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Shifting toward Digital Era: Navigating the Role of Artificial Intelligence Literacy and Readiness in Sculpting Nursing Students' Well-being

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Abstract

Background

Globally, artificial intelligence is reshaping nursing education and clinical practices. Therefore, adequate AI literacy and readiness can boost nursing students' confidence and wellbeing. So, **this research aimed** to evaluate the influence of artificial intelligence literacy and readiness in sculpting nursing students' well-being.

Methods

This research adopted a cross-sectional descriptive and correlational research design. Non-proportional stratified sampling on 588 undergraduate nursing students at Faculty of Nursing, Tanta University. Four tools were utilized: Tool (I): The demographic form, Tool (II): The Artificial Intelligence Literacy Scale, Tool (III): Technology Readiness Index & Tool (IV): Student's well-being questionnaire.

Results

The results of this research show that more than half of the students (57.8%) achieved a high level of AI literacy, with less than half of them (45.1%) scoring at the high level of readiness and (59%) of them scored at the high level of wellbeing. AI literacy showed a strong positive correlation with overall well-being ($\rho = .644$, $p < .001$) and was the only significant predictor of well-being in multiple regression ($\beta = .622$, $p < .001$), explaining 41.9% of the variance; technology readiness was not a significant independent predictor ($\beta = .062$, $p = .067$).

Conclusions

All well-being subscales and overall well-being showed strong positive associations with total AI literacy. While individual well-being domains and overall well-being had medium positive associations with the Technology Readiness Index. Thus, this research recommends; incorporating practical exercises with AI tools that allow students to build real-world skills.

Clinical trial number Not applicable.

Introduction

Creation of computer systems that can carry out tasks which normally require human intelligence is known as artificial intelligence (AI) that is swiftly permeating the healthcare industry, revolutionizing both clinical practice and nursing education. The expanding digitalization of healthcare has heightened the requirement for a professional nursing staff that can successfully interface with AI technologies (Al-Anazy, W., Al-Mutairi, N., & Al-Aseeri, R. (2026) (Alrazeeni, D. M., etal., (2026).

Nursing students are increasingly exposed to AI technologies that efficiently reinforce their clinical decision-making, operational efficiency, data analysis skills and patient outcomes, as they become the future frontline healthcare providers must have not only traditional clinical abilities, but also demonstrate digital competency, technical literacy and the capacity to analyze and assess AI-generated outputs (Alrasheeday, A., etal (2026). Thus, it's very essential to incorporate AI in nursing education where the integration of AI in nursing curriculum rely on different options such as; simulations and virtual patients, the use of AI-driven clinical decision support systems, and the investigation of AI ethics and responsibility (Alshowkan, A., & Shdaifat, E. (2025).

The merging of AI in nursing education is beset with challenges including data privacy concerns, ethical dilemmas, resistance from teachers, and financial limitations tied to infrastructure to overcome these challenges will require strategic investment, appropriate training, collaboration with stakeholders and a commitment to safeguarding the core human elements of nursing education, critical thinking, empathy and creativity (Glauberman, G., Ito-Fujita, A., Katz, S., & Callahan, J. (2023), (O'Connor, S., Alharthi, A., Benton-Lee, J., Horcasitas-Tovar, A. G., McArdle, C., Ouner, J., ... & Yuen, R. (2026).

International research shows that nursing students frequently feel unprepared to interact with AI devices in real-world situations thusly AI literacy has emerged as a vital competency, which comprises of theoretical understanding, practical expertise, ethical and legal considerations, and the readiness to adopt AI tools into therapeutic settings (Kembau, A., Putra, I., Tampinongkol, F., & Raditya, D. 2026). AI literacy training will empower nursing students to critically analyze AI-based suggestions, enhance patient safety through AI-assisted decision making and interact synergistically with intelligent clinical systems (Al-Anazy, W., Al-Mutairi, N., & Al-Aseeri, R. 2026)

Evidence from various national and international research findings supported that nursing students ' readiness to interact with AI-based systems has been demonstrated to be positively impacted by their AI literacy. AI readiness is the ability of a person or institution to successfully embrace and utilize artificial intelligence (AI) technologies (Özkan, Z. K., & Eyi, S. 2026). AI readiness in nursing means being aware of artificial intelligence (AI) technologies and feeling flexible and confident in employing digital tools. The more we rely on artificial intelligence for monitoring, diagnosis and decision support the more important it is for nurses to gain the skills to work in high-technology environments (Catan-Inan, F. 2026). In this view, being prepared for AI involves more than just technical proficiency; it also includes professional responsibility for technology adoption, cultural acceptance, and cognitive openness in order to ensure that nurses can transition from awareness of AI to meaningful application in their clinical routines thus becomes an enabling condition for innovation (Chen, Y., Lv, Z., Li, X., Chen, Y., & Li, W. 2026). .

