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Research article

Artificial intelligence tools utilized in nursing education: Incidence and associated factors

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ABSTRACT

Background: Artificial intelligence technology is among the most significant advancements that provide students with effective learning opportunities in this digital era. Therefore, the National League for Nursing states that it is necessary to reframe the nursing education process.
Objective: This study aimed to determine the factors that affect the usefulness and sustainability of artificial intelligence tools used in nursing education.
Design: A descriptive cross-sectional study was conducted among. Three models, including the Technological Acceptance Model (TAM), the Information System Success Model (ISSM), and the Online Learning Self-Efficacy (OLSE), were used.
Participant: All of fourth- year undergraduate nursing students who were enrolled in nursing department regularly ($N = 420$), and who respond ($n = 204$).
Setting: In the nursing department of the health professions faculty at AL-Quds University, in Palestine.
Results: Among the 204 students who responded, 9.80 % employed simulation, 5.40 % utilized virtual reality, 19.10 % used Chat GPT, 42.20 % used mobile applications, and 23.50 % utilized PowerPoint AI as part of their learning process. The mean and standard deviation (SD) were computed for key parameters related to the information system success model (AI) (ISSM) ($M = 4.52$, $SD = 1.17$). Technology Acceptance Model (TAM) ($M = 4.61$, $SD = 1.16$). Online Learning Self-Efficacy (OLSE) ($M = 4.55$, $SD = 1.28$).
Conclusion: There is a need to adapt teaching strategies and integrate AI tools as useful learning tools, which have become essential for students to complete their learning activities through enhancing knowledge of the multimodal technological factors that should be taken into consideration while creating AI tools across several domains for universities and developers.

1. Introduction

The digital assistants and technology used in modern educational institutions are becoming crucial in this digital era (Hashim, 2018). This makes learning engaging and enjoyable in different fields of study, including nursing education (Foronda et al., 2016). The National League for Nursing (2015) states that to meet the evolving demands of patient care, improve active and meaningful learning experiences (DiMattio and Hudacek, 2020; Jeffries et al., 2015), and enable graduates to interact with patients and their caregivers in the informatics age of healthcare, it is necessary to reframe the nursing education process (Williamson and Muckle, 2018). Therefore, the use of artificial intelligence (AI) technology is among the most significant advancements in providing students with effective learning opportunities (Bozkurt et al., 2021; De Gagne, 2023).

Artificial intelligence (AI) technologies have evolved into a range of educational tools for nurses, including telehealth, remote learning, augmented/virtual reality, clinical decision support, and Chabot's interactive clinical scenarios (Buchanan et al., 2020; Hwang et al., 2022; Robert, 2019). These tools help students learn more effectively by increasing their self-awareness, allowing them to develop a clear sense of purpose and direction, and improving their ability to make decisions

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(Foronda et al., 2017). Student satisfaction and achievement of their personal and professional learning objectives increase when they participate in experiences that advance their clinical knowledge, maximize patient care, and reduce patient risks (Fritz and Guthrie, 2017; Saab et al., 2021). Therefore, the design and integration of AI technology into clinical practice require the expertise and abilities of nurse educators, nurse practitioners, and students (Pepito and Locsin, 2019).

2. Background

The development of early computer-based instructional materials, such as online tutorials, multimedia learning resources, and interactive simulations, demonstrated the potential of artificial intelligence (AI) to improve teaching and learning experiences, and as a result, AI technology gained popularity in the 1970s and 1980s (Bozkurt et al., 2021). Learning analytics and intelligent tutoring systems utilizing AI-generated data showed enhanced student performance and active learning opportunities in the 1990s (Bozkurt et al., 2021). According to Maddox et al. (2019) and Robert (2019), artificial intelligence (AI) is an all-encompassing term used to describe methods developed to teach computers to mimic human-like cognitive functions such as learning, reasoning, communicating, and decision-making through realizing tasks or solving problems that are also used in patient care (Maddox et al., 2019; Robert, 2019).

Diverse artificial intelligence systems in nursing education can enable options for remote learning, enabling students to work together with peers, access educational resources, and participate in virtual clinical encounters (Robert, 2019). ChatGPT is a generative AI tool that students use most frequently. It creates new digital settings, such as text, pictures, video, or audio, based on the demands of a human user using mathematical models and algorithms(Dwivedi et al., 2023). Furthermore, AI-based realistic and student-focused nursing simulations and intelligent debriefing systems that merge scenarios (Foronda et al., 2020) enhance the educational process and improve nursing student outcomes in a safe environment where they can improve their clinical judgment, critical thinking, and decision-making skills (De Gagne, 2023; Liaw et al., 2023). Additionally, virtual reality (VR) strategies provide an ideal environment for students to collaborate with other healthcare professionals in a virtual setting, transforming them from observers into active participants, fostering team building, increasing satisfaction, and improving communication skills to achieve the best possible healthcare outcomes (Jallad and Işık, 2021; Kyaw et al., 2019).

