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Effectiveness of Artificial Intelligence on Critical Thinking and Self-Efficacy among Nursing Students

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ABSTRACT:

Background: In this era of digital revolution, information technology in health education is now readily available everywhere. The information and communication technology is common in schools today. Majority of teachers employ digital technology to improve the integration of AI tools like Chat-GPT into teaching strategies to bring a significant difference in the learning of digital technology. The objective of this study is to determine the effect of AI tools on the critical thinking and self-efficacy of nursing students.

Methodology: A Quasi experimental study design was carried out at a private institute of nursing Lahore. A sample of n=100 Nursing students was recruited through purposive sampling technique. Critical thinking scale and Self-efficacy scales questionnaires were used to collect data. At pre intervention, data was collected and then the intervention as Artificial Intelligence educational sessions were provided to the interventional groups for 16 weeks. Soon after the intervention, data was collected using the same data collection tools. The data was entered and analyzed through SPSS version 29 considering P. value< 0.05 as significant.

Results: Finding of this study revealed a noticeable improvement in critical thinking where the mean critical thinking score was improved 56.40+ 4.870 before the intervention to 96.90+ 15.009 after the intervention (P value <0.001). Furthermore, the self-efficacy mean score improved from 10.28+ 2.041 to 20.58+ 3.908 after the artificial intelligence based intervention (P value <0.001). Furthermore the independent t test revealed that at the post-intervention phase the intervention group had significantly high mean scores. It was found that mean critical thinking score for control group was (59±4.219) and intervention group (96.90±15.009) and similarly the self-efficacy the control group (10.28±2.548) and intervention group was (20.58±3.908) with p value<0.001. These finding suggest that the AI intervention is effective and enhances the students' critical thinking and self-efficacy.

Conclusion: It is concluded that nursing students' critical thinking and self-efficacy, was improved by adding artificial intelligence into nursing education. Students showed improved analytical and problem-solving skills after the intervention.

INTRODUCTION:

Nurses are integral part of healthcare system of every country. Well qualified and professional nurses contribute to positive health care outcome. These professional, skilled and advance practice nurses can be produced with the integration of global standards to nursing education (Baker, Cary, & da Conceicao Bento, 2021). A cross-sectional study in Pakistan highlighted the importance of nurses' training to support the provision of quality patient care (Bhatti, Soomro, & Shah, 2023).

They are responsible for care of patients globally. They are considered as the most effective players in the patient's outcomes (Lukewich et al., 2022). Hence, it is essential to enhance the efficiency of nursing care by understanding the needs of patients. It would not only increase patient satisfaction but also increase the satisfaction of nurses in their profession (Kim, Kim, & Lee, 2022).

Literature revealed different perspective of quality nursing care where various themes were identified regarding quality of nursing care. Themes included a) "Quality care is holistic care," b) "Good care is an interpersonal issue," c) "Leadership is crucial," and d) "Best care is our responsibility" Holistic care that competently attends to all patient needs and strives for the greatest possible patient outcomes was deemed to be the characterization of quality care. Results indicate that maximum participant agreed that being knowledge able vis essential for provision of quality care (Stavropoulou et al., 2022). Evidence base practice is essential component of informed patient care and should be in routine nursing practice. In contrast a study, conducted in Karachi Pakistan in 2023, revealed that 33% of participant nurses face barrier to evaluate the quality of research for its utilization in patient care (Bibi et al.).

Education also plays important role in the providing efficient care by inculcating analytical and problem-solving skill in nurses. It empowers nurses to implement nursing care in best possible way. Nurses who are qualified with recent developments typically possess superior clinical knowledge and abilities, allowing them to deliver higher-quality care (Gustini et al., 2024).

Systematic review by Vincent and colleagues (2022) examined that faculty consider that traditional clinical examination assessment is not as much effective as objective structured clinical examination (OSCE) (Vincent et al., 2022). Another study was conducted to evaluate effectiveness of traditional teaching compared to blended classroom (flipped + internet plus). Post test result of two groups traditional vs flipped were respectively 88.08 ± 3.28 and 86.08 ± 2.74 , indicate flipped classroom effectively enhanced knowledge acquisition, learning satisfaction and self-evaluation in evidence-based medicine (Liu et al., 2024).