AI literacy and readiness are interconnected constructs that are increasingly recognized as essential competencies for nursing students in the digital health care era. Improved AI literacy and readiness have been associated with better academic performance, increased learning engagement, higher confidence in clinical decision making and lower technology related anxiety. These factors contribute positively to students' psychological wellbeing by

fostering empowerment, resilience and satisfaction with their learning experience (Zhang Y, Ji X, Zhao L and Yang X 2026) , (Ismail, A., Elkhayat, N., Elzeny, O., Adel, T., & Wahdan, M. (2025) .

Conversely, if the nursing students had poor AI literacy, they might be less equipped to use AI, which could make them fearful of technology, increase their stress levels related to their studies, and negatively impact their wellbeing (Lestari, N. S., Gunawan, A., Natalina, H. D., & Triana, I. (2026). In order to increase nursing students' academic performance, psychological health, and professional readiness for an AI-enabled healthcare environment, it is imperative that AI literacy instruction be incorporated into undergraduate nursing curricula (El-Bassal, N. A. M., El-Sayed, A. A. I., & Elgamal, H. G. (2025).

Significance of study: Despite this global momentum, empirical evidence from Egypt specifically linking AI literacy and readiness to nursing students' well-being remains scarce (Yang, Q., Zhao, M., Yang, L., Wang, X., & Yang, C. (2026). Given the global trend towards heightened AI literacy and enhancing student's readiness to apply AI technology in education and health care is become an imperative need (Tbaishat, D. M., & Elfadel, M. W. 2025). In the end, this research will help to ensure that the future nursing graduates will possess adequate level of AI literacy and readiness that will impact confidently on their wellbeing as well as patient outcomes. So, the aim of this research is to evaluate the influence of artificial intelligence literacy and readiness in sculpting nursing students' well-being.

Research Hypotheses:

- H1: There is a statistically significant positive relationship between artificial intelligence literacy and nursing students' well-being (overall and across subscale).
- H2: There is a statistically significant positive relationship between artificial intelligence readiness (Technology Readiness Index) and nursing students' well-being.
- H3a: Artificial intelligence literacy independently and significantly predicts nursing students' overall well-being, when controlling for technology readiness.
- H3b: Technology readiness independently and significantly predicts nursing students' overall well-being, when controlling for AI literacy.

Methods

Research design:

This research adopted a cross-sectional descriptive and correlational research design consistently with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Setting

Data collection took place at Nursing Faculty of Tanta University in Egypt. This institution operates under the authority of the Egyptian Ministry of Higher Education and comply with national regulations governing nursing education. The college includes nine academic departments specializing in various branches of nursing practice and education.

Sample of the research:

This research targeted undergraduate nursing students in the second, third, and fourth academic years at Tanta University, Faculty of Nursing; first-year students were excluded from the sampling frame due to their limited exposure to AI-related coursework and clinical placements at that early stage of the program. The eligible population across these three levels totaled 3,131 students (second year: 1,030; third year: 1,070; fourth year: 1,031). A non-proportional (equal allocation) stratified sampling approach was adopted, whereby an equal number of students were targeted from each academic level regardless of that level's share of the total population, to ensure adequate representation across all three eligible stages of the program rather than over-representing the larger strata. A minimum target of 178 students per level (534 in total) was set based on Cochran's sample-size formula for correlational research, adjusted for the number of predictors in the primary regression analysis (Cochran, 1977). To account for an anticipated 10% rate of attrition and incomplete or unreturned questionnaires, this target was inflated to 202 students per level (approximately 606 in total). Within each level, students who met the following inclusion criteria were invited to participate voluntarily through WhatsApp group announcements and classroom notifications, which ensured fair and equal access to participation across cohorts: voluntary participation in the study; no communication or understanding problems; possession of a smartphone or computer; and access to the Internet. Students were excluded if they declined to provide informed consent, submitted questionnaires with more than 20% of items missing, or had already participated in the pilot study. Of the 606 students approached, 588 returned complete and usable questionnaires, corresponding to a response rate of 97% (588/606) and yielding the final analyzed sample of 588 students reported in this study.

Tools

Tool I: The demographic form

A structured demographic data form was utilized to gather essential background information from participants. The collected variables included age, sex, marital status, place of residence, and family type. Socioeconomic data were also captured, including perceived family income.

Tool II: The Artificial Intelligence Literacy Scale:

AILS was adopted from (Wang B, Patrick Rau R, and Yuan T, 2022), this tool used to assess the nursing student's knowledge regarding artificial intelligence. The scale consists of four sub-dimensions: Awareness, usage, evaluation, and ethics, each dimension included three items; Awareness; assess the ability to identify and differentiate between AI related concepts for example; I can identify the AI technology employed in the applications and products I use. Usage; it was used to evaluate the extent to which students easily and regularly engage with AI for example; I can use AI applications or products to improve my work efficiency. Evaluation; investigating the capability to appraise the effectiveness and constraints of AI technologies post usage for example; I can choose the most appropriate AI application or product from a variety for a particular task. Ethics; assessing the extent to which the students comply with the ethical principles when using AI for example: I am always alert to the abuse of AI technology. The response scale of the scale is a 7-pointLikert type scale that provides the students with seven options ranging from "strongly agree" to "strongly disagree." The scale has a total of 12 items with scores ranging from a minimum of 12 to a maximum of 84 (taking into consideration the reverse of the score for negatively worded items NO. 2, 5, 11). As the score obtained from the scale increases, so does the participant's level of AI literacy.

