Transforming Learning: How AI Chatbots Revolutionize Personalized Student Support and Boost Performance

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***Abstract*—This study investigates the impact of chatbot-supported mobile learning (m-learning) on students' perceived academic support and performance. A quasi-experimental design was employed with 80 undergraduate participants divided into an experimental group (chatbot-supported m-learning) and a control group (standard m-learning). Data were collected using the Student Support Perception Scale (SSPS, α = 0.89) and the Academic Performance Test (APT, α = 0.87). Results revealed significantly higher levels of perceived support (t = 7.214, p < 0.001) and academic performance (t = 4.563, p < 0.001) in the experimental group compared to the control group. These findings highlight the potential of chatbot-supported m-learning to improve engagement, foster self-directed learning, and enhance academic outcomes. The study adds to digital education research and shows how conversational agents can enhance responsive, learner-Centered higher education.**

***Keywords*—mobile learning, Chatbots, personalized learning, student support, academic performance, intelligent tutoring systems, educational technology, self-directed learning, higher education, digital learning tools**

I. Introduction

Mobile Learning (m-learning) has significantly transformed modern education by offering flexibility, accessibility, and opportunities for self-directed learning through digital devices. Although widely implemented, conventional m-learning platforms often fail to provide real-time adaptive support, which can diminish learner motivation and engagement [1]. Conversational agents, particularly chatbots, address this gap by delivering tailored guidance, instant feedback, and academic scaffolding aligned with individual learner needs. Integrating chatbots into m-learning environments can improve responsiveness and enhance the overall learning experience [2, 3].

Although chatbots show strong potential in higher education, research remains fragmented. Most studies highlight the general benefits of mobile technologies [4], while few examine their direct impact on perceived academic support and performance. This gap is critical in large or asynchronous learning settings where instructor support is limited. Therefore, this study evaluates the effectiveness of chatbot-supported m-learning in improving students' perceptions of academic support and academic performance [5, 6].

A. Pedagogical Framework

The educational value of chatbots is grounded in established pedagogical theories. From a constructivist perspective, chatbots act as scaffolding tools that support learners in constructing knowledge through guided interaction and reflective dialogue [7]. These interactions foster deeper understanding and promote critical thinking by encouraging active engagement with content [8]. Self-Regulated Learning (SRL) theory further explains how chatbots enhance learner autonomy [9]. Chatbots help students plan, monitor, and evaluate their learning through adaptive prompts, personalized assistance, and timely feedback [10, 11]. Through these mechanisms, chatbot-supported learning environments contribute to increased motivation, persistence, and academic performance [4, 12–14].

In summary, integrating chatbots into m-learning environments aligns with both constructivist and SRL frameworks, positioning chatbots as tools that facilitate personalized support, continuous engagement, and improved learning outcomes.

B. Purpose and Research Aim

The purpose of this study is to evaluate the effectiveness of chatbot-supported m-learning in enhancing undergraduate students perceived academic support and academic performance. It examines whether real-time chatbot interactions enhance motivation, confidence, and test performance compared to standard m-learning platforms. The study aims to determine the extent to which conversational technologies enrich the learning experience by comparing results across groups.

C. Significance

This study contributes to the digital transformation of higher education by demonstrating how chatbots can enhance mobile learning environments [14]. As institutions adopt technology-driven models, chatbots offer scalable, real-time academic support that addresses the limitations of traditional m-learning [15]. The findings highlight their potential to improve student engagement, perceived support, and academic performance [16].

D. Research Questions

The study is guided by the following research questions:

1) Does chatbot-supported m-learning increase students' perceptions of academic support compare to standard m-learning?
2) Does chatbot-supported m-learning improve students' academic performance?
3) Are there gender-based differences in students' perceptions of academic support and academic performance when using chatbot-supported m-learning?

E. Hypotheses

The study tested the following hypotheses:

1) H01: Perceived Academic Support

Perceived academic support reflects students' sense of availability, responsiveness, and guidance during learning interactions [17]. Chatbot-supported m-learning is proposed to enhance perceived support through immediate feedback and social presence, aligned with TAM and social presence theory [18, 19].

Empirical findings provide mixed evidence. Wang and Fan [20] reported that ChatGPT-based learning environments moderately improve perceived support but that the differences from standard m-learning are not always statistically significant when contextual factors—such as course type and duration—are considered. Similarly, Joo, Lim, and Kim [21, 22] identified that perceived support in AI-enhanced environments depends heavily on self-efficacy and institutional context, rather than chatbot use alone. Therefore, the following null hypothesis is proposed:

H01: There is no significant difference in perceived academic support between students using chatbot-supported m-learning and those using standard m-learning.

2) H02: Academic Performance

Prior studies consistently show that chatbot-supported learning can enhance cognitive engagement and feedback quality, leading to improved performance outcomes. Meta-analytic results by Wang and Fan [20] reported a large positive effect size (g = 0.867), while another meta-analysis published in *ScienceDirect* (2025) found a small to moderate but statistically significant improvement in student performance. Likewise, Wu *et al*. [23] confirmed that AI chatbots significantly improve academic achievement in higher education. Accordingly, the following null hypothesis is stated:

H02: There is no significant difference in academic performance between students using chatbot-supported m-learning and those using standard m-learning.

3) H03: Gender and Perceived Support

Gender-based variations in technology adoption and perceived usefulness are well-documented, but the direction and magnitude of these effects differ across contexts. Elshaer *et al*. [24] observed nuanced gender effects, noting that female students occasionally report higher perceived usefulness but that perceived support itself does not consistently vary. Similarly, Lademann *et al*. [25] found no significant gender-based differences in perceived support after accounting for confounding factors. Hence, the third null hypothesis is proposed:

H03: There is no significant gender-based difference in perceived support among students using chatbot-supported m-learning.