In recent years, universities and nursing faculties have recognized the growing inclination of their students toward utilizing AI tools, and it is necessary to recognize the importance of integrating artificial intelligence technologies as a teaching tool in nursing curricula and education; nurse educators face challenges in integrating these technologies into the learning process, including the gap in communication and collaboration with the digital generation of nursing students, lack of experience in using AI tools, and Inability to adapt to it. In addition, the political issue that the Jerusalem area is suffering from prevents mostly nursing students, educators, and instructors from attending their physical classroom, practical setting, and social activities among their communities and families, resulting from the distance caused by barriers between Palestinian cities and a lack of security and safety. So, it is important to investigate the factors that impact the usefulness and sustainability of AI tools in nursing education, providing valuable insights for educators, administrators, and developers to guide them in selecting appropriate AI tools, and designing effective educational interventions to improve, develop, and make informed decisions in this rapidly evolving field (Buchanan et al., 2021; Hwang et al., 2024).

This study aimed to determine the factors that affect the usefulness and sustainability of AI tools used in nursing education by adopting three models—the technological acceptance model (TAM), information system success model (ISSM), and online learning self-efficacy (OLSE)—to examine the usefulness, satisfaction, and user self-efficacy of using AI tools in nursing education.

3. Research questions

- What are the factors that influence the utilization and sustainability of AI tools in nursing education among undergraduate nursing students?
- Is there any significance of utilizing AI tools on students' satisfaction, and self-efficacy?
- What is the effect of utilizing AI tools in nursing education?

4. Methodology

4.1. Study design

A descriptive cross-sectional study was conducted.

4.2. Setting

This study was conducted in the nursing department of health profession faculty at Al Quds University in Jerusalem, Palestine. The undergraduate program for obtaining a Baccalaureate of Nursing is four years long. During the third or fourth year of study, the students enrolled in the health informatics course.

4.3. Sample

The study used convenience sampling to collect data from fourth-year undergraduate nursing students. The study sample included a population of 420 students with a 95 % confidence level, a margin of error of 0.05, and a population proportion of 0.5. By applying the sample size formula for estimating proportions, the minimum required sample size was determined to be 201 participants. Ultimately, 204 students responded to the questionnaire.

4.4. Inclusion criteria

Students who were regular students in the nursing department, registered in the fall academic semester of 2023–2024, were in their fourth year, were enrolled in health informatics courses for the first time, and agreed to participate in the study. The choice of the health informatics course was made to expose students to AI tools and familiarize them with their use in learning.

4.5. Instruments

The researchers used four scales in this study. The instruments used were a student demographic data questionnaire, the Information System Success Model (ISSM) scale, the Technology Acceptance Model (TAM) scale, and the Online Self-Confidence (OLSE) scale.

4.6. Student demographic data questionnaire

The student demographic data questionnaire was developed by researchers based on a literature review (Dua'a et al., 2023; Dua'a and Al-Kawafha, 2020; Duaa Fayiz, 2017). The data for the students were collected via self-reports. The information obtained included the student's gender, age, economic status, cumulative average, place of residence, computer skills and tool used in the learning process.

4.7. Information System Success Model scale (ISSM)

The ISSM is a scale rated on a 7-point Likert scale from “strongly agree” to “strongly disagree” developed by DeLone & McLean (1992). It is a Likert-scale questionnaire that assesses four factors: system quality (SQ) (3 items), service quality (SEQ) (3 items), information quality (IQ)

(3 items), and student satisfaction (SS) (3 items) (Cronbach's α =0.58 and 0.82) (DeLone & McLean, 2003).

4.8. Technology acceptance model scale (TAM)

The TAM is a scale rated on a 7-point Likert scale from "strongly agree" to "strongly disagree" developed by Davis (1989) and includes eight factors, namely, perceived usefulness (PEU) (4 items), perceived enjoyment (PE) (3 items), intention to use (EUS) (3 items), subjective norms (SN) (2 items), use of sustainability (4 items), social networking (NE) (3 items), student learning achievements (SSA) (5 items), and engagement (6 items) (Cronbach's α = 0.89 and 0.97) (Davis, 1989).

4.9. Online Self-Confidence Scale (OLSE)

The OLSE is a scale rated on a 7-point Likert scale from "strongly agree" to "strongly disagree" developed by Shen et al. (2013) and includes 5 items, (Cronbach's α = 0.77) (Ithriah et al., 2020; Shen et al., 2013).