Tool III: Technology Readiness Index (TRI)

This tool was primitively developed by Parasuraman and Colby (2015) and adopted for utilizing in this study. that encompassed of 16 items intended to measure technology readiness through four domains: for optimism (4 items), innovativeness (4 items), discomfort (4 items), and insecurity (4 items). Each item was rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Optimism and innovativeness reflect positive predispositions toward technology, while discomfort and insecurity represent negative tendencies. To calculate the overall total TRI Score, the negatively worded domains (insecurity and discomfort) were reverse coded by subtracting each item score from 6.

Tool IV: Student’s well-being questionnaire

This tool adopted by the researchers from Khatri P et al., (2024) and applied in this research to determine the student’s well-being, this questionnaire composed of five dimensions and 23 items on a 7-point Likert type scale that provides the students with seven options ranging from "strongly agree" to "strongly disagree.". The dimensions are as follows; Academic wellbeing (9 items) such as; I am satisfied with the quality of faculty at my university; I am satisfied with the course content offered by my university for my degree. Financial wellbeing (4 items) such as; the fees of the course are easily manageable for me; I feel that this course is not expensive. Physical wellbeing (3 items) such as; I actively participate in physical activities/sports at my university; I hardly visit the university infirmary. Psychological resilience (4 items) such as; I can cope with stress easily, I am able to adjust in a changing environment to Relational wellbeing (3 items) such as; I am missed on the campus in case of absence, I find it easy to discuss my personal problems with my teachers. The total score for the items for each dimension is categorized as follows; High wellbeing, Moderate wellbeing, low wellbeing.

Tools of the Study

Prior to starting the study, an official agreement outlining its purpose was obtained from the responsible authority of the Nursing Faculty, Tanta University.

Tool I was developed by researchers based on an extensive review of recent and relevant literature, while the remaining tools were adopted from existing instruments. Tools II, III, and IV were translated into Arabic by the researchers and back translated by a bilingual expert in the field of nursing. Content validity of the tools was established by a jury of five expert professors in the fields of obstetric and gynecological, pediatric, and nursing administration nursing; their feedback informed the final versions of the tools prior to piloting.

Pilot Study

A pilot study was carried out on 59 students, who were excluded from the main study sample, to test the feasibility of the study and to ascertain the relevance, clarity, and applicability of the tools, as well as to calculate the time needed for completion. Based on the pilot findings, the tools were revised and modified accordingly prior to their use with the main study sample.

Data Collection

Data collection took place from March 2026 to May 2026, during which the researcher approached each student individually, briefly introducing herself and explaining the study's title, objectives, and the voluntary nature of participation. Students who expressed interest were provided with further details about the study and asked to provide informed consent prior to enrollment. Following consent, the researcher distributed the self-administered questionnaire packet comprising the four study tools, and each participant completed the questionnaires individually in a quiet, non-disruptive environment. The researcher remained available throughout to clarify any questions without influencing responses, and completion of the questionnaire packet took approximately 20–30 minutes per participant.

Validity and Reliability

Tool's reliability was tested using Cronbach's alpha to measure internal consistency. The constructs relevant to the three study tools were evaluated using all items within each instrument. As shown in Table S2, overall internal consistency was excellent ($\alpha = .936$), reflecting adequate dependability across subscales. Internal consistency was also sufficient at the individual scale level, with Cronbach's alpha values of .757 for the Artificial Intelligence Literacy Scale (12 items), .872 for the Technology Readiness Index (16 items), and .940 for the Student Well-being Scale (23 items) (Table S2).

Because AI literacy, technology readiness, and well-being are conceptually distinct, independently validated constructs rather than facets of a single construct, exploratory factor analysis was conducted separately for each instrument (Supplementary Tables S3–S5). Sampling adequacy was excellent across all three tools (KMO = .872, .861, and .949, respectively; all $p < .001$ on Bartlett's test). None of the three instruments fully reproduced its hypothesized subscale structure in this sample: the AI Literacy Scale's four hypothesized subscales collapsed to two components (53.1% variance), with reverse-worded items (AI_2, AI_5, AI_11) separating from the positively worded items a pattern most likely reflecting a wording/method effect, given that reverse-coding was verified as correct, rather than a distinct content domain. The Technology Readiness Index's four hypothesized subscales collapsed to three components (57.3% variance), broadly consistent with the instrument's documented higher-order "contributor" (Optimism/Innovativeness, which merged) versus "inhibitor" (Discomfort/Insecurity, which largely separated) structure. The Well-being Scale's five hypothesized subscales collapsed to four components (61.7% variance), with Academic and Psychological well-being replicating cleanly as distinct components, while Financial, Physical, and Relational items were less clearly differentiated. These deviations from the hypothesized structures are addressed further as a limitation of the adopted tools' construct validity within this population.