Since the advent of the digital revolution, information is now readily available everywhere, and ICT (information and communication technology) technologies are common in schools today. Nowadays, the majority of teachers employ digital technology to improve student participation and learning. Higher education institutions need to completely embrace these digital advances in order to remain competitive and provide high-quality instruction (Alenezi, Wardat, & Akour, 2023).

Furthermore technology is prevailing almost in every field around the globe, so is the case with healthcare system (Haleem et al., 2022). It also has been integrated in to nursing profession to enhance the patient care such as health portal, nursing informatics that not only bring advances to profession but also impact patient care (Nes et al., 2021). Modern AI technology integration has become need of the hour for the production of quality, skilled and digital literate nursing personnel to stride with this strong-growing technological era (Ma et al., 2025).

As technology is advancing different digital technologies are being introduced. Simulation, gaming, immersive virtual learning is few of these. Active teaching strategies involve these for active engagement, adult self-directed learning and problem-centered approach. Active engagement is key to learn clinical expertise (Altmiller & Pepe, 2022).

With these digital advances, artificial intelligence (AI) has emerged quickly and taking horizon of many disciplines including education. People now understand the importance of AI in learning and appreciate how it makes learning interactive and interesting for students (Huang, Saleh, & Liu, 2021).

AI technology has developed tools that can process language, understand patterns and make decisions based on data. These includes different chatbots like Bing, Chat-GPT (Owan et al., 2023). These technologies give opportunities to nurses for efficient learning, decision making and critical thinking. It is possible as generative intelligence provide real time approach to sea of medical knowledge and simulation of real patient scenarios (Borromeo et al., 2025). Integration of AI tools like Chat-

GPT into teaching strategies not only brings a significant difference in the learning of digital technology but also improves the grades in summative assessment.(Tseng, Huang, & Chen, 2025).

A past study was conducted to evaluate effect of virtual reality simulation education on nursing competency in Korea. The result was in support of virtual reality simulation effectiveness in improving nursing process competency, critical thinking and self-efficacy evident from result respectively ($t = -3.776$, $t = -3.608$, $t = -3.508$ $p=.001$). This body of knowledge support the integration of simulation for clinically prepared student. Simulation and gamification proved to be effective in students' academic and cognitive development but these strategies need technological training and also require hefty finances(Lim, 2021).

Educational self-efficacy also holds great impact in active engagement of students in their learning process. It has seen that level of involvement in learning activities greatly contribute to educational results. Kwak et al., (2022) conducted a cross-sectional study in South Korea influence of AI ethics awareness, attitude, anxiety and self-efficacy on nursing students' behavioral intentions. Self-efficacy was measured on a 4-point Likert scale using TAM model. Results reflected higher correlation ($r: .25$) in AI ethics awareness and self-efficacy (Kwak, Ahn, & Seo, 2022).

Integration of AI tools to educational field represents a paradigm shift especially with in professional educational like Nursing which is a main element for the healthcare system in society (Qawqzeh, 2024). Nursing education support critical thinking, problem solving and many other cognitive actions that are needed for quality patient care, encounter opportunities as well as challenges with the use of AI (Labrague et al., 2023).

Chat-GPT facilitates students in their learning process by helping them to understand difficult topics. It creates practice scenarios that guide nursing student regarding communication with real patients also enhance their clinical reasoning abilities. It expedite their professional growth by giving quick access to research and medical guidance (Lata & Kudi, 2024). Mobile chat bots (what's app Meta AI) are also play important role in this context as it also help student enhance their learning and self-efficacy in education by supporting them to browse and search for their educational content (Chang, Hwang, & Gau, 2022).

OBJECTIVE OF THE STUDY

1. To determine the effect of AI tools on the critical thinking and self-efficacy of nursing students.

MATERIAL AND METHODS

This study followed a quantitative research approach using a quasi-experimental two group study research design among BS Nursing Students at a private institute of nursing Lahore from January 2026 to July 2026. Purposive sample of $n=50$ in each control and the intervention groups was recruited based on the inclusion criteria.