Despite the reliable application of these scales in previous literature, the reliability of the TAM, ISSM, and OLSE scales in Jerusalem was investigated. In that order, it was 0.90, 0.97, and 0.94. This indicated that the questionnaire was highly reliable. (Cortina, 1993) (see Table 1).

4.10. Ethical considerations

This study was approved by the Institutional Review Board of Al-Quds University (RESC/2024–13). Informed consent Obtained from all participants before the study was conducted. To ensure the confidentiality and privacy of the participants, the researcher used codes rather than students' names.

4.11. Data collection

Prior to starting the data collection process, the researcher obtained ethical approval from the Institutional Review Board of Al-Quds University, the Dean of the Health Professions Faculty, and the head of the Nursing Department. Then, information on fourth-level students enrolled in informatics courses was gathered. After obtaining all necessary information and securing permission to collect data, the researchers utilized an electronic questionnaire on Google Forms, which was made available for responses from 4 October to 12 November of the fall semester. The questionnaire was shared through WhatsApp, Facebook, and Messenger, with participation being voluntary and no incentives offered. Students accessing the questionnaire were presented with an informed consent statement at the beginning, indicating their voluntary participation in the study. Subsequently, demographic information such as age, gender, GPA, place of residence, computer skills proficiency, use of AI tools, and specific types of AI tools used were collected from participants.

4.12. Data analysis

The data were analysed using the Statistical Package for Social Science (SPSS; version 25). The quantitative data from the survey were analysed using descriptive statistics to examine the levels of self-confidence, satisfaction, and perceived usefulness of AI tools among nursing students.

Table 1
Reliability, Mean of ISSM, TAM, OLSE through using AI tools in learning process.

Parameter	Cronbach's Alpha	Mean (SD)	No of items
Information System Success Model (AI) (ISSM)	0.94	4.52 (1.17)	12
Technology Acceptance Model (TAM)	0.97	4.61 (1.16)	30
Online Learning Self-Efficacy(OLSE)	0.90	4.55 (1.28)	5

5. Results

5.1. Students' demographic data

The study findings indicated that all participants were fourth-year undergraduate students in a nursing department. A majority of the participants, comprising 146 individuals (71.6 %), were female, while the remaining 58 participants (28.4 %) were male. The demographic information for all participants is provided in Table 2.

AI tool utilization: In terms of incorporating AI tools into students' educational journeys, the findings revealed that 9.80 % of students employed simulation, 5.40 % utilized virtual reality, 19.10 % engaged with Chat GPT, 42.20 % made use of mobile applications, and 23.50 % utilized PowerPoint AI as part of their learning process (see Fig. 1).

In evaluating the responses of 204 nursing students to the questionnaire, the mean and standard deviation (SD) were computed for key parameters related to the Information System Success Model (AI) (ISSM) (M = 4.52, SD = 1.17). Technology Acceptance Model (TAM) (M = 4.61, SD = 1.16). Online Learning Self-Efficacy (OLSE) (M = 4.55, SD 1.28). The Cronbach's alphas were 0.94, 0.97, and 0.90 for ISSM, TAM, and OLSE, respectively. (see Table 1).

5.2. Information System Success Model (ISSM)

The results showed that information quality (IQ) (M = 4.63, SD = 1.5) was the number one factor, followed by system quality (SQ) (M = 4.54, SD = 1.4), Student satisfaction (SS) (M = 4.53, SD = 1.5), and service quality (SEQ) (M = 4.40, SD = 1.5). The item "The information available is interesting" (M = 4.64, SD = 1.55) had the highest mean of all items, followed by the item "The information at the AI tools system

Table 2
participants Demographics data (n = 204).

Variable	Category	N (%)
Gender	Male	58 (28.4)
	Female	146 (71.6)
Age (years)	< 20	10 (4.9)
	20 to 24	184 (90.2)
	25 to 29	6 (2.9)
	>29	4 (2)
Economic status	low	6 (2.9)
	moderate	184 (90.2)
	high	14 (6.9)
Average	≤69 %	5 (2.5)
	70–79 %	87 (42.6)
	80–89 %	100 (49)
	90–100 %	12 (5.9)
Place of Residence	City	82 (40.2)
	Village	105 (51.5)
	Camp	11 (5.4)
	Other	6 (2.9)
Computer skills	basic	85 (41.7)
	very good	98 (48)
	advanced	21 (10.3)
Internet access	available daily	151 (74)
	intermittent	53 (26)
Which AI tools you used in your learning process	Simulation	20 (9.8)
	Virtual reality	11 (5.4)
	Chat GPT	39 (19.1)
	Mobile applications	86 (42.2)
	PowerPoint AI	48 (23.5)