Data Analysis

A systematic coding and data entry process was implemented to ensure correctness and integrity. The data was entered and analyzed using IBM SPSS Statistics (Version 27.0). Descriptive statistics, including means, standard deviations, medians, variances, ranges, and interquartile ranges, were produced for each continuous variable. To make cross-subscale comparisons more convenient, mean percent ratings were also generated. The results were evaluated in conjunction with skewness and kurtosis values after normality was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Both the overall scale and each subscale's internal consistency were evaluated using Cronbach's alpha. The Kaiser–Meyer–Olkin (KMO) measure of sample adequacy and Bartlett's Test of Sphericity were used to assess construct validity and verify that the data was appropriate for factor analysis. Pearson's product-moment correlation coefficient was used to examine bivariate correlations between variables, given that composite scale scores approximated a normal distribution (skewness and kurtosis within ± 1.0; see Supplementary Table S1). The AI Literacy and Technology Readiness Index were entered together to determine the predictors of overall student well-being using simultaneous multiple regression; multicollinearity was assessed using Tolerance and VIF values, model fit was evaluated using R^2 and the overall F statistic, and all coefficient estimates were validated using bootstrap resampling (1,000 samples, 95% confidence intervals).

Results

The socio-demographic data of the 588 nursing students that took part in the study is shown in Table 1. With a mean age of 21.26 ± 0.74 years, females made up the bulk of the sample (84.5%, n = 497); the largest age group was 20–22 years (60.0%, n = 353). Most participants (94.0%, n = 553) were unmarried. Most students (66.3%, n = 390) lived in rural areas, and somewhat more than half (53.8%, n = 314) were from extended family structures. 80.6% (n = 474) of families said they had enough money to cover their expenses.

Table 1
Sociodemographic data of the nursing students (588)

Demographic characteristics	No.	%
Age (years)		
18 < 20	3	0.5
20 < 22	353	60.0
22 < 24	232	39.5
24 ≤ 26	0	0.0
Mean ± SD	21.26 ± 0.74	
Gender		
Male	91	15.5
Female	497	84.5
Marital Status		
Single	553	94.0
Married	35	6.0
Residence		
Urban	198	33.7
Rural	390	66.3
Type of family		
Nuclear	274	46.6
Extended	314	53.4
Family income		
Enough	474	80.6
Not enough	114	19.4

Table 2 shows the distribution of scores and mean percent scores (MPS) for each of the sub-dimensions of student well-being, technology readiness index (TRI), and artificial intelligence (AI) literacy. With an overall mean score of 62.56 ± 8.54 for AI literacy and an MPS of 74.48 ± 10.17%, more than half of the students (57.8%) achieved a high level, while only 0.3% scored at a low level. Evaluation recorded the highest MPS (79.28 ± 13.37%) at the sub-dimension level, with 68.9% of students achieving a high level and a mean score of 16.65 ± 2.81. This indicates that students demonstrated the strongest skill in critically assessing and interpreting AI-generated information. Usage (MPS = 74.63 ± 12.48%; mean = 15.67 ± 2.62; high level: 50.2%) and Awareness (MPS = 72.30 ± 12.25%; mean = 15.18 ± 2.57; high level: 39.8%) were followed. With 2.6% of students scoring at the low level, Ethics had the lowest MPS of the four AI literacy sub-dimensions (MPS = 71.72 ± 13.63%; mean = 15.06 ± 2.86; high level: 38.8%). This suggests that students' ethical reasoning and responsible use of AI lagged their practical and evaluative AI competencies and may represent a gap requiring targeted educational intervention.

With an MPS of 69.49 ± 9.51%, the total mean score for the Technology Readiness Index was 58.37 ± 7.99, with 45.1% of students scoring at the high level and 0.3% at the poor level. Optimism received the highest MPS (73.68 ± 11.54%; mean = 15.47 ± 2.42; high level: 70.6%) of the four TRI sub-dimensions, indicating generally optimistic views regarding the advantages and potential of technology in day-to-day living. Second place went to insecurity (MPS = 70.75 ± 12.22%; mean = 14.86 ± 2.57; high level: 56.8%), followed by innovativeness (MPS = 68.93 ± 12.54%; mean = 14.47 ± 2.63; high level: 54.1%).Among the TRI sub-dimensions, discomfort had the lowest MPS (MPS = 64.61 ± 14.27%; mean = 13.57 ± 3.00; high level: 40.5%), with 6.0% of students reporting low scores. This suggests that a significant percentage of students are uncomfortable and resistant to using technology, which may prevent them from fully engaging with digital learning environments.