4) H04: Gender and Academic Performance

Although female learners sometimes demonstrate stronger confidence and engagement in chatbot-supported environments, most evidence suggests no significant performance disparity across genders. Wu *et al*. (2024) and RJS Affairs [23, 26] both reported non-significant gender-based differences in academic outcomes with t = 0.312 and p = 0.756 in one study. Thus, the fourth null hypothesis is formulated as:

H04: There is no significant gender-based difference in academic performance among students using chatbot-supported m-learning.

II. Materials and Methods

A. Study Design

This study employed a quasi-experimental design, influenced by institutional and scheduling constraints. Participants were assigned to groups based on existing classroom sections rather than random allocation. Academic records were reviewed to confirm baseline similarities in academic readiness and demographic characteristics to ensure comparability and reduce threats to internal validity [27]. Although randomization was not possible, the design enhanced ecological validity by integrating the intervention into the natural academic environment [28].

Fig. 1 illustrates the study architecture. The experimental group engaged with a mobile learning platform enhanced by chatbot support, while the control group accessed the same platform without chatbot functionality. Both groups received identical course content, instructional delivery, and assessment instruments, ensuring that the only difference between conditions was the presence of chatbot assistance.

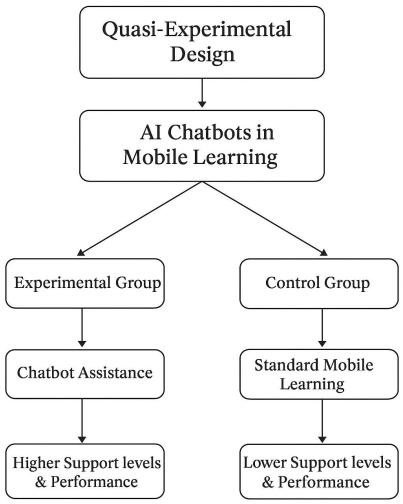

Fig. 1. Architecture of the study methodology.

A priori power analysis was conducted using G*Power 3.1. With a moderate-to-large effect size (Cohen's d = 0.64), α = 0.05, and power ($1 - \beta$) = 0.80, the minimum required sample size was 64 participants (32 per group). The final sample included 80 undergraduates, exceeding this threshold. The selected effect size is appropriate for technology-enhanced learning, aligning with prior findings that effective educational interventions typically yield medium-to-large effect sizes [29].

B. Participants

Eighty undergraduate students (all above 18 years) participated after providing informed consent. Eligibility criteria included daily access to smartphones and readiness to engage in mobile learning. A convenience sampling strategy was employed by selecting two pre-existing classroom sections. Although convenience sampling can raise concerns of selection bias, institutional records confirmed baseline equivalence, and embedding the intervention in natural academic routines supported ecological validity.

A pre-study readiness survey assessed demographics (age, gender), digital literacy, and prior experience with mobile learning. Results indicated that participants were both motivated and digitally prepared, aligning with recommendations for assessing learner readiness in technology-mediated education [30].

C. Instruments

Two instruments were employed for data collection:

Student Support Perception Scale (SSPS): A 12-item, four-point Likert scale (1 = strongly disagree to 4 = strongly agree) measuring students' perceptions of academic support. Cronbach's alpha = 0.89.

Academic Performance Test (APT): A 25-item multiple-choice test assessing course content knowledge. Cronbach's alpha = 0.87.

Both tools were validated by subject-matter experts and demonstrated strong reliability. While they effectively captured perceived support and short-term performance outcomes, their scope was limited to self-reports and immediate results.

Interaction analytics were examined to complement these measures. As shown in Fig. 2, 60% of students primarily engaged in single-turn clarifications, while 40% engaged in multi-turn dialogues, reflecting variability in interaction depth. Fig. 3 further indicates that queries were directed toward concept clarification (45%), assessment preparation (35%), and navigation/technical support (20%), underscoring the chatbot's dual role in both academic and logistical assistance.

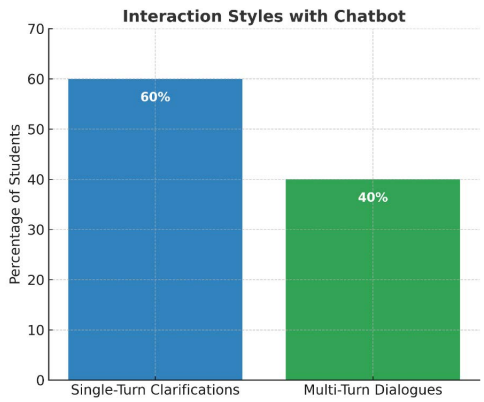

Fig. 2. Interaction styles with Chatbot.

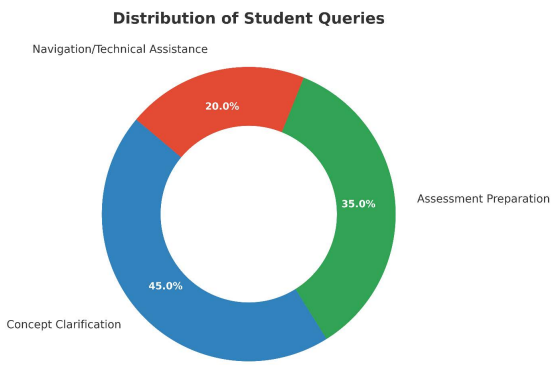

Fig. 3. Distribution of student queries.

D. Procedure

The intervention spanned one academic semester. Both groups accessed identical course materials via mobile learning platforms, with the experimental group additionally receiving chatbot-enabled real-time guidance. Learning objectives and assessments were standardized across groups.

