the intercept significantly differs from zero. E-books have an estimate of .570, and it is the expected change in the M-learning for each one-unit change in E-books. It ( $SE = .03$ , at  $t = 20.1, p <.001$ , indicates that E-books usage is a significant predictor of M-learning.

#### 4.2. Contribution of M-learning to academic performance

To examine the effect of M-learning on university students' academic performance, we formulated the second hypothesis and deployed simple linear regression to test it. The results are presented in **Table 5**.

**Table 5.** Contribution of M-learning to Academic Performance.

Predictor	Estimate	SE	t	p
Intercept	-.129	.08	-1.59	.111
M-learning	1.027	.02	48.61	<.001
R	.92			
R <sup>2</sup>	.847			
F(1,428)	2363, p <.001			

Dependent Variable: Academic performance

**Table 5** provides the results of the simple linear regression analysis for H2. It shows an estimate ( $B = 1.149, SE = .092, t = -1.59, p <.001$ ), indicating that the intercept is not significantly different from zero. M-learning has an estimated value of 1.027, which is the expected change in academic performance for each one-unit change in M-learning. It has  $SE = .02$ , at a very high  $t = 48.6, p <.001$ , indicating M-learning is a highly significant predictor and contributor to academic performance. It also shows that the relationship between M-learning and university students' academic performance is positive, linear, and significant ( $R = .92, p <.001$ ). The value of  $R^2$  (.847) advocates that approximately 84.7 % of the variance in academic performance can be explained by M-learning. It is also found that the model significantly predicts academic performance at  $F(1,428) = 2363, p <.001$ .

#### 4.3. Measuring academic performance through E-books and M-Learning

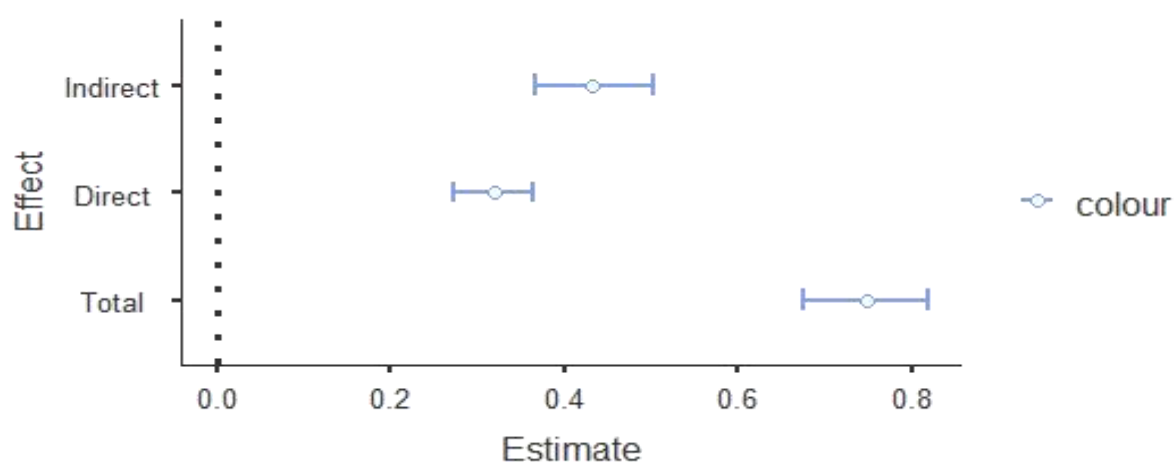


We developed the third hypothesis to explore the mediating effect of M-learning on the relationship between E-books and the academic performance of university students. After deploying the mediation analysis, the results are presented in **Table 6**.

**Table 6.** Academic Performance through E-Books and M-learning.

Effect	Estimate	SE	95 % Confidence Interval (CI)		Z	p	Mediation (%)
			Lower	Upper			
Indirect	.421	.03	.365	.502	12.6	< .001	57.5
Direct	.319	.02	.273	.363	14.6	< .001	42.5
Total	.749	.03	.675	.818	21.2	< .001	100.0

**Table 6** provides the results of the mediation analysis for the third hypothesis. It reveals that M-learning significantly mediates the relationship between E-books and the academic performance of university students. The indirect effect of E-books on academic performance through M-learning is ( $B = .421$ ,  $SE = .03$ , 95 % CI [.365, .502],  $Z = 12.6$ ,  $p < .001$ ), indicating 57.5 % of the total effect. The direct effect of E-books on academic performance is also significant ( $B = .319$ ,  $SE = .02$ , 95 % of CI [.273, .363],  $Z = 14.6$ ,  $p < .001$ ), and it accounts for 42.5 % of the total effect. The total effect of E-books on academic performance is ( $B = .749$ ,  $SE = .03$ , 95 % of CI [.675, .818],  $Z = 21.2$ ,  $p < .001$ ). The graphical interpretation of the mediating effect is given in Figure 2.



**Figure 2.** Estimate Plot.

## 5. Discussion

In the present study, we examined the impact of E-books on M-learning behaviour in HE contexts, revealing the importance of digital resources in improving students' academic performance. We also highlighted the crucial role of E-books in enabling M-learning based on UTAUT. It supports the theoretical expectations of performance expectancy, effort expectancy, social influence, and supporting conditions. The observed positive correlation between E-books and M-learning is consistent with previous studies conducted by Qashou [13] and Ehsanpur and Razavi [21], which emphasise M-learning's flexibility and ease of access. With this, Xodabande and Hashmi [22] study show a transformation process in education by integrating technologies for learning. Here, Viberg et al. [23] research also aligns with them as learning is transformed due to technological adaptation. It validated the significance of technology for learning tools like E-books and M-Learning, which changes the learning experiences for students and enhances the achievement level.