Inclusion Criteria

- ▶ Students enrolled in Adult Health Nursing II course
- ▶ Students having basic skills to operate digital devices

Exclusion criteria

- ▶ Prior AI development/programming experience
- ▶ Absent for more than a week due to medically certified acute disease or hospitalization (severe respiratory infection, dengue)
- ▶ Having long-term physical or psychological condition that interfere with study participation (epilepsy, major depressive disorder)

Phase I/Pre intervention started after taking approval from institutional research ethical board (UOL/IREB/26/16/3/11) of University of Lahore. A meeting was conducted with participants for recruitment and briefing regarding the study. Two group were (control and intervention) formed. Informed consent was obtained from the participants of study. Consent and Pre-intervention data about critical thinking and self-efficacy was obtained in four weeks, two weeks for each group. Phase I was completed in one month during January 2026. Internet access to students was ensured at campus during intervention phase.

Phase II was the intervention phase. Intervention was done for sixteen weeks. Experimental group received intervention for two sessions each of sixty minutes per week. Intervention was delivered through interactive lectures with the integration of AI tools. The intervention was conducted from February 2026 to June 2026. The intervention was designed as two sessions every week for 16 weeks during the semester work. Furthermore, each session consisted of 60 minutes. The sessions were delivered by integration of AI tools with the existing teaching methodology through interactive lectures. Each session consisted of briefing of topic by subject faculty preceded by AI chatbots integration. Primary investigator (PI) provided structured prompts for nine weeks. In week ten, student were trained to generate prompt for themselves. For six weeks, students used AI with their own prompts for educational purpose. Main prompts included as under

Following the execution of the intervention, follow-up data was obtained after two weeks of intervention, from the participants of the study by using the research tools used in pre-intervention data collection.

The data was analyzed using Statistical Package for the Social Sciences (SPSS version 29.0). Descriptive statistics were proceeded with computation of central tendency (mean) and measure of dispersion (standard deviation) for all continuous variables. Categorical variables were summarized by percentages and frequency counts. Data visualization was employed by frequency tables, and bar graphs. Normality of data was assessed formally by Shapiro wilk test. As the data fulfilled the assumptions of normality because all the Shapiro wilk test values were greater than 0.05 which were significant, thus parametric test “the independent sample t-test” and paired t test was used.

RESULTS

This chapter presents the findings for the dependent variables, which include the critical thinking, self-efficacy, clinical performance and academic performance and the demographic characteristics of the study participants. The data was entered and analyzed using SPSS version 29. First of all, the demographic data is presented, after which the normality of the data has been checked to guide about the application of more appropriate test. After that descriptive statistics for all the four tools are presented and at the last portion the inferential statistics has been discussed.

Tables 1: Demographic Characteristics of the study Participants

Variables		Control group		Intervention group	
		f	%	f	%
Age in years	17-20	21	42%	30	60
	21-23	27	54	19	38%
	24-27	2	4%	1	2%
Gender	Male	42	84	36	72
	Female	8	16%	14	28%
Marital status	Single	48	96	44	88
	Married	2	4%	6	12%
Exposure of AI	Yes	30	60	23	46%
	No	20	40%	27	54

According to the demographic profile of the study in Table 1, participants were divided into two groups, the interventional group and the control group. Among participants in the control group, 21 (42%) were age 17 to 20 years and 27 (54%) were in the age group of 21 to 23 years while only 2 (4%) were 24 to 27 years of age. In comparison, the intervention group had little higher number of participants in age group 17 to 20 years 30 (60%) and participants in the age group 21 to 23 years were 19

(38%) and only 1 (2%) were in the age group 24 to 27 years. There was also a difference in the two groups' representation of gender. The control group had comparatively more males 42 (84%) than the intervention group 36 (72%). Number of female participants in the control group was 8 (16%) and in the intervention group was (14 (28%) which is prominently less than the male participants. Finding also revealed that there was a high number of unmarried participants both in the control as well as intervention groups 48 (96%) and 44 (88%) respectively. When the participants were asked about their prior exposure to artificial intelligence, some mixed findings were revealed where in the control group 30 (60%) said yes that they had exposure whereas 20 (40%) said that they had no prior exposure. On the other hand, the interventional group also found somewhat similar findings where 23 (46%) said that they had prior exposure to AI while 27 (54%) said that they did not have prior exposure to AI.

