Factors Influencing Acceptance of Nursing Informatics System Among Nursing Students in Nursing Education

A Cross-sectional Study

Samar Thabet Jallad, PhD, RN, Raya Sawalha, PhD, Fawwaz Tawfiq Awamleh, PhD

Nursing informatics has become a requirement for nursing curricula, developed and integrated into the healthcare system, and supplied to hospitals with qualified nurses who have sufficient informatics skills already taught at the university level to ensure the delivery of safe and high-quality patient care. This study aims to examine the factors that may impact the integration of nursing informatics into the nursing curriculum. A cross-sectional design was used with 155 nursing students who were enrolled in a health informatics course in nursing program. The TAM, or Technology Acceptance Model, was used. The results showed the majority of participants had some experience with health information systems and nursing informatics in a clinical setting. The average score for nursing informatics acceptance was 3.51 ± 0.76. Additionally, all aspects impacting nursing informatics acceptance—human, technological, organizational, and usefulness and ease of use—were positively and significantly correlated (P = .00). Thus, to successfully integrate nursing informatics, this study demonstrated the importance of technology quality, organizational support, educational training, sociodemographic aspects, and ethical concerns. Educational institutions may improve patient care and healthcare outcomes by addressing these factors and facilitating the adoption and successful use of nursing informatics systems.

KEY WORDS: Nurse students, Nursing education, Nursing informatics, TAM model

In today's technology-driven era and modern healthcare environment, there is persistent pressure to challenge the status