With an overall MPS of 73.85 ± 12.75% and a mean score of 118.89 ± 20.52 for student well-being, 59.0% of students scored at the high level and only 1.0% at the low level. Academic well-being had the highest MPS (77.75 ± 12.89%; mean = 48.98 ± 8.12; high level: 69.4%) of the five well-being categories, with 69.4% of students attaining a high level. This suggests that students had the best perceptions of their academic success, engagement, and study environment. This was followed by Relational well-being (MPS = 72.87 ± 15.89%; mean = 15.30 ± 3.34; high level: 53.2%), Psychological resilience (MPS = 71.81 ± 16.52%; mean = 20.11 ± 4.62; high level: 50.2%), and financial well-being (MPS = 70.71 ± 16.85%; mean = 19.80 ± 4.72; high level: 46.3%). Physical well-being recorded the lowest MPS among all well-being domains (MPS = 70.01 ± 16.40%; mean = 14.70 ± 3.44; high level: 43.4%), with 6.3% of students scoring at the low level. Notably, both Physical and Financial well-being exhibited the highest standard deviations among all sub-dimensions (SD > 16%), reflecting wide variability in students' experiences of bodily health and economic security and identifying these two domains as priority areas for targeted student support and institutional intervention.

Table 2
Distribution of the student nurses studied according to their levels and mean percent score (n = 588)

Variables	Low		Moderate		High		Mean ± SD	Mean % Score
	No.	%	No.	%	No.	%		
Awareness	8	1.4	346	58.8	234	39.8	15.18 ± 2.57	72.30 ± 12.25
Usage	7	1.2	286	48.6	295	50.2	15.67 ± 2.62	74.63 ± 12.48
Evaluation	12	2.0	171	29.1	405	68.9	16.65 ± 2.81	79.28 ± 13.37
Ethics	15	2.6	345	58.7	228	38.8	15.06 ± 2.86	71.72 ± 13.63
AI LITERACY (Total)	**2**	**0.3**	**246**	**41.8**	**340**	**57.8**	**62.56 ± 8.54**	**74.48 ± 10.17**
Optimism	6	1.0	167	28.4	415	70.6	15.47 ± 2.42	73.68 ± 11.54
Innovativeness	14	2.4	256	43.5	318	54.1	14.47 ± 2.63	68.93 ± 12.54
Discomfort	35	6.0	315	53.6	238	40.5	13.57 ± 3.00	64.61 ± 14.27
Insecurity	11	1.9	243	41.3	334	56.8	14.86 ± 2.57	70.75 ± 12.22
TRI (Total)	**2**	**0.3**	**321**	**54.6**	**265**	**45.1**	**58.37 ± 7.99**	**69.49 ± 9.51**
Academic WB	7	1.2	173	29.4	408	69.4	48.98 ± 8.12	77.75 ± 12.89
Financial WB	44	7.5	272	46.3	272	46.3	19.80 ± 4.72	70.71 ± 16.85
Physical WB	37	6.3	296	50.3	255	43.4	14.70 ± 3.44	70.01 ± 16.40
Psychological WB	35	6.0	258	43.9	295	50.2	20.11 ± 4.62	71.81 ± 16.52
Relational WB	27	4.6	248	42.2	313	53.2	15.30 ± 3.34	72.87 ± 15.89
TOTAL WELL-BEING	**6**	**1.0**	**235**	**40.0**	**347**	**59.0**	**118.89 ± 20.52**	**73.85 ± 12.75**

Note. WB = Well-being; TRI = Technology Readiness Index.

Pearson correlations between the subscale variables and overall well-being are shown in Table 3. The only correlation that was not statistically significant at the $p < .01$ level (two-tailed) was that between academic well-being and discomfort ($\rho = .079$, $p > .05$). All well-being subscales (range: $\rho = .511–.585$) and overall well-being ($\rho = .644$, $p < .01$) showed strong positive associations with AI literacy (total). Individual well-being domains (range: $\rho = .217–.248$) and overall well-being ($\rho = .264$) had medium positive associations with the Technology Readiness Index. Academic well-being ($\rho = .884$) and financial well-being ($\rho = .873$) showed the strongest associations with overall well-being among the well-being subscales. As these two subscales are components summed into the total well-being score, this strong association is partly definitional rather than an independent empirical finding and should not be interpreted as evidence that academic and financial well-being causally drive overall well-being.

Table 3
Pearson Correlation Matrix among Study Variables (n = 588)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1. Awareness	1														
2. Usage	.502**	1													
3. Evaluation	.397**	.476**	1												
4. Ethics	.470**	.499**	.421**	1											
5. AI Literacy	.733**	.781**	.740**	.770**	1										
6. Optimism	.094*	.202**	.240**	.148**	.203**	1									
7. Innovativeness	.183**	.229**	.283**	.201**	.278**	.584**	1								
8. Discomfort	.195**	.267**	.120**	.272**	.252**	.228**	.487**	1							
9. Insecurity	.196**	.213**	.109**	.172**	.200**	.273**	.365**	.425**	1						
10. TRI	.222**	.311**	.233**	.257**	.310**	.656**	.806**	.740**	.678**	1					
11. Academic WB	.410**	.408**	.553**	.430**	.573**	.210**	.243**	.079	.181**	.217**	1				
12. Financial WB	.433**	.401**	.465**	.443**	.548**	.169**	.267**	.196**	.146**	.247**	.714**	1			
13. Physical WB	.457**	.452**	.435**	.480**	.585**	.170**	.255**	.178**	.157**	.248**	.637**	.711**	1		
14. Psych. WB	.397**	.390**	.496**	.491**	.575**	.210**	.244**	.168**	.166**	.247**	.633**	.659**	.659**	1	
15. Relational WB	.389**	.398**	.432**	.414**	.511**	.155**	.269**	.173**	.176**	.246**	.616**	.648**	.663**	.631**	
16. Total WB	.472**	.471**	.560**	.518**	.644**	.216**	.282**	.159**	.176**	.264**	.884**	.873**	.827**	.825**	