DESCREPTIVE STATISTICS:

Table 2: Critical Thinking of nursing students in Control and Interventional Groups

Critical Thinking	Control Group				Interventional group				P. value
	Pre		Post		Pre		Post		<0.001
	f	%	f	%	f	%	f	%	
Poor Critical Thinking	38	76	26	52	41	82	0	0.0	
Moderate Critical Thinking	12	24	24	48	09	18	13	26	
Significant Critical Thinking	0	0.0	0	0.0	0	0.0	37	74	

According to the control group's findings shown in Table. 2, among the control group the majority participants (76%) had poor critical thinking at the pre-intervention stage, whereas the remaining participants (24%) had moderate critical thinking. At pre intervention phase, none of the participants received a rating of significant critical thinking. A notable change was seen following the intervention. During the post intervention phase in the poor critical thinking group, there were (52%) participants, a somehow decrease from 76% in pre intervention phase. In contrast, 48%, fell into the moderate critical thinking category. Nevertheless, none of the individuals in the post intervention achieved the significant critical thinking level, suggesting that while the control group made progress, they did not fully achieve the maximum degree of critical thinking. On the other hand the intervention group reported that pre intervention of critical thinking scores were comparable to those of the control group, with 82% classified as poor critical thinking and 18% as moderate critical thinking. There was no one in the significant critical thinking category at pre intervention. But after the intervention, there was a noticeable change as none of the individuals was left in the poor critical thinking category. Rather, 26% of the total participants, attained the moderate critical thinking, while a huge number 74% participants attained the significant critical thinking. Given that many participants achieved the highest level of critical thinking, the significant increase in critical thinking indicates that the intervention was successful in improving participants' critical thinking abilities.

Table 3: Self-Efficacy of nursing students in Control and Interventional Groups

Self-Efficacy	Control Group				Interventional group				P. Value
	Pre		Post		Pre		Post		
	f	%	f	%	f	%	f	%	<0.001
Low self-efficacy	30	60	25		29	58	0	0.0	
Moderate self-efficacy	20	40	20	50	21	42	13	26	
High self-efficacy	0	0.0	5	10	0	0.0	37	74	

According to the control group's findings shown in table. 3, among the control group, the majority participants (60%) were having low self-efficacy during pre-intervention phase, and the remaining (40%) of the study participants had moderate self-efficacy. During this pre-intervention phase, 0% participants were found in high self-efficacy. Comparable findings were obtained during the post intervention phase, where in the low self-efficacy group, there were (50%) participants. Furthermore 40%, were found as moderate self-efficacy and 10% were found as high self-efficacy. These findings suggest that while the control group made some progress, but they did not fully achieve a significant change in self-efficacy at the post intervention phase. It was also revealed that the intervention group reported that pre intervention of self-efficacy scores were comparable to those of the control group, with 58% classified as low self -efficacy and 42% as moderate self-efficacy. There was no one found in the high self-efficacy category at pre intervention. On the other hand, after the intervention, there was a noticeable change observed where no participant was found in the low self-efficacy category. Moreover, 26% of the total participants, attained the moderate self-efficacy, while a large percentage 74% participants were found as having high self-efficacy. Looking at the results, many participants achieved the high self-efficacy indicates that the intervention was helpful in improving participants' self-efficacy.

Table 4: Descriptive statistics for Critical thinking and Self-Efficacy in intervention group

Variables	Pre Intervention	Post Intervention	P. Value
	Mean $\pm$ SD	Mean $\pm$ SD	
Critical Thinking	56.40 $\pm$ 4.870	96.90 $\pm$ 15.009	<0.001
Self-Efficacy	10.28 $\pm$ 2.041	20.58 $\pm$ 3.908	<0.001

The results in table 4 demonstrate that there was a considerable change in the outcomes of the participants between the pre-intervention and post-intervention assessments. A significant improvement in critical thinking was indicated by the mean score for Critical Thinking (CT), which increased from 56.40 $\pm$ 4.870 before the intervention to 96.90 $\pm$ 15.009 post intervention with a mean difference of 40.50. Similar to this, participants' self-efficacy (SE) levels increased from 10.28 $\pm$ 2.041 at baseline to 20.58 $\pm$ 3.908 with a mean difference of 10.30 after the intervention.