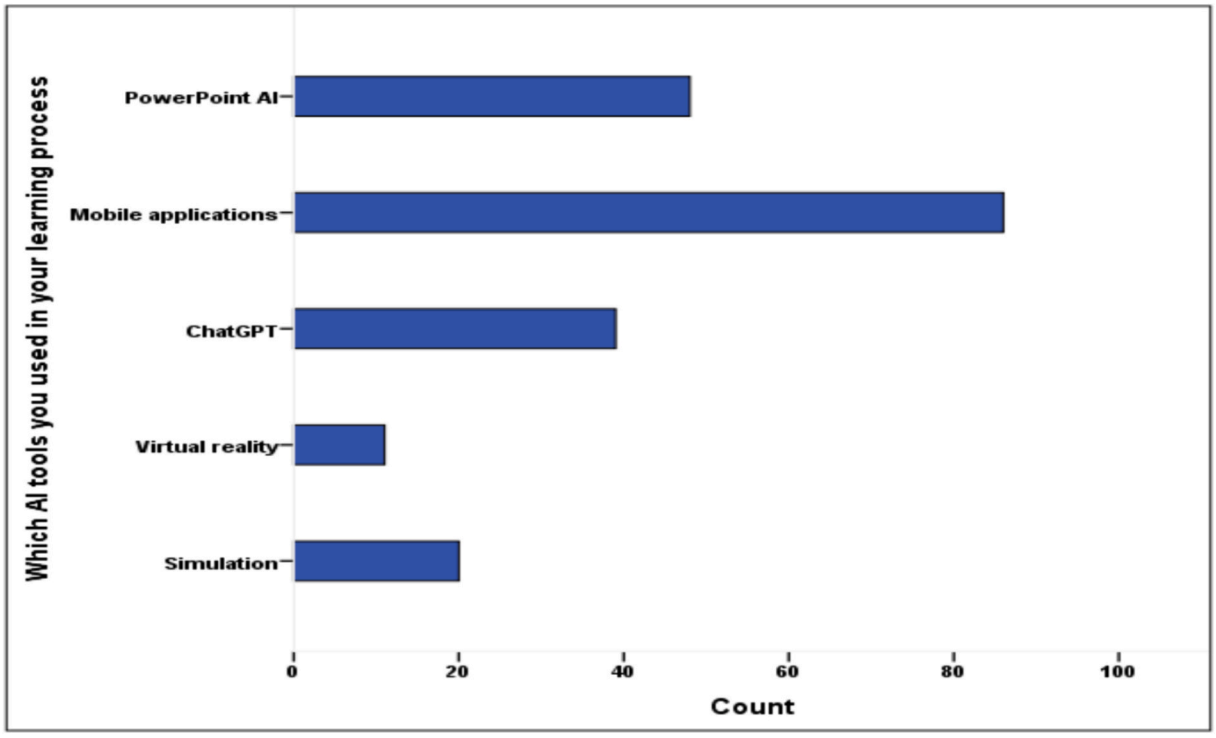

Fig. 1. AI tools that participants used in learning process.

available is helpful" (M = 4.64, SD = 1.51); both were under the information quality (IQ) factor. The last two items, "The AI tools have a mechanism for overcoming the problems that I am facing quickly" and "You feel safe with AI tools in terms of security and privacy", with means of 4.31 and 4.29, respectively, were both under the service quality (SEQ) factor. (see Table 3).

Table 3
Information System Success Model (ISSM).

Factor/ Item	Factor ranking	Item ranking	Mean	SD
1. System Quality (SQ)	2		4.54	1.4
The AI tools has easy-to-understand navigation.		10	4.39	1.48
The AI tools allows me to find the information I need easily.		3	4.63	1.47
The AI tools has a good education strategy structure.		6	4.59	1.47
2. Service Quality (SEQ)	4		4.40	1.5
The AI tools has a mechanism for overcoming the problems that I am facing quickly.		11	4.31	1.60
The system on AI tools is up to date.		4	4.60	1.43
You feel safe with AI tools in terms of security and privacy.		12	4.29	1.54
3. Information Quality (IQ)	1		4.63	1.5
The information at the AI tools system available is helpful.		2	4.64	1.51
The information available is interesting.		1	4.64	1.55
The information available is reliable.		5	4.60	1.46
4. Student Satisfaction (SS)	3		4.53	1.5
If there is any chance to use digital technology learning again, I will gladly do it.		7	4.56	1.61
I am satisfied with the AI tools process.		8	4.53	1.45
I feel learning with AI tools gives me what I need.		9	4.51	1.47

5.3. Technology Acceptance Model (TAM)

Student learning achievements (SSAs) (M = 4.69, SD = 1.45) ranked as the number one factor, followed by perceived enjoyment (PE) (M = 4.65, SD = 1.43), intention to use (EUS) (M = 4.63, SD = 1.52), and social networking (NE) (M = 4.63, SD = 1.51). Subjective Norm (SN), Engagement, Use of Sustainability, and Perceived Usefulness (PEU) were ranked 5th, 6th, 7th, and 8th, respectively.