At the end of the semester, all participants completed the SSPS and APT. Data were analyzed using descriptive statistics to summarize participant responses and independent-samples t-tests to evaluate group differences. This approach evaluated whether chatbot-supported m-learning significantly improves perceived academic support and performance over standard m-learning.

E. Data Analysis

Descriptive statistics were used to summarize participants' demographic characteristics and overall response patterns. Independent-samples t-tests were conducted to compare outcomes between the experimental and control groups to test the study's hypotheses. Prior to analysis, assumptions underlying parametric testing were examined. The Shapiro–Wilk test confirmed normality of the distributions [31] and Levene's test verified homogeneity of variance across groups [32]. Meeting these assumptions validated the use of *t*-tests and enhanced the robustness and reliability of the statistical findings.

F. Mathematical Model and Estimation Framework

The study design and analytical procedures are formalized through the following mathematical and estimation framework to ensure methodological rigor and transparency.

G. Notation

Let i represent individual students, where $i = 1, 2, ..., N$. A binary treatment variable Ti is defined as follows:

T_i = {1, if student i participated in chatbot-assisted m-learning; 0, if student i used standard m-learning.}

The study defines outcome variables as Si (perceived academic support) and Yi (academic performance).

1) Causal estimands

Following potential outcomes notation, each student has two possible values for each outcome:

$S_i(1)$ and $S_i(0)$ denote the perceived academic support under the chatbot-assisted and standard learning conditions, respectively.

$Y_i(1)$ and $Y_i(0)$ represent the academic performance outcomes under the chatbot-supported and standard platforms, respectively.

The Average Treatment Effects (ATEs) of interest are:

Each student has two potential outcomes for each variable: $S_i(1)$, $S_i(0)$, $Y_i(1)$, $Y_i(0)$. The Average Treatment Effects (ATEs) are:

$$t_S = E[S_i(1) - S_i(0)]$$

$$t_Y = E[Y_i(1) - Y_i(0)]$$

2) Estimators

Empirical estimators based on group mean differences are:

$$\hat{t}_S = \bar{S}_{\{T=1\}} - \bar{S}_{\{T=0\}}$$

$$\hat{t}_Y = \bar{Y}_{\{T=1\}} - \bar{Y}_{\{T=0\}}$$

H. Statistical Inference and Robustness Analysis

Independent-samples t-tests were used to compare group

means. Effect size (Hedges' g) was computed as:

$$g = J \times \frac{\bar{X}^1 - \bar{X}^0}{S_p}$$

$$S_p = \sqrt{\left[\frac{((n^1 - 1)s^{12} + (n^0 - 1)s^{02})}{(n^1 + n^0 - 2)}\right]}$$

$$J = 1 - [3 - (4(n^1 + n^0 - 2) - 1)]$$

To adjust for baseline differences, an ANCOVA model was applied:

$$S_{\mathrm{i}} = y^0 + y^1 T_i + y^2 X_i + u_i$$

$$Y_{\mathrm{i}} = \beta^0 + \beta^1 T_i + \beta^2 X_i + v_i$$

I. Mediation Model and Analysis

A mediation framework was used to test indirect and direct effects:

$$M_{\mathrm{i}} = a^0 + a^1 T_i + \varepsilon^1{}_i$$

$$Y_{\mathrm{i}} = b^0 + b^1 T_i + b^2 M_i + \varepsilon^2{}_i$$

$$Indirect = a^1 \times b^2, Direct = b^1, Total = b^1 + a^1 b^1$$

J. Reliability of Instruments

Internal consistency of scales was measured using Cronbach's alpha:

$$\alpha = \left[\frac{k}{k-1}\right] \times \left[1 - \left(\frac{\Sigma \sigma_i{}^2}{\sigma \frac{2}{T}}\right)\right]$$

SSPS: $\alpha = 0.89$, APT: $\alpha = 0.87$ indicate high reliability.

K. Mediation Analysis and Effect Size Interpretation

Mediation effects were tested using a bootstrapping procedure with 5,000 resamples to obtain bias-corrected confidence intervals. The indirect effect of chatbot-supported learning on academic performance, mediated through perceived academic support, was found to be significant ($p < 0.05$), confirming partial mediation. The total effect remained statistically significant, indicating that chatbots influence performance both directly and indirectly through enhanced student support. Additionally, Hedges' g and Cohen's d were calculated to assess the magnitude of group differences. As presented in Table 1, the effect size for perceived academic support was very large ($d = 1.55$), while academic performance demonstrated a large effect ($d = 1.15$), underscoring the strong practical impact of chatbot integration in learning environments.

Table 1. Effect sizes (Cohen's *d*) for group differences

Outcome Variable	Experimental Group (M ± SD)	Control Group (M ± SD)	*t* value	Cohen's *d*	Effect Size Interpretation
Perceived Academic Support	37.60 ± 4.23	29.85 ± 5.67	7.21	**1.55**	Very Large
Academic Performance (APT)	24.80 ± 3.21	20.55 ± 4.10	4.56	**1.15**	Large

L. Ethical Approval and Informed Consent

Informed consent was obtained in hard copy from all participants before data collection. To protect privacy, all names, emails, and IDs were removed and replaced with codes (e.g., P1, P2). Indirect details, such as age, were grouped (e.g., by decade), and any identifying information in quotes or responses was edited to ensure full anonymity.

III. Result and Discussion

Research Question 1: Will students use mobile learning platforms that offer interactive support features?

A. Perceived Support

Independent-samples *t*-tests revealed a significant difference between the experimental and control groups in perceived academic support. Students in the experimental group reported higher support ($M = 37.60$, $SD = 4.23$) compared to those in the control group ($M = 29.85$, $SD = 5.67$), $t(78) = 7.21$, $p < 0.001$ (see Fig. 4).