Inferential Statistics

Table.5: Comparison of Critical thinking and Self-Efficacy of Intervention group, pre-intervention and post-intervention values

Variables	N	Pre-intervention Mean $\pm$ SD	Post-intervention Mean $\pm$ SD	Mean Difference	P. Value
Critical Thinking	50	56.40 $\pm$ 4.870	96.90 $\pm$ 15.009	40.50	<0.001
Self-Efficacy	50	10.28 $\pm$ 2.041	20.58 $\pm$ 3.908	10.30	<0.001

Table 5 above revealed that there are notable variations in the intervention's effectiveness over time when comparing the critical thinking, self-efficacy, clinical performance and academic performance scores before and after the intervention. The post assessment of critical thinking had a significantly higher mean score of 96.90 with a standard deviation of 15.009, whereas the pre assessment mean critical thinking score at baseline was 56.40 with a standard deviation (SD) of 4.870. The t-test result of -17.928 and the p-value of 0.000, which showed that the two assessments, pre-assessment and post assessment scores differed statistically significantly. Similarly the self-efficacy scores at pre intervention was mean $\pm$ SD =10.28 $\pm$ 2.041 which increased to mean $\pm$ SD =20.58 $\pm$ 3.908 (p. value = 0.000) shows a statically significant difference.

Table 6: Comparison of Critical thinking and Self-Efficacy control and intervention groups at Post intervention phase

Variables	N	Control- Mean $\pm$ SD	Intervention- Mean $\pm$ SD	Mean Difference	P value
Critical Thinking	50	59 $\pm$ 4.219	96.90 $\pm$ 15.009	37.90	<0.001
Self-Efficacy	50	10.28 $\pm$ 2.548	20.58 $\pm$ 3.908	10.30	<0.001

According to Table 6, at the post intervention phase, there was found a statistical significant difference between the control and intervention groups'. At the post intervention stage, the control group's mean critical thinking score was 59 $\pm$ 4.219, while the intervention group's was 96.90 $\pm$ 15.009 ($t = -17.199$, $p = 0.000$) indicated statically significant improvement in critical thinking after the artificial intelligence intervention. Similarly at the post intervention phase, the control group's mean self-efficacy was 10.28 $\pm$ 2.548, while the intervention group's self-efficacy was 20.58 $\pm$ 3.908 ($t = -15.613$, $p = 0.000$) revealed a statistically significant difference in self-efficacy.

DISUSSION

This current research study found that how well artificial intelligence-based intervention enhanced BS nursing students' critical thinking. The findings revealed a notable change in students' critical thinking skills between pre intervention and the post intervention assessments, which demonstrate a prominent effect of the artificial intelligence use among students. The noticeable change in critical thinking after the intervention was one of the study's main findings. Majority of the study participants of the intervention group (82%) scored in the poor critical thinking skills at baseline, showing very low level of critical thinking. However, following the AI based intervention, there was a noticeable upward shift in the critical thinking, with 0% in poor critical thinking and 74% in significant critical thinking.

Furthermore, it was also revealed by paired t test that this AI based intervention increased the mean critical thinking from 56.40 $\pm$ 4.870 at pre intervention phase to 96.90 $\pm$ 15.009 at post intervention phase with p-value <0.001. This indicated that the intervention has statistically significant effect on the critical thinking among BS nursing students. Moreover, the independent t test also revealed a significant increase in the critical thinking where the critical thinking score was significantly high among the intervention group 96.90 $\pm$ 15.009 as compared to the control group 59 $\pm$ 4.219 with p-value <0.000. This difference due the intervention was statistically significant, which support that the intervention was highly effective.