Table 4 presents the simultaneous multiple regression model's outcomes. With R2 = .419, Adjusted R2 = .417, F(2,585) = 211.083, p < .001, and 41.9% of the variance in overall well-being, the overall model was statistically significant. The most important and statistically significant predictor was AI literacy (B = 1.495, SE = .081, β = .622, t = 18.373, p < .001, 95% CI [1.335, 1.655]). This means that, while keeping TRI constant, total well-being improved by 1.495 points for every unit rise in AI literacy score. A positive but slightly non-significant coefficient was obtained using the Technology Readiness Index (B = .159, SE = .087, β = .062, t = 1.832, p = .067, 95% CI [− .012,.330]). No redundancy was found using multicollinearity diagnostics (Tolerance = .866; VIF = 1.155 for both predictors). Coefficient stability was validated by bootstrap resampling (1,000 samples) and residual independence (Durbin–Watson = 1.994).

Table 4
Multiple Regression Analysis Predicting Total Student Well-being from AI Literacy and Technology Readiness (n = 588)

Predictor	B	SE	β	t	p	95% CI Lower	95% CI Upper	Tolerance	VIF
Model fit: R^2 = .419, Adjusted R^2 = .417, F(2, 585) = 211.083, p < .001									
Constant	16.046	5.762	—	2.785	.006	4.730	27.362	—	—
AI Literacy (Total_AI)	1.495	.081	.622	18.373	< .001	1.335	1.655	.866	1.155
Technology Readiness (Total_TRI)	.159	.087	.062	1.832	.067	− .012	.330	.866	1.155

Note. Dependent variable: Total Well-being. Predictors entered simultaneously (Enter method). CI = Confidence Interval; SE = Standard Error; β = standardized coefficient. Durbin-Watson = 1.994. Bootstrap based on 1000 samples.

Discussion

The well-being of any individual depends extensively on whether they can learn to adapt technological changes. Artificial intelligence (AI) become increasingly integrated into clinical practice, the awareness and readiness of future health care professionals particularly nursing students emerge as critical factors for the effective and ethical utilization of AI in health care settings. Nurses and nursing students are in a unique position to drive the adoption of AI in the nursing field and to influence other potential consumers of AI-based technologies. In this context, navigating the role of artificial intelligence literacy and readiness in sculpting nursing students' well-being which offers valuable insights into how to integrate AI into future health care delivery systems.

The current study findings presented as follow; the mean age of the studied students were 21.26 ± 0.74 years, females made up the bulk of the sample (84.5%, n = 497); the largest age group was 20–22 years (60.0%, n = 353). Most participants (94.0%, n = 553) were unmarried. Most students (66.3%, n = 390) lived in rural areas, and somewhat more than half (53.8%, n = 314) were from extended family structures. 80.6% (n = 474) of families said they had enough money to cover their expenses.

Pertaining to AI literacy in this study, an overall mean score of 62.56 ± 8.54 and more than half of the students achieved a high level. This finding supported by Elsawy et al., (2024) who studied the relationship between nurse well-being and artificial intelligence, they stated that more than half of them had knowledge about artificial intelligence. On contrast, Jakalat et al., (2025) who explored artificial intelligence literacy among midwifery students, they revealed that more than a half of the student had a low literacy level toward AI with a mean score of 50.55 + 9.03. From the researcher's outstanding view this disagreement may be attributed to different setting and studying curriculum related to AI.

Regarding AI Literacy sub-dimensions, firstly, more than two thirds of students achieving a high level of evaluation with a mean score of 16.65 ± 2.81. This indicates that students demonstrated the strongest skill in critically assessing and interpreting AI-generated information. Secondly, high level of usage represented among about half of students, with a mean score of 15.67 ± 2.62. Thirdly, awareness mean = 15.18 ± 2.57, with high level among slightly less than one fourth. Fourthly, ethics mean = 15.06 ± 2.86, with high level among less than one fourth of them. This suggests that students' ethical reasoning and responsible use of AI lagged their practical and evaluative AI competencies and may represent a gap requiring targeted educational intervention.

Partially agree with this findings, Catan-Inan et al., (2026) who studied artificial intelligence literacy and readiness in future health care professionals, they claimed that mean scores of awareness, usage, evaluation and ethics were (14.64 ± 2.85, 14.37 ± 3.09, 15.83 ± 3.99 and 15.01 ± 3.46, respectively). Also, Sumengen et al., (2024) who assessed the nursing students' attitudes and literacy toward artificial intelligence, they claimed that mean scores of awareness, usage, evaluation and ethics were (14.21 ± 2.442, 14.02 ± 2.679, 14.88 ± 3.020 and 15.55 ± 2.987, respectively).