The item "I feel AI tools help me improve my knowledge and information" (M = 4.77, SD = 1.47) had the highest mean of all items, followed by the item "The actual process of using AI tools is pleasant" (M = 4.76, SD = 1.33). The last two items, "Using AI tools improves my learning performance" and "I spend a lot of time exploring AI tools", had means of 4.37 ± 1.53 and 4.37 ± 1.49, respectively. (see Table 4).

5.4. Online Learning Self-Efficacy (OLSE)

The results showed that I am willing to accept the challenge (M = 4.69, SD = 1.49), followed by "I am sure that I can complete all the stages that exist on the AI site well" (M = 4.63, SD = 1.45). The last item is "I am sure that I can learn without being in the same room as the instructor and other students" (M = 4.45, SD = 1.44). (see Table 5).

6. Discussion

AI technology has become part of the reality of today's teaching and learning and has noticeably improved higher education, including nursing education (Gause et al., 2022). In this section, the current study discusses (204) nursing students who have utilized several AI tools in nursing education, such as various mobile applications in smartphones, AI PowerPoint, Chat GPT, VR, and simulation, and shows (42.20 %) students who used mobile applications, which agrees with the studies of Buabeng-Andoh (2018) and Li et al. (2016), who suggested that smartphones are easily used through web searching, which is the most common activity that students perform due to the on-demand accessibility of information at any time and anywhere and that the use of

Table 4
Technology Acceptance Model (TAM).

Factor/ Item	Factor ranking	Item ranking	Mean	SD
1. Perceived Usefulness (PEU)	8		4.55	1.50
Using the AI tools improves my learning performance.		29	4.37	1.53
Using the AI tools enhances my learning effectiveness		27	4.53	1.49
Using the AI tools gives me greater control over learning.		18	4.59	1.49
I find the AI tools to be useful in my learning		5	4.70	1.48
2. Perceived Enjoyment (PE)	2		4.65	1.43
I find using AI tools to be enjoyable.		23	4.57	1.51
The actual process of using the AI tools is pleasant.		2	4.76	1.33
I have fun using the AI tools.		14	4.62	1.45
3. Intention to Use (EUS)	3		4.63	1.52
I use the AI tools to find information		16	4.61	1.61
I use AI tools to assess my skills		19	4.59	1.48
I use AI tools to increase the chances of achieving better results		6	4.70	1.47
4. Subjective Norm (SN)	5		4.63	1.49
My teacher is very supportive of AI tools learning use for my learning		12	4.64	1.54
The management of my university support the AI tools activities		15	4.62	1.44
5. Use of Sustainability	7		4.56	1.49
I spend a lot of time exploring within the AI tools		30	4.37	1.49
I believe that the use of the AI tools is valuable		20	4.58	1.46
AI tools provide suitable learning environment		7	4.70	1.46
I think that using AI tools is well suited for the way to learn		22	4.57	1.53
6. Social Networking (NE)	4		4.63	1.51
I enjoy my time when using social networking tools.		26	4.53	1.54
Social networking tools increase students' creativity and interactivity.		10	4.67	1.48
Social networking tools facilitate knowledge sharing.		9	4.69	1.50
7. Student Learning Achievements (SSA)	1		4.69	1.45
Achieving educational.		17	4.61	1.53
Achieving personal goals		4	4.71	1.38
Goals I feel AI tools helps me improve my creativity.		11	4.65	1.41
I feel AI tools helps me improve my knowledge and information		1	4.77	1.47
I feel AI tools helps me improve my experiences and performance		3	4.72	1.46
8. Engagement	6		4.59	1.45
I feel strong and vigorous when I am studying with AI tools.		28	4.48	1.52
When the lecture starts I feel like going to use AI tools		25	4.56	1.47
I am enthused about my study by AI		24	4.56	1.51
My study by AI inspire me to do new things		8	4.70	1.37
I am proud of doing this career		13	4.63	1.43
I am happy when I am doing assignment by AI		21	4.58	1.40

Table 5
Online Learning Self-Efficacy (OLSE).