A similar study was conducted in Saudi Arabia on enhancing medical student critical thinking skill through Chat-GPT. The aim of the study was to evaluate Chat-GPT's effectiveness in enhancing critical thinking of medical students. Results revealed that 92.6% participant showed confidence in integration of Chat-GPT for critical thinking enhancement. Out of these 92.7% 174 participants were strongly agree on the notion that Chat-GPT has proven effective for improvement in their critical thinking (Almazrou et al., 2024). Further-more a mix method study has been carried out in 2025 at Faculty of nursing, Chiang Mia University in Thailand. The aim of this study was to evaluate the effectiveness of artificial intelligence assisted podcast intervention on critical thinking and digital literacy among student nurses. Pre and post data was analyzed using paired t-test. Result exhibited that critical thinking increased significantly from M= 89.71, SD=13.43 to M 117.29, SD=9.94. These results are extremely suggestive of AI assisted podcast effectiveness in improvement of critical thinking and digital literacy among student nurse (Xuto et al., 2026).

The findings of this current study are also aligned with another previous study where the educational intervention significantly enhanced the critical thinking abilities among nursing students ($p < 0.001$). This research emphasizes the necessity of such intervention initiatives leading to enhanced students' critical thinking skills. Future nurses can be better able of making evidence-based decisions and reflective judgments for their clients (López et al., 2020). Consistent findings were also revealed in another past study, where the control group's posttest mean score on critical thinking was 58.26 $\pm$ 6.364, on the other hand the intervention group's mean critical thinking score was 107.11 $\pm$ 1.968, p-value <0.001 which is less than.05 and indicates the statistical difference between the pre and post scores following the intervention. The study found that participants' critical thinking abilities improved as a result of the intervention (Kousar & Afzal, 2021). These suggests that integrating these kinds

of AI strategies into nursing education may help BS nursing students to achieve higher critical thinking, enhancing their preparedness for professional practice. Moreover, future research can further discover the optimal intervention designs to maximize benefits across diverse student groups and learning environments.

Accordingly, BS nursing students at Borujen Nursing School Iran, participated in a pre-test and post-test quasi-experimental study. Findings revealed that the experimental group's critical thinking skills were found to be positively impacted by the social problem-solving course following the instructional course ($P < 0.01$). Based on the found results, the intervention could enhance critical thinking, cognitive problem-solving, and decision-making abilities (Ahmady & Shahbazi, 2020). Similarly, another study conducted in China found that critical thinking has significant positive correlation with AI literacy ($r=0.44$, $p < 0.001$) (Jiang et al., 2026). Another study conducted in China evaluated the effects of emerging generative artificial intelligence based different types of teaching modalities. Upon completion of course, significant difference was seen in pre and post phase; high order thinking skills (HOTS) scores (142.74 ± 16.76) (156.74 ± 14.41 , $p < 0.001$) and AI literacy (165.79 ± 22.0) (189.20 ± 17.44 , $p < 0.001$) of experimental group. Moreover, at post intervention phase, high order thinking skills (HOTS) scores (156.74 ± 14.4) ($p = 0.018$) was better than control group (151.21 ± 12.12). This conclude that AI can be a supplementary teaching tool. In prospective era, it can effectively contribute to enhancement of clinical reasoning of nursing student. Therefore it should be included in nursing education (Zaid et al., 2026).

In line with this, the interventional group of another past investigation revealed a significant after the intervention ($P = 0.01$). Additionally, at post intervention, a significant difference was seen between CT aspects in both groups. The paired t test, showed a significant difference between the intervention group before and after the intervention ($P < 0.01$) (Kazemi et al., 2022). It is being interpreted that these findings produce evidence that AI-based interventions in nursing education provide support to enhance nursing students' critical thinking skills. The consistency of this current study with past studies further indicates that AI facilitates nursing students' analytical thinking and problem-solving potentials, by providing personalized learning exposure to AI.

Inconsistent results were revealed in a past study where no difference in critical thinking scores was found among who took part in the skills intervention and those who did not ($t(50) = 0.174$, $p = 0.86 > 0.05$). Nearly similar test scores for critical thinking were obtained by the intervention group ($M = 67.88$, $SD = 5.99$) and the control group ($M = 67.59$, $SD = 5.81$) (Gonzalez et al., 2020). Another somewhat comparable findings were obtained where the Post intervention mean critical thinking score among nursing students in the control group was 16.0 ± 2.3 and in the intervention group was 17.5 ± 2.1 with (p value 0.02) (Salameh & Alkhateeb, 2025).