Concerning the Technology Readiness Index, the total mean score was 58.37 ± 7.99, with less than half of students scoring at the high level. More than two thirds of students achieving a high level of optimism with a mean score of 15.47 ± 2.42. While, more than half of them had high level of insecurity and innovativeness with mean score of 14.86 ± 2.57 and 14.47 ± 2.63 respectively. Also, less than half of students reported high level of discomfort with mean score 13.57 ± 3.00. This suggests that a significant percentage of students are uncomfortable and resistant to using technology, which may prevent them from fully engaging with digital learning environments.

Partially align with the study findings, Abousoliman et al., (2026), who studied nursing students' readiness for and acceptance of artificial intelligence technologies in clinical skills training, they claimed that participants demonstrated a moderate to high level of overall readiness for artificial intelligence. As well Aktura &Dertli, (2026), who disclosure the readiness of nurses and nursing students to use artificial intelligence in healthcare and influencing factors, they demonstrated that nurses and nursing students had a moderate level of readiness for medical artificial intelligence.

While AL-Olaimat et al., (2025) who exploring readiness and acceptance of nursing students regarding AI-based health care technology on the training of nursing skills in Saudi Arabia, they stated that mean scores for AI readiness including optimism, innovativeness, discomfort and insecurity were (17.88 ± 2.63, 16.02 ± 3.37, 9.81 ± 3.98 and 9.08 ± 3.45, respectively). Furthermore, El-Bassal et al., (2025) who investigating the interplay between professionalism, AI readiness, and self-efficacy, they claimed that total mean scores of AI readiness was 82.24 ± 19.99, this higher readiness than the current study may be due to that nursing staff in actual field had more experience that make them had more readiness for AI in health care setting than nursing students.

The well-being of any individual depends considerably on whether they can learn to adapt

technological changes. In the current study less than two-thirds of them had high level of well-being. Also, about half of them had higher level of psychological well-being and less than half reported higher level of physical well-being. Supporting these findings Ravi & Mohamed, (2023), who assessed well-being among nursing students, found that nearly two-thirds of the study participants reported good well-being. Partially agree with the present study findings, Elsawy et al., (2024), they revealed that about two fifths of them had a high level of total well-being, while about two thirds of the nurses studied had moderate physical well-being and about half of studied nurses had high psychological well-being.

Moreover, the current study results were presented that, all well-being subscales and overall well-being showed strong positive associations with total AI literacy. One plausible explanation is that students with higher AI knowledge in this sample also reported higher well-being; however, as the design is cross-sectional, this association cannot establish that AI literacy causes improved well-being, and the reverse or a shared third factor remain equally plausible. These findings corresponding with Alshowkan & Shdaifat, (2025) who assessed the impact of AI literacy on well-being among nursing students—mediating roles of empowerment and anxiety, they showed that AI literacy significantly influences overall well-being.

Also, Elsawy et al., (2024), they declared that there was a highly statistically significant positive strong correlation between dimensions of wellbeing and dimensions of artificial intelligence among the studied nurses. Again, the present study finding was supported by Alhwaiti, (2023), who conducted a study to explore acceptance of artificial intelligence application in the post-COVID era and its impact on faculty members' occupational well-being and teaching self-efficacy, they found that there was a positive statistically significant correlation between physical, psychological and occupational well-being with acceptance of artificial intelligence application among the faculty members.

Another notable finding was individual well-being domains and overall well-being had medium positive associations with the Technology Readiness Index. In the same line, Tuasikal et al.,)2023) who validated if technological readiness and psychological well-being serve as predictors of students' academic performance, they indicated a significant positive relationship between technology readiness and psychological well-being of the participants.

It is also worth noting that although the Technology Readiness Index correlated positively with well-being at the bivariate level, it was not a statistically significant independent predictor once AI literacy was entered into the regression model (β = .062, p = .067); this suggests that readiness's apparent contribution to well-being may be substantially explained by its overlap with AI literacy rather than an independent effect. Furthermore, academic well-being and financial well-being showed the strongest associations with overall well-being among the well-being subscales, though this is expected given that both are components of the composite well-being score. This pattern aligns with Junca &Dias,)2023) who explored the role of financial status, attitudes, behaviours and knowledge for overall well-being in Portugal, they showed that financial well-being mediated the overall well-being. Additionally, Smith et al.,

)2026) who studied Impacts of financial stress on mental health and wellbeing of nursing students, they found that there were multifaceted and compounding effects of financial stress on nursing students' mental health and wellbeing.

Finally, these findings may represent an important educational consideration within the broader context of ongoing healthcare transformation in Egypt. National initiatives aimed at strengthening the integration of artificial intelligence which can be directed to nursing education programs consequently support nursing students' preparedness for future technology-enabled clinical practices as well as enhance their well-being which support sustainable development goal 3: good health and well-being.

Strengths and limitations

This study offers insights into the relationship between AI literacy, readiness, and well-being among nursing students. Its strengths include the use of validated, previously published measurement tools, an adequate sample size relative to the number of study variables, and rigorous reliability and construct-validity testing (Cronbach's alpha, KMO, Bartlett's test). However, several limitations should also be considered.