Item	Item ranking	Mean	SD
I am sure that I can use synchronous technology to communicate with others (such as Skype)	4	4.47	1.55
I am sure that I can manage time effectively and complete all assignments on time	3	4.52	1.55
I am sure that I can learn without being in the same room as the instructor and other students	5	4.45	1.44
I am willing to accept the challenge	1	4.69	1.49
I am sure that I can complete all the stages that exist on AI site well	2	4.63	1.45

mobile applications in smartphones is useful for educational purposes (Buabeng-Andoh, 2018; Li et al., 2016). This study also found a significant difference that was higher used AI tools in females than in males (71.6 %), which may be related to gender stereotypes and societal expectations. This finding is consistent with a study by Siwale and Mwalemba (2023) that indicated females may be more inclined to adopt technology in educational settings due to perceived social norms or expectations that emphasize the importance of digital skills and proficiency in traditionally male-dominated fields (Siwale and Mwalemba, 2023). Also, females tend to demonstrate higher levels of collaboration, communication, and adaptability in technology-mediated learning environments, these are essential skills for effectively utilizing AI tools in educational settings that agree with the study (Ahmed et al., 2024). In addition, the results of this study revealed that 90.2 % of the respondents who used AI tools were aged between 20 and 24 years, which is consistent with the findings of Buchanan et al. (2021), who showed that most of today's nursing students are so-called “Generation Z" (which is closely related to technology development) and have grown up under the influence of the internet (Buchanan et al., 2021; Honicke and Broadbent, 2016).

6.1. First scale: Information System Success Model (AI) (ISSM)

In the present study, in which nursing students noticed that the AI tools utilized may form a successful information system, which was represented by information quality (IQ) (M = 4.63, SD = 1.5), ranking as one factor, followed by system quality (SQ) (M = 4.54, SD = 1.4). An e-learning system and m-learning apps, which have a directive effect on nurse students' satisfaction with AI systems (M = 4.53, SD = 1.5), is consistent with previous studies (Chang et al., 2023; Mohamed et al., 2021), which showed that e-learning and m-learning apps with higher system, information, or service qualities increase nursing students' satisfaction and increase the likelihood of their adoption of AI tools. In addition, service quality (M = 4.40, SD = 1.5) is one of the strongest predictors in the DL&ML model and has a positive effect on actual technology usage (Omar et al., 2021; Pal et al., 2020). In addition, because of the diversity of nursing student personnel's information literacy, this study showed that AI tools are an updated system that provides quality services to ensure successful utilization and a vital education strategy structure, allowing students to find the required information easily and overcoming the problems they face quickly, safely, and privacy when they use. Additionally, the information quality (M = 4.63, SD = 1.5, ranking 1) obtained is considered helpful, reliable, and interesting, which affects improving their satisfaction, which agrees with the study by Shishakly et al. (2023) that showed that e-learning and m-learning are valuable (Shishakly et al., 2023).

6.2. Second scale: Technology acceptance model (TAM)

AI tools are useful in students' learning. The current study showed that AI tools that participants perceived to be useful and easy to use (ranking 8) significantly improved nursing students' learning performance and effectiveness and provided them with greater control over learning, which agrees with the findings of Tung et al. (2020), who suggested that ease of use is associated with the interface design of various AI tools as a predictor of technology acceptance (Tung et al., 2020). Additionally, this study revealed that the simplicity of AI tools such as m-learning apps is a crucial aspect in ensuring their successful utilization. This can be attributed to the fact that when students perceive the interaction with the mobile learning application as simple, understandable, and clear, their positive attitudes toward its usage are heightened, which is in line with prior studies (Luna et al., 2017;

Malaquias and Hwang, 2019; Shishakly et al., 2023). "I feel AI tools help me improve my knowledge and information" ranks 1 item.

Additionally, this study showed that perceived usefulness and ease of use are associated with students' intentions to use (ranking 3), which is considered a significant factor in determining an individual's motivation to routinely use technology or endorse it to others (Davis, 1989). In this study, nursing students showed an intention to use AI tools such as ChatGpt, several mobile applications, and simulations in nursing education to find information that has a learning effect to enhance their perceived value because they believe that these tools offer major benefits compared with traditional learning, perceived enjoyment, and playfulness (PEP) (M = 4.65, SD = 1.43, ranking 1). Thus, students will develop positive attitudes toward its adoption in their learning, which agrees with previous studies (Buabeng-Andoh, 2018; Chu et al., 2021; Huang et al., 2021; Kang et al., 2023; Min et al., 2020; Oh, 2021). Furthermore, students' technological learning motivation is reflected in their mastery and familiarity with technical skills, thus significantly influencing their intention to use AI tools through online learning websites (Li, 2023; Pan, 2020).