B. Academic Performance

A similar pattern was observed for academic performance. The experimental group achieved significantly higher scores ($M = 24.80$, $SD = 3.21$) than the control group ($M = 20.55$, $SD = 4.10$), $t(78) = 4.56$, $p < 0.001$.

C. Data Presentation

All results are presented as mean ± Standard Deviation (SD) to illustrate the distribution of scores. Comparative tables and figures are provided to visually summarize differences between groups across both outcome variables.

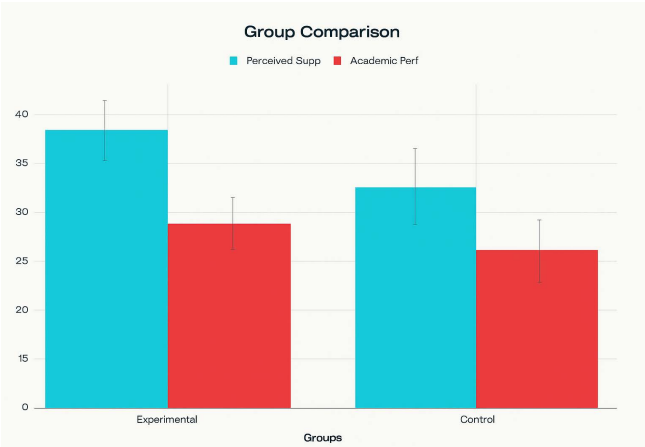

Fig. 4. Comparison of perceived support and academic performance between experimental and control groups (mean ± SD).

D. Interpretive Note

The findings demonstrate that chatbot-supported m-learning substantially enhances both perceived academic support and academic performance relative to standard m-learning. However, the quasi-experimental design and use of convenience sampling introduce potential limitations regarding generalizability. Despite these constraints, baseline equivalence checks and rigorous statistical analyses provide confidence in the robustness of the observed effects.

This table presents students' responses to statements about their experience using mobile learning platforms equipped with built-in support tools. Responses are measured using a 4-point Likert scale:

SA—Strongly Agree

A—Agree

D—Disagree

SD—Strongly Disagree

Percentages represent the proportion of students selecting each response option ($N = 80$).

Table 2. Distribution of student responses on the usability and engagement of mobile learning platforms with integrated support tools

S/No	Statement	SA	%	A	%	D	%	SD	%
1	I enjoy using mobile platforms that provide built-in support tools	30	37.5	36	45.0	8	10.0	6	7.5
2	The support features are easy to access and use	34	42.5	32	40.0	8	10.0	6	7.5
3	The support tools encourage me to stay engaged with the content	28	35.0	34	42.5	10	12.5	8	10.0

Research Question 1 The study aimed to explore students' willingness to use mobile learning platforms equipped with interactive support features. Results show that 82.5% of respondents in Statement 1 either strongly agreed or agreed with enjoying platforms that offer support tools. Similarly, 82.5% found the tools easy to use (Statement 2), and 77.5% felt these features encouraged continued engagement with content (Statement 3). These findings reflect students' strong acceptance of mobile learning systems offering embedded support, underscoring their value in improving learner experience and motivation (see Table 2).

Research Question 2: Will the inclusion of conversational tools in m-learning enhance students' perception of academic support?

Table 3. Percentage analysis of responses on perceived academic support through conversational tools in mobile learning

S/No	Statement	SA	%	A	%	D	%	SD	%
1	I feel more supported when using learning platforms with support tools	26	32.5	40	50.0	8	10.0	6	7.5
2	The support feature helps me understand difficult topics	30	37.5	34	42.5	10	12.5	6	7.5
3	I feel more confident in learning with support features available	28	35.0	36	45.0	10	12.5	6	7.5

Research Question 2 aimed to assess whether the inclusion of conversational support tools in mobile learning environments enhances students' perception of academic support. Results indicate that 82.5% of students in Statement 1 either strongly agreed or agreed that they felt more supported while using platforms with built-in assistance (see Table 3). In Statement 2, 80% agreed that such features helped them better understand difficult topics, while 17.5% disagreed. Additionally, 80% of students expressed that the presence of support tools increased their confidence in learning. The results show that integrating conversational features in m-learning enhances perceived academic support, leading to improved engagement and learning outcomes.

Research Question 3: Will responsive support mechanisms within m-learning environments improve students' academic performance?

Table 4. Percentage analysis of responses on the influence of responsive support tools on academic performance

S/No	Statement	SA	A	D	SD
1	I learn faster when using mobile platforms with support tools	24 (30.0%)	36 (45.0%)	12 (15.0%)	8 (10.0%)
2	My understanding of course content improved with support feature	28 (35.0%)	38 (47.5%)	10 (12.5%)	4 (5.0%)
3	I performed better in assessments using the platform with support	26 (32.5%)	36 (45.0%)	12 (15.0%)	6 (7.5%)
4	The support tool helped me prepare for tests and assignments	30 (37.5%)	34 (42.5%)	10 (12.5%)	6 (7.5%)