These findings highlight the potential of AI-based interventions to greatly enhance the critical thinking skills of nursing students. They also show that not all interventions work, indicating that the kind of intervention and how well it fits with cognitive goals are important factors. The results highlight the importance of fostering critical thinking abilities for the development of reflective, adaptable, and evidence-based nursing professionals and suggest future study to examine the best intervention designs and long-term impacts. The inconsistency observed in this present study with some past research studies may be because of the differences found in type of AI intervention, use of different study design, duration of the AI intervention, characteristics of the participants, and educational settings of the institutes. Differences in participants' existing digital literacy, awareness of AI technologies, and teachers' support may also lead to the variations in outcomes.

The current study's findings also showed that how effective artificial intelligence intervention is for enhancing self-efficacy among BS nursing students. No study participant remained in the low self-efficacy category after the AI intervention. Following the intervention, the percentage of study participants in high self-efficacy raised dramatically from 0% to 74%. The mean score of self-efficacy for the intervention group increased from 10.28 ± 2.041 pre-intervention to 20.58 ± 3.908 as post-intervention, resulting mean difference of 10.30, p -value < 0.001 . This increased in self-efficacy was statistically significant. This increase emphasizes how important the AI intervention is for enhancing self-efficacy among BS nursing students. Moreover the mean score of self-efficacy at the post intervention phase for the intervention group was high 20.58 ± 3.908 in comparison to the control group 10.28 ± 2.548 , resulting mean difference of 10.30, p -value < 0.001 . This increased in self-efficacy was statistically significant.

A past study found the results that are in line with the current study, which found that before the intervention, almost all of the of the nursing students in the control group such as (93.3%) and (100%) of the intervention group had poor self-efficacy levels. After receiving the intervention, the intervention group 100% of the participants achieved high levels of self-efficacy and on

the other hand the control group 60% achieved high self-efficacy (Abd-Elfattah et al., 2022). Another past quasi-experimental study was conducted in Taiwan in 2022 on impact of AI chatbots on college students' self-efficacy. Experimental group reviewed the learning material after-class by using chatbots while control group reviewed with the help of their instructor. After two weeks of experiment results implied that experimental group had better self-efficacy than the control group and their post-test results also showed improvement after experimentation. Result were experimental group's average performance was $M=66.33$ with standard deviation $SD=10.39$ while the control group has average performance $M=57.40$, $SD=12.33$ (Lee, Hwang, & Chen, 2022).

Results from another prior study found consistent results where the mean post-test scores for nursing students' self-efficacy enhanced from the pretest, and showed a very significant differences between control and intervention groups (Shi et al., 2025). The results of another past study showed that the experimental group had high mean scores for self-efficacy 48.83 ± 97.5 at post intervention phase as compared to 43.13 ± 29.5 at pre intervention phase. The findings suggested a highly statistically significant effect ($p = <0.001$) (Saeedi¹ et al., 2026). Another congruent study conducted in South Korea studied the influence of AI awareness, on nursing students' self-efficacy. Self-efficacy in the study was measured on a Likert scale having 4 points, using TAM model. Results of the study reflected a high co relation ($r: .25$) in AI awareness among students and self-efficacy among them (Kwak, Ahn, & Seo, 2022).

Another study was conducted in Saudia Arabia (2026) to investigate artificial intelligence literacy and academic resilience along with mediating role of self-efficacy. The findings of the study depicts positive correlation between AI literacy and self-efficacy ($r=0.118$, $p<0.05$). This study provide evidence that AI literacy has a correlation with self-efficacy. Furthermore it will also prepare students for better adaptation to today's AI- assisted learning environment (Chen et al., 2026). According to another previous study, statistically significant increase was observed among the intervention group indicating enhanced self-efficacy $p < 0.001$ (Creighton).