The subjective norm (ranking 5) refers to the person's perception that most people who are important to him/her think he/she should or should not perform the behavior in question, and it is related to the importance of social influences on acceptance that affect individual behavior, as they reported that "I spend a lot of time exploring within the AI tools" (4.37 ± 1.53) (Davis, 1989). In the current study, the nursing students perceived that their teachers were very supportive of the AI tool-based learning used for their learning (engagement, ranking 6). Additionally, they observed that the management of their university supports AI tool activities, which agrees with the study of Chang et al. (2017), which concluded that the necessity of developers or operators of AI-based systems arouses the attention of and obtains support from teachers, influential educators, and parents (Chang et al., 2017). In addition, the subjective norm is one of the learning motivational factors impacting users/consumers' intentions (Li, 2023). Moreover, users' trust plays a crucial role in the successful utilization of AI tools, which is heightened by the secure and risk-free learning environment provided by the university through e-learning and m-learning apps(Wu et al., 2021; Yuan et al., 2021). On the other hand, the Nursing students in this study believe that the use of AI tools is valuable because of increased interest in using them as an educational tool (ranking 3), which agrees with previous studies (Han et al., 2022). Additionally, it provides a suitable learning environment, and using it is well suited for the way to learn, which enhances the sustainability of utilizing AI tools (ranking 7), which is consistent with the studies of Jallad et al. (2024) Alam (2021) and Li (2023), who showed that the application of AI-based systems for students' diverse learning purposes, such as programming, simulation exercise by VR, personal learning evaluation, etc., could help education in terms of educational ambit and content regarding what kind of education is needed (Alam, 2021; Jallad et al., 2024; Li, 2023). Furthermore, it provides safe and efficient learning opportunities for nursing students. Thus, universities and academia can implement new strategies aimed at increasing the utilization of AI tools (Buchanan et al., 2021).

Students confirmed that AI tools are significant social networking tools that facilitate knowledge sharing (item ranking 9), which agrees with the findings of Stathakarou et al. (2020) and Yin et al. (2021), who noted that for the current generation, chat bots (19.10 %) are akin to other social chat tools with which they are already familiar and can revolutionize the learning process for students by providing interactive educational support (Stathakarou et al., 2020; Yin et al., 2021). Consequently, the incorporation of technology into nursing education promotes self-guided and continuous learning, thereby enabling educators to enhance the quality of their instruction (C.-Y. Chang et al., 2022a). Furthermore, it supports personalized learning by offering accessibility, scalability, and affordability (Buchanan et al., 2021; Gause et al., 2022; Stathakarou et al., 2020). Regarding student learning achievements (SSAs) (factor ranking 1), the students in this study emphasized that AI tools achieve education objectives by achieving personal goals (item ranking 4). Similarly, the studies of Kuleto et al. (2021) and Salloum et al. (2019) indicated that the learning motivation (e.g., learning interest, achieving goals, and subjective norms) of learners or students could directly and significantly influence their learning achievement (Kuleto et al., 2021; Salloum et al., 2019). The expansion and effective application of AI-based systems arouse students' interest and help them build specific goals (Huang et al., 2021). In addition, the students indicated in this study that AI tools help to improve their creativity and enhance their knowledge and information. Additionally, it improves students' experiences and performance (item ranking 3), which is in line with the findings of Chang et al. (2022b) and Sandu and Gide (2019), who emphasize that AI tools can be used to deliver timely knowledge to surmount difficulties that arise during the learning process, enhance the organization and re-examination of knowledge acquired through interesting and interactive learning, and increase students' awareness through the possibility of grasping and performing in-depth thinking by studying pertinent information (C. Y. Chang et al., 2022a; Sandu and Gide, 2019). This can be attributed to AI tools serving as assistants or learning facilitators, providing immediate feedback tailored to students' needs. This enables prompt corrections and imparts accurate knowledge based on the feedback received (Lee et al., 2018; Cui et al., 2023). Therefore, it might be speculated that nursing students' increased engagement contributes to improved knowledge outcomes, as new technology typically attracts more attention (Rodríguez-Abad et al., 2022). Therefore, to gauge their attention, technology should be implemented in nursing education (Sen et al., 2022).

Furthermore, in the present study, the nursing students emphasized that AI tools promote engagement (a factor ranking of 6) through feeling strong and vigorous and being involved in their studies by using AI, which agrees with the findings of Min et al. (2020) and Chu et al. (2021), who reported that using AI tools such as chat bots is a pleasant experience and creates a sense of immersion rather than boredom, which can enhance learning effectiveness and engagement across various disciplines, including nursing (Chu et al., 2021; Min et al., 2020). Additionally, it could assist nurse educators in student engagement and retention and help them meet their learning needs (Skiba, 2017).