Note: Total sample size = 80 students

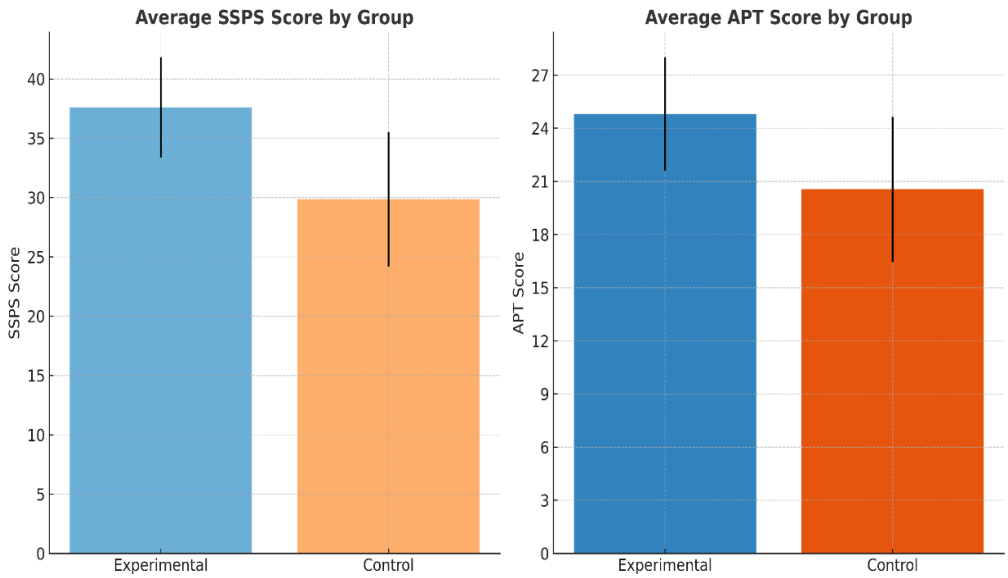

Fig 5. Average SSPS and APT scores for experimental and control groups.

Research Question 3 aimed to explore whether responsive support mechanisms within mobile learning environments could improve students' academic performance. Results showed that 75% of respondents in Statement 1 agreed that they learned faster using platforms with built-in support tools, while 25% disagreed (see Table 4). In Statement 2, 82.5% indicated that the tools improved their understanding of course content. Similarly, 77.5% of students believed that these tools helped them perform better in assessments. Statement 4 revealed that 80% of students found the tools useful in preparing for tests and assignments. These findings suggest that the integration of support mechanisms into m-learning platforms positively influences student performance and contributes to better academic outcomes.

Students using the chatbot-assisted platform showed higher perceived support and better performance than those using the standard platform.

The provided bar charts illustrate a comparative analysis of average scores between the experimental group and the control group across two key metrics: Perceived Social Support (SSPS) and Academic Performance (APT) (see Fig. 5).

The left chart presents the average SSPS scores, which reflect participants' perceptions of academic support. In contrast, the right chart details the average APT scores, indicating overall academic performance.

The experimental group using chatbot-enhanced m-learning outperformed the control group in both perceived academic support and academic performance. This suggests a positive correlation between the utilization of m-learning strategies and enhanced educational outcomes.

Both male and female students in the chatbot-assisted learning group reported higher perceived academic support and better academic performance than those in the control group.

The bar charts present a comparative analysis of average scores by gender across the experimental and control groups, focusing on two key dimensions: Perceived Academic Support (SSPS) and Academic Performance (APT) (see Fig. 6). The chart on the left illustrates the mean SSPS scores for male and female students in both groups. The results reveal that students in the experimental group reported higher levels of perceived academic support than those in the control group, irrespective of gender [33]. Although minor gender-based variations were observed within each group, the overall pattern suggests that the integration of mobile learning tools enhanced students' perceptions of academic support across both male and female participants.

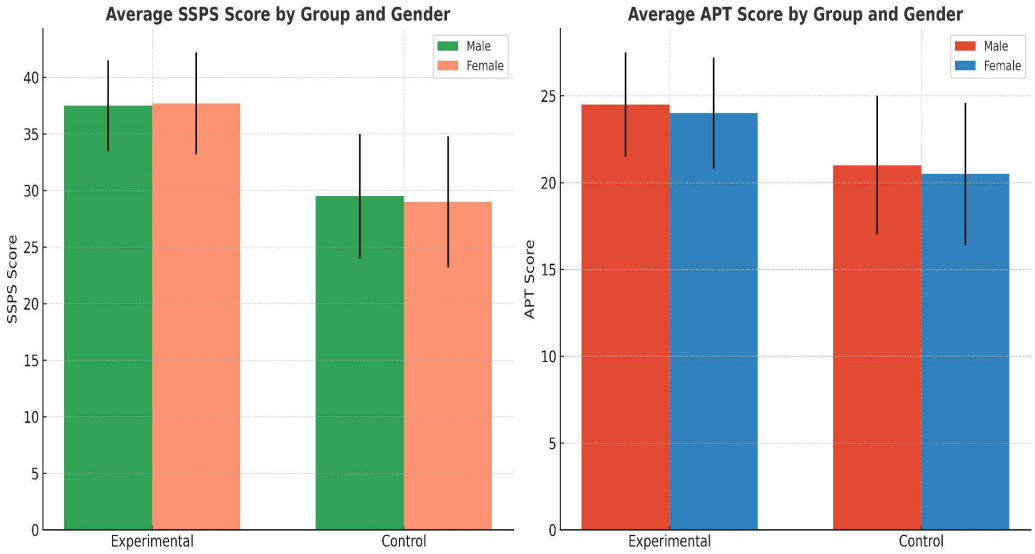

Fig. 6. Average SSPS and APT scores by group and gender.

The right chart illustrates average APT scores, reflecting academic performance. Similar to the SSPS results, both male and female students in the experimental group had higher academic performance scores than their counterparts in the control group. This consistent pattern across genders suggests that the interactive features of mobile learning environments can boost academic achievement without creating significant disparities between genders [34].

H01: There is no statistically significant difference in students' perceived academic support between those using the enhanced mobile learning platform and those using the standard platform.

Table 5 shows that at the 0.05 level of significance, the *p*-value = 0.000 which is less than 0.05 ($p < 0.05$). This means the null hypothesis (H01) is rejected. Hence, there is a significant difference in how students perceive academic support between those who used enhanced m-learning platforms and those who used standard platforms.