The results of our first hypothesis are aligned with the findings of Pedro et al. [16], Matzavela and Alepis [24], and Islamoglu et al. [46], which was a systemic review. Studies also included the same impact on M-learning utilisation in HE levels and its enhancement role in student achievement. This recognition allows teachers and students to incorporate technology like E-books to enhance learning purposefully. It emphasises how important it is to alter our educational approach to make learning more accessible, flexible, and personalised. This lends support to the theoretical frameworks put forth by UTAUT and seems like a viable strategy for upcoming academic projects involving technology-enhanced education.

The analysis of the second hypothesis reveals the significant contribution of M-learning on students' academic performance at the university level, supporting the notion that M-learning greatly improves academic results. This is consistent with the broader discussion on incorporating mobile technologies in educational environments, as emphasised by Aremu and Adeoluwa [28] and García-Martínez et al. [27]. Both studies highlight the transformative power of M-learning in enhancing learning experiences by making mobile devices adaptable and accessible. The findings strongly support the incorporation of M-learning as a fundamental element in educational initiatives, highlighting its efficiency in supplementing and greatly enhancing academic performance. M-learning's contribution and predictive value on academic performance highlight its effectiveness as an educational tool, providing persuasive evidence of its function in promoting higher academic performance.

The third hypothesis was designed to measure the mediating effect of M-learning on the relationship between E-books and university students' academic performance. The present study explored that M-learning significantly mediated the relationship between E-books and academic performance. It provided an in-depth understanding of the dynamics of digital learning at the university level. This mediational effect revealed an interesting channel by which E-books enhance students' performance, utilising M-learning's widespread and adaptable traits. The findings support the hypothesis that M-learning directly affects academic performance and is vital in connecting digital materials (E-books) availability with improving learning outcomes. This finding is consistent with the changing educational paradigms that emphasise the significance of combining digital resources such as E-books with mobile devices to enhance students' learning experiences. Prior studies conducted by Alsadoon [32] and Wen et al. [33] have emphasised the significant capacity of E-books to bring about significant changes in the field of education. Simultaneously, research conducted by Wu et al. [34] and Lebedeva et al. [30] has highlighted the critical significance of M-learning in improving academic performance. This supports the findings of our study, which showed a positive combined effect of E-books, M-learning, and students' educational outcomes.

The prominent role of M-learning highlights the mutual reliance of digital resources and mobile technologies in influencing educational outcomes. This emphasises the potential for maximizing the effectiveness of E-books through the deliberate implementation of M-learning to enhance student performance. The relationship between digital tools and educational approaches has been demonstrated in the studies conducted by Naveed et al. [9] and Masa'deh et al. [36]. These studies found that incorporating electronic resources in education improved academic performance. In addition, this study extends to the discussion on the crucial impact of digital technologies in education, as proposed by Amjad et al. [19], by presenting scientific evidence of the effectiveness of integrating E-books with M-learning methodologies. The present research contributes to the UTAUT by better understanding how M-learning affects the relationship between E-books and academic performance.

## **6. Conclusion**

The presented study aimed to investigate the influence of E-books and M-learning on university students' academic performance. The study's results indicate a strong and positive correlation between using E-books and adopting M-learning habits. This highlights the technologies' significant impact on students' academic outcomes. Utilising UTAUT, the results illustrate how perceived usefulness, simplicity of use, social influence, and facilitating conditions influence students' involvement with digital learning tools. In addition, the study revealed that M-learning plays a vital role in integrating E-books and academic performance, emphasising the relationship between digital resources and mobile technology in improving educational results. These findings enhance our comprehension of technology acceptance and utilisation in *HE* and provide practical insights for teachers and students aiming to optimise the integration of digital resources to improve students' learning experiences and outcomes. The study highlights the crucial significance of E-books and M-learning in promoting the academic performance of *HE* students. This emphasises the need to utilise digital technologies to improve educational results in today's learning environment.

## **7. Limitations and future direction**

Despite the significant results, our study had several limitations. For example, we collected data using a self-reported questionnaire, where the respondents could give biased responses. This limitation can be addressed by taking observation data in future studies. Another limitation was that we used cross-sectional design which presented the overall picture of the phenomenon at a certain point of time only. This limitation can be overcome by planning longitudinal studies to examine the long-term effect of E-Books and M-learning on university students' academic performance. The data were collected from the university students only. Thus, our results cannot be true for school or college-level students. However, this imitation can be managed by collecting data from diverse participants from school, college, and university students.

The present study's results have significant practical recommendations for students, teachers, policymakers, and future research in *HE*. Prioritising the integration of E-books and M-learning into curriculum materials is vital due to their substantial positive influence on students' academic outputs. Teachers and students must get sufficient training and assistance to incorporate these digital tools into their teaching-learning process. In addition, universities should ensure essential technological infrastructure and support services to assist students' utilisation of E-books and M-learning platforms. In addition, future studies should prioritise investigating the precise processes by which E-books and M-learning enhance academic performance, including potential factors that moderate or mediate these effects. Future researchers can conduct qualitative or mixed-methods studies to offer valuable insights into the enduring impact of digital learning tools on students' academic performance. Policymakers are suggested to consider providing policy implementation of digital technology in *HE* institutions and advocating for measures to reduce the inequality in access to digital resources among students. Incorporating E-books and M-learning into *HE* can ultimately enhance learning experiences and provide better academic results for students.

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