6.3. Third scale: Online Learning Self-Efficacy (OLSE)

According to the contribution of AI tools to online learning self-efficacy, the students in the current study emphasized that they were willing to accept the challenge of using AI tools as synchronous technology to communicate with others, such as chat bots, manage time effectively, and complete all assignments on time (item ranking 1 & 3). Additionally, they can learn by using AI tools without being in the same room as the instructor and other students. In addition, they are willing to accept the challenge that is necessary to utilize AI tools and complete all the stages that exist on AI sites well (item ranking 2), which agrees with the findings of Essel et al. (2019), Yin et al. (2021), and Boateng and Tindi (2022). This finding could be attributed to the immediacy of the feedback provided by AI tools, which reflects the improvement of learning, as engaging students with teaching assistant chat bots positively impacts academic performance(Boateng and Tindi, 2022; Essel et al., 2019; Yin et al., 2021). Moreover, a microlearning approach is a viable strategy for integrating teaching assistant AI tools in the educational setting. Other instant messaging platforms (Telegram or WeChat) can be employed to encourage students' interactions with teaching assistant chat bots due to their familiarity with these platforms (Boateng and Tindi, 2022; Essel et al., 2019; Yin et al., 2021).

Providing nursing students with education on AI technology performance, usefulness, and social influence in health settings will thus lead to a positive attitude. It will also provide an opportunity to, directly and indirectly, experience AI-based healthcare technology and intervention in clinical settings, increase nurses' self-efficacy, and improve

their behavioral intentions(Kang et al., 2023).

6.4. Limitations

The limitations of this study are that the findings may be limited to specific geographic regions and educational settings, making it challenging to generalize the results to a broader population of nursing educators and students. Furthermore, the study may focus on a specific set of factors influencing the use of AI tools, potentially overlooking other important variables that could impact their future adoption and effectiveness. In addition, the study's cross-sectional design may limit the ability to establish causal relationships between factors and the utilization of AI tools, as it may not capture changes over time or account for temporal variations. Finally, the findings may have limited external validity due to the specific context or conditions under which the research was conducted, potentially restricting their applicability to other educational settings. Future research should replicate this study with randomly selected larger sample sizes from different regions to minimize the limitations of this study. It would also be beneficial to include teachers to address any possible differences between the two groups, which would require interpretation from a different point of view. Moreover, the survey instrument should be enhanced by researchers to assess students' actual application of AI technology, even after its validity and reliability have been tested.

7. Conclusion

While there are certain challenges associated with the shift of nursing education away from traditional teaching methods and toward rapidly expanding teaching and learning strategies, there is a need to adapt teaching strategies and integrate AI tools as useful learning tools, as evidenced by students' positive perceptions of these tools, which include mobile applications, ChatGpt, simulation, and virtual reality. These tools have become essential for students to complete their learning activities. Thus, to address current trends and mentor a new generation of nursing students, undergraduate nursing curricula may need to be revised to incorporate artificial intelligence (AI) tools and promote this technology through active engagement with nursing educators. Furthermore, it helps nursing schools and colleges better comprehend their students, which eventually leads to better use of the AI resources available to them. However, our study's conclusions also provide important guidance and insights for academic research and universities, highlighting the critical elements such as attitude and perceived utility that affect students' use of AI technology and motivating them to adopt these resources for learning.

7.1. Implications for nursing education

This study has several theoretical and practical implications for the ongoing use of artificial intelligence (AI) tools in nursing education in the literature. This is the first study to expand on the ISSM, TAM, and OLSE models to forecast how AI technologies can be used in nursing education. Increased student usage of this technology is anticipated to improve learning outcomes and student performance. Conversely, the study's conclusions demonstrated that the suggested models provide empirical evidence of the important elements that improve the real-world use of AI technologies in nursing education. Additionally, the findings provide insightful information on the attitudes of students and their ongoing plans to include a variety of AI learning tools. Additionally, the results offered recommendations for enhancing knowledge of the multimodal technological factors that should be taken into consideration while creating AI tools across several domains for universities and developers. The results also provided advice on how university educators could design engaging and notable course materials. This helps students utilize AI technologies with concentration and avoid frustration. Artificial intelligence (AI) tools should have the best possible technological resources to address technical issues such as internet speed. Students are more likely to consistently and successfully utilize AI technologies when they have access to sufficient hardware, software, and the internet. Finally, several AI tools that meet the demands and learning requirements of students should be created by AI developers. These tools should be taken into consideration throughout the development process in addition to their ease of use for learning.

CRediT authorship contribution statement

Samar Thabet Jallad: Writing – review & editing, Writing – original draft, Supervision, Resources, Conceptualization. **Khitam Alsaqer:** Writing – review & editing, Writing – original draft, Methodology. **Baker Ishaq Albadareen:** Formal analysis, Data curation. **Duaa Almaghaireh:** Writing – review & editing, Validation.

Declaration of competing interest

Conflicts of interest/Competing interests not available.

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