Several limitations should be considered when interpreting these findings. First, the cross-sectional design precludes causal inference; the observed associations between AI literacy, readiness, and well-being cannot establish directionality or rule out reverse causation. Second, the use of convenience sampling at a single faculty in one country limits the generalizability of the results to other nursing student populations with different curricula or technology exposure. Third, all variables were measured through self-report questionnaires, which are susceptible to social desirability and recall bias. Fourth, the study did not control for potential confounders such as prior AI coursework, digital device ownership beyond basic access, or prior clinical exposure to AI-enabled technologies. Finally, although Cronbach's alpha and factor-analytic indices supported the reliability and construct validity of the adopted tools within this sample, the study did not report a formal sample-size justification, which limits the ability to evaluate whether the achieved sample was adequately powered for the regression model. Finally, exploratory factor analysis conducted separately for each instrument (Supplementary Tables S3–S5) indicated that none of the three tools fully reproduced its hypothesized subscale structure in this sample: the AI Literacy Scale's four subscales collapsed to two components separated by item wording direction rather than content, the Technology Readiness Index's four subscales collapsed to three components, and the Well-being questionnaire's five subscales collapsed to four components. This suggests the subscale-level structure of these tools may not be fully held in this population, and total/composite scores as used in the primary analyses should be interpreted with this caveat in mind; future work should consider confirmatory factor analysis to formally test measurement invariance in similar samples.

Conclusion

In the light of the main study results; it can be concluded that about half of nursing students achieved a high level of AI literacy and technology readiness. Additionally, less than two-third of them had high level of well-being. Moreover, all well-being subscales and overall well-being showed strong positive associations with total AI literacy, and AI literacy was the only statistically significant independent predictor of overall well-being in multiple regression. While, individual well-being domains and overall well-being had medium positive associations with the Technology Readiness Index, though readiness was not an independent significant predictor once AI literacy was accounted for ($p = .067$). Academic and financial well-being showed the strongest correlations with overall well-being, though this reflects their status as components of the composite score rather than distinct causal drivers.

Implications for nursing practice

The findings highlight important considerations for clinical settings. Nursing students who are more AI-literate showed better well-being, suggesting that practical, hands-on AI exposure during clinical placements — not just classroom instruction — may support both clinical readiness and psychological well-being.

- Incorporate practical exercises with AI tools into clinical training so students build real-world skills and confidence.
- Clinical instructors and preceptors should model responsible AI use and offer timely guidance on integrating AI tools into patient-care workflows.
- Attend to students' physical and psychological well-being directly (e.g., through wellness workshops), given that these domains showed the lowest mean percent scores in this sample.

Implications for nursing education and policy

In educational contexts, the results emphasize the need to embed structured AI-literacy content into the nursing curriculum, focused specifically on the ethics sub-domain, which lagged behind the other AI-literacy components in this sample.

- Academic programs should embed artificial intelligence concepts into coursework, focusing on foundational principles, clinical applications, and the ethical and legal implications of AI use.
- Working nurses require continuing-education opportunities — such as online modules, seminars, and interactive workshops — to stay current with technological innovations.
- At a policy level, faculties and affiliated clinical sites should establish clear governance for ethical AI usage, safeguard patient confidentiality, and ensure continuous technical support for staff and students.

Recommendations for future research

Building on the limitations of this study, future research should:

- Replicate the study on a larger, multi-site, and more diverse sample to improve generalizability of the results.
- Report a formal sample-size justification and participant flow, and adopt longitudinal designs to clarify the direction of the associations reported here.
- Test whether the relationship between AI literacy and well-being holds after controlling for potential confounders such as prior AI coursework and clinical exposure to AI-enabled technologies.

Declarations

Ethical approval

Ethical approval for the study was secured from the Research Ethics Committee of the Faculty of Nursing at Tanta University, Egypt (Reference No. 862-12-2025). The study adhered to national guidelines, institutional policies, and the ethical standards outlined in the Declaration of Helsinki, with particular emphasis on safeguarding participants' rights, privacy, and well-being. Participants received comprehensive information about the study's objectives and were clearly informed that their involvement was entirely voluntary and anonymous. Confidentiality of the collected data was strictly maintained, ensuring access was limited to the designated research team. Written informed consent was obtained from all participants prior to initiating data collection.

Consent for publication

Not applicable.

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Author Contribution

Eman Ahmed El-Kholy contributed to conceptualization, methodology, and data collection and writing; Nagwa Ibrahim Mabrouk Baraka contributed to conceptualization, writing, reviewing, and editing; Samia Mohamed Sobhi Mohamed contributed to formal analysis, statistical analysis, review and editing of the manuscript; and Toha Ali El-Sayed Abo-Hatab contributed to conceptualization, methodology, and data collection and writing, with all authors having read and approved the final manuscript.

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Data availability

The datasets generated during and analyzed during the current study are available from the corresponding author upon reasonable request.

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