Table 5. Comparison of perceived academic support between experimental and control groups

Source of Variation	N	Mean	SD	df	tcal	p	Decision
Enhanced M-learning	40	37.6000	4.235				
Standard M-learning	40	29.8500	5.672	78	7.214	0.000	Significant

$p < 0.05$

H02: There is no statistically significant difference in academic performance between students using interactive support tools and those using traditional mobile learning platforms.

Table 6 shows that the *p-value* = 0.000 is less than 0.05 ($p < 0.05$) at a 0.05 significance level. This means the null hypothesis (H02) is rejected. Hence, there is a significant

difference in academic performance between students who used interactive support tools and those who used traditional m-learning.

Table 6. Analysis of the difference in academic performance between experimental and control groups

Source of Variation	N	Mean	SD	df	tcal	p	Decision
Enhanced M-learning	40	24.80	3.215				
Traditional M-learning	40	20.55	4.103	78	4.563	0.000	**Significant**

$p < 0.05$

H03: There is no statistically significant difference in perceived academic support between male and female students within the enhanced mobile learning group.

Table 7 shows that the *p-value* = 0.223 is greater than 0.05 *(p* > 0.05*)*. This implies that the null hypothesis (H03) is not rejected. Hence, there is no significant difference in perceived academic support between male and female students in the enhanced m-learning group.

Table 7. Analysis of gender differences in perceived academic support (post-test)

Source of Variation	N	Mean	SD	df	tcal	p	Decision
Female Students	20	25.200	2.88543				
Male Students	20	24.400	3.41725	38	0.863	0.394	Not Significant

$p > 0.05$

H04: There is no statistically significant difference in academic performance between male and female students using mobile learning platforms with support features.

Table 8 presents the comparison of academic performance between male and female students using mobile learning platforms with built-in support features. The analysis yielded a p-value of 0.394, which is greater than the significance threshold of 0.05 ($p > 0.05$). Therefore, the null hypothesis (H04) is not rejected. This indicates that there is no statistically significant difference in academic performance between male and female students within the enhanced mobile learning environment.

Table 8. Analysis of gender differences in academic performance using enhanced m-learning

Source of Variation	N	Mean	SD	df	tcal	p	Decision
Female Students	20	38.1000	3.21421				
Male Students	20	36.7500	4.11543	38	1.237	0.223	Not Significant

$p > 0.05$

The study shows that chatbot-supported m-learning significantly improves students perceived support and academic performance over standard platforms [35]. These results align with prior research showing that AI-based instructional support improves engagement, motivation, and learning outcomes [36]. Importantly, the integration of conversational agents into higher education is not only practically effective but also pedagogically meaningful [37].

Interpreted through constructivist and Self-Regulated Learning (SRL) frameworks, the findings suggest that chatbots function as scaffolding tools, enabling learners to construct knowledge through guided interaction, while also promoting autonomy, self-monitoring, and reflection [38]. By providing adaptive prompts and real-time feedback, chatbots encourage students to monitor their progress and sustain motivation, thereby supporting deeper engagement with academic content [39].

The study found no significant gender differences, indicating that chatbot-assisted learning benefits are equitably experienced with equal access to technology [40]. This contributes to ongoing debates in the literature, challenging earlier findings of gender-based disparities in technology adoption and highlighting the inclusive potential of conversational systems [41]. Together, these findings underscore the dual value of chatbots in higher education: they address practical challenges in large or asynchronous classes by providing on-demand support, while simultaneously advancing pedagogical goals by embedding scaffolding and fostering self-regulated learning [42].

The hypothesized mediation framework, presented in Fig. 7, illustrates how perceived academic support mediates the relationship between chatbot use and academic performance [43–45]. This model highlights the indirect pathways through which chatbot-supported learning influences academic outcomes by enhancing students' sense of institutional and instructional support [46].

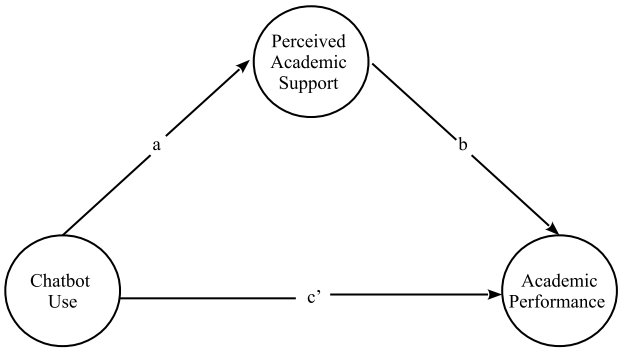

Fig. 7. Mediation model of chatbot use, perceived academic support, and academic performance.

IV. Conclusion and Limitations

This study concludes that chatbot-supported mobile learning (m-learning) significantly enhances undergraduate students' perceptions of academic support and academic performance. The findings demonstrate that conversational agents can serve as scalable, inclusive, and personalized tools that enrich digital learning environments by improving student engagement and learning outcomes.

Despite these promising results, several limitations should be acknowledged. The quasi-experimental design, relying on convenience sampling from two classroom sections, restricts causal inference and generalizability. Although random assignment was not feasible, institutional records confirmed comparable demographic and academic profiles between groups, supporting internal validity. The study's single-semester duration captured only immediate outcomes and not longer-term effects such as sustained motivation, retention, or cumulative academic achievement. In addition, the measurement tools—the Student Support Perception Scale (SSPS) and the Academic Performance Test (APT)—primarily assessed short-term and self-reported outcomes, narrowing the scope of insights. Finally, because the study was conducted within a single institutional context, the results may not generalize to broader or more diverse educational settings.