Another study was conducted in Egypt on role of artificial intelligence literacy and innovation mindset in shaping nursing student's career and talent self-efficacy. Study results depict a positive relation between AI literacy and self-efficacy as results depict that 59.4% students have $GPA>3$ however they did not attended any workshop on career or talent development (El-Sayed et al., 2025). Another similar study was conducted in Egypt. Results showed that AI readiness and professionalism are significant interpreter of nurses' self-efficacy ($\beta= 0.143$, $p<0.017$) ($\beta= -0.147$, $p<0.014$). A direct effect of AI readiness and professionalism was observed on the self-efficacy of nurses. This conclude that in today's emerging AI environment, nursing leaders should integrate AI in nursing curriculum to help nurse be ready for AI adaptation in practical life. This would not only improve digital literacy but also self confidence in their competencies (El-Bassal, El-Sayed, & Elgamal, 2025).

Another congruent findings were observed by a study conducted in Egypt in 2024-2025, which claims that AI has an effect on the levels of self-efficacy among BS nursing students. The results demonstrate a negative correlation between reliance on ChatGPT and academic self-efficacy ($\beta= -0.248$, $p<0.001$) while academic self-efficacy is positively associated with self-directed learning ($\beta= 0.742$, $p<0.001$) and negatively associated with problem solving difficulties ($\beta= -0.569$, $p<0.001$). (Elzeky, Alanazi, & FM Shahine, 2026). According to another past study mean self-efficacy score of the participants rose dramatically (from 87.57 to 142.13) following the intervention. The results found that the self-efficacy of nursing students are highly impacted by simulation education (Azizi et al., 2022). Overall, these research' consistent findings support the importance of AI intervention in fostering student enhancement in self-efficacy. All the above literature discussed considered, the fact that these findings hold true for different research reveal that how well the AI intervention may be used to improve self-efficacy among BS nursing students. Collectively, the above researches point to a continuous pattern showing that AI teachings are very successful in raising nursing professionals' self-efficacy. Furthermore the research support the idea that effective teaching strategies enhance technical proficiency while also boosting motivation and self-efficacy.

An inconsistent study was conducted where the results revealed that the changes in self-efficacy were more similar between the control and intervention groups and they were not statistically significantly different ($F = 1.808$, $p = 0.185$) (Hong et al., 2025). This inconsistency might be because of methodological biases or errors or may be because of contextual differences.

CONCLUSION

According to the study's findings, nursing students' critical thinking and self-efficacy improved when artificial intelligence was included into nursing education. Students showed improved analytical and problem-solving skills and increased self-assurance

after the intervention. Active participation and a deeper comprehension of the course material were made possible by the deployment of AI-supported learning technologies, which offered prompt feedback, personalized learning opportunities, and interactive educational experiences. As a result, the study encourages the use of AI-based educational interventions as a novel strategy to raise the standard of nursing education and enhance student learning outcomes.

RECOMMENDATIONS

Following recommendations can be made based on the study findings

5.3.1. Recommendations for Nursing Education:

- 1 To improve critical thinking and self-efficacy, the head of departments and teachers should incorporate artificial intelligence-based learning resources into their undergraduate nursing courses.
- 2 Nursing educators should be trained through faculty development programs in the efficient use of AI technology from students' perspective to support student.
- 3 AI-assisted learning platforms need to be made available for teachers to flexible learning opportunities that might boost students' critical thinking and self-efficacy.

5.3.2. Recommendations for Nursing Practice and Administration

- 1 To improve nurses' critical thinking, self-efficacy and education outcomes, nursing leaders from clinical side should encourage the use of artificial intelligence-based instructional and clinical decision-support systems in healthcare settings.
- 2 In order to enable nurses to employ AI technology in patient care and professional growth while upholding ethical and safe nursing practice standards, healthcare organizations should set up ongoing training and support programs.

5.3.3. Recommendations for Future research

- 1 To increase the generalizability of results about the usefulness of AI in nursing education, future research should include larger and more varied samples from several nursing schools.
- 2 To determine whether gains in critical thinking, self-efficacy, and educational outcomes are maintained over time and applied to clinical practice, researchers should carry out longitudinal studies.
- 3 To determine the best strategies for nursing students, future studies should examine various AI-based educational interventions (such as chatbot-assisted learning, virtual simulations, and intelligent tutoring systems).

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