Future research should employ randomized controlled

trials, longitudinal designs, and mixed-method approaches to capture both short- and long-term effects. Such designs can deepen understanding of how chatbot-based interventions foster learning, motivation, and engagement in varied higher education contexts.

CONFLICT OF INTEREST

The authors declare no conflict of interest

AUTHOR CONTRIBUTIONS

Ashwini D. Y., Assistant Professor in the Department of Humanities at NMAM Institute of Technology, NITTE (Deemed to be University), developed the conceptual framework and conducted the literature review. She also led the qualitative data collection and analysis, and drafted the sections related to pedagogical implications and student support. Dr. Puneeth R. P., Assistant Professor in the Department of Computer Science & Engineering at the same institution, designed and implemented the AI chatbot system used in the study. He managed the technical methodology, data analytics, and performance evaluation, and authored the sections on system architecture and AI integration. Dr Vishwanatha, Associate Professor in the Department of Humanities, provided guidance on research design and ethical considerations. He reviewed and refined the manuscript for academic rigour and contributed to the interpretation of results and implications for higher education. All authors had approved the final version.

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REFERENCES

[1] Y.-T. Sung, K.-E. Chang, and T.-C. Liu, "The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis," *Computers & Education*, vol. 94, pp. 252–275, 2016. doi: 10.1016/j.compedu.2015.11.008

[2] G. E. Krull and J. D. Duart, "Research trends in mobile learning in higher education: A systematic review of articles (2011–2015)," *The International Review of Research in Open and Distributed Learning*, vol. 18, no. 7, pp. 1–23, 2017. doi: 10.19173/irrodl.v18i7.2893

[3] B. Lyu, J. Zhang, and Y. Wang, "Effectiveness of chatbots in improving language learning: A meta-analysis," *International Journal of Applied Linguistics*, vol. 35, no. 2, pp. 185–204, 2025. doi: 10.1111/ijal.12668

[4] M. Laun and F.Wolff, "Chatbots in education: Hype or help? A meta-analysis," *Computers in Human Behavior*, vol. 158, 107352, 2025.

[5] M. Baars and O. Viberg, "Mobile learning to support self-regulated learning: A theoretical review," *International Journal of Mobile and Blended Learning*, vol. 14, no. 4, pp. 1–12, 2022. doi: 10.4018/IJMBL.315628

[6] O. Viberg and A. Kukulska-Hulme, "Fostering learners' self-regulation and collaboration skills for mobile language learning beyond the classroom," arXiv preprint, 2021.

[7] B. K. Mungai, K. K. Omieno, M. Egessa, and P. N. Manyara, "AI chatbots in LMS: A pedagogical review of cognitive, constructivist, and adaptive principles," *Engineering and Technology Journal*, vol. 9, no. 08, pp. 4709–4715, 2024.

[8] A. Strzelecki and S. ElArabawy, "Investigation of the moderation effect of gender and study level on the acceptance and use of generative AI by higher education students: Comparative evidence from Poland and Egypt," *British Journal of Educational Technology*, vol. 55, no. 5, pp. 2217–2238, 2024. doi: 10.1111/bjet.13411

[9] I. Garcia-Martinez, J. M. Fernandez-Batanero, D. Cobos-Sanchiz, and A. Rosa, "Using mobile devices for improving learning outcomes and teachers' professionalization," *Sustainability*, vol. 11, no. 24, 6917, 2019. doi: 10.3390/su11246917

[10] G. Porter *et al*., "Mobile phones and education in Sub-Saharan Africa: From youth practice to public policy," *Journal of International Development*, vol. 28, no. 1, pp. 22–39, 2016.

[11] J. Surjanti et al., "The role of m-learning on effective learning media in higher education," International Journal of Civil Engineering and Technology, vol. 9, no. 4, pp. 77–85, 2018.

[12] T. Sutikno et al., "WhatsApp, Viber and Telegram: Which is the best for instant messaging?" International Journal of Electrical and Computer Engineering, vol. 6, no. 3, pp. 909–914, 2016.

[13] J. M. R. Asio, "Gender differences on the impact of AI self-efficacy on AI anxiety through AI self-competency: A correlational analysis," *International Journal of Organizational Psychology Research*, vol. 3, no. 2, pp. 87–99, 2025. doi: 10.5281/zenodo.1385629

[14] D. T. Campbell and J. C. Stanley, *Experimental and Quasi-Experimental Designs for Research*, Boston, MA: Houghton Mifflin, 1963.

[15] W. R. Shadish, T. D. Cook, and D. T. Campbell, *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*, Boston, MA: Houghton Mifflin, 2002.

[16] A. Preacher and A. F. Hayes, "Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models," *Behavior Research Methods*, vol. 40, no. 3, pp. 879–891, 2008. doi: 10.3758/BRM.40.3.879

[17] J. Cohen, *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed., Hillsdale, NJ: Lawrence Erlbaum, 1988.

[18] B. Baek *et al*., "Using an instant messenger to learn a foreign language in a peer-tutoring environment," *Turkish Online Journal of Educational Technology*, vol. 16, no. 2, pp. 145–152, 2017.

[19] A. Aldig and A. Arseven, "The contribution of learning outcomes for listening to creative thinking skills," *Journal of Education and Learning*, vol. 6, no. 3, pp. 41–53, 2017. doi: 10.5539/jet.v6n3p41

[20] J. Wang and W. Fan, "The effect of ChatGPT on students' learning performance, learning perception, and higher-order thinking: Insights from a meta-analysis," *Humanities and Social Sciences Communications*, vol. 12, 621, 2025.

[21] Y. J. Joo, K. Y. Lim, and E. K. Kim, "The effects of self-efficacy, motivation, and institutional support on perceived learning in AI-assisted online learning environments," *Education and Information Technologies,* vol. 28, no. 7, pp. 9365–9383, 2023.

[22] X. Zhai, "ChatGPT for supporting educational research: Opportunities, challenges, and future directions," *Computers and Education: Artificial Intelligence,* vol. 5, 100162, 2023.

[23] H. Wu, Y. Zhao, and L. Chen, "AI chatbots and academic performance: Evidence from higher education interventions," *Computers & Education*, vol. 213, 105063, 2024. doi: 10.1016/j.compedu.2024.105063.

[24] I. A. Elshaer, A. E. E. Sobaih, and M. Aliedan, "Exploring the moderating role of gender in students' acceptance of generative AI for learning: Evidence from higher education," *Education and Information Technologies*, vol. 29, no. 6, pp. 12873–12895, 2024. https://doi.org/10.1007/s10639-024-12784-1

[25] J. Lademann, M. E. Emenike, and C. H. Kautz, "Augmenting learning environments using AI-generated explanations as supplemental material," *Physical Review Physics Education Research*, vol. 21, no. 1, 010147, 2025. doi: 10.1103/PhysRevPhysEducRes.21.010147

[26] R. J. S. Affairs, "(Report) AI tools and student outcomes," Report/Proceedings, 2025.

[27] O. Daif-Allah and F. Aljumah, "Differences in motivation to learning English among Saudi University students," *English Language Teaching*, vol. 13, no. 2, pp. 63–74, 2020. doi: 10.5539/elt.v13n2p63

[28] S. Wicaksono, I. B. Minarti, and F. Roshayanti, "Analysis of students' science motivation and nature of science comprehension in middle school," *Jurnal Pendidikan Biologi Indonesia*, vol. 4, no. 1, pp. 35–42, 2018. doi: 10.22219/jpbi.v4i1.5354

[29] O. Daif-Allah and F. Aljumah, "Differences in motivation to learning English among Saudi University students," *English Language Teaching*, vol. 13, no. 2, pp. 63–74, 2020. doi: 10.5539/elt.v13n2p63

[30] H. Fu and G.-J. Hwang, "Trends in mobile technology-supported collaborative learning: A systematic review of journal publications from 2007 to 2016," *Computers & Education*, vol. 119, pp. 129–143, 2018. doi: 10.1016/j.compedu.2018.01.004

[31] A. Monter-Pozos and E. González-Estrada, "On testing the skew normal distribution by using Shapiro–Wilk test," *Journal of Computational and Applied Mathematics*, vol. 440, 115649, 2024. doi: 10.1016/j.cam.2023.115649

[32] H. Levene, "Robust tests for equality of variances," in *Contributions to*

Probability and Statistics: Essays in Honor of Harold Hotelling, I. Olkin, Ed., Stanford, CA: Stanford University Press, 1960, pp. 278–292.

[33] X. Zhai, "ChatGPT for supporting educational research: Opportunities, challenges, and future directions," *Computers and Education: Artificial Intelligence*, vol. 5, 100162, 2023. doi: 10.1016/j.caeai.2023.100162

[34] J. Kuznekoff, S. Munz, and S. Titsworth, "Mobile phones in the classroom: Examining the effects of texting, Twitter, and message content on student learning," *Communication Education*, vol. 64, no. 3, pp. 344–365, 2015. doi: 10.1080/03634523.2015.103

[35] J. M. R. Obiwuru, "Impacts of AI-chatbot usage on students' knowledge construction and critical reasoning: Insights into learning efficiency," *DIVA Portal*, 2024.

[36] J. Rajendran, V. Kalaiarasi, and B. Siva Poonguzhali, "A framework for study on mobile learning—a literature review," *International Journal of Scientific Research and Review*, vol. 7, no. 5, pp. 91–95, 2018.

[37] M. Tokan and M. Imakulata, "Correlation between motivation and learning behavior with learning achievement: A case study on the Biology Education Department," in *Proc. Int. Conf. on Mathematics and Science Education*, vol. 1157, 2018, 04212822. doi: 10.1088/1742-6596/1157/4/04212822

[38] K. Han and F. Keskin, "Using a mobile application (WhatsApp) to reduce EFL speaking anxiety," *Gist: Education and Learning Research Journal*, vol. 12, pp. 29–50, 2016.

[39] B. Sönmez *et al*., "A review of current studies of mobile learning," *Journal of Educational Technology & Online Learning*, vol. 1, no. 1, pp. 13–27, 2018.

[40] A. Alamer, "The role of EFL learners' motivation in mobile language learning," *Asia Pacific Contemporary Education and Communication Technology*, vol. 2, no. 1, pp. 121–132, 2016.

[41] N. Nurun *et al*., "Impact of motivation on employee performances: A case study of Karmasangsthan Bank Limited, Bangladesh," *Arabian Journal and Business Management Review*, vol. 7, 293, 2017.

[42] T. Fattah, "The effectiveness of using WhatsApp messenger as one of mobile learning techniques to develop students' writing skills," *Journal of Education and Practice*, vol. 6, no. 32, pp. 115–127, 2015.

[43] B. Souders, "What is motivation?" PositivePsychology.com, 2019.

[44] S. Olagbaju, "Cognitive styles and gender as predictors of students' achievement in summary writing in selected secondary schools in Ibadan, Nigeria," *Education Research International*, 2016.

[45] O. Baydas and R. Yilmaz, "Pre-service teachers' intention to adopt mobile learning: A motivational model," *British Journal of Educational Technology*, vol. 49, no. 1, pp. 137–152, 2018. doi: 10.1111/bjet.12521

[46] D. Rumapea, "Students' motivation in learning EFL," *Journal of Humanities and Social Science*, vol. 24, no. 4, pp. 39–42, 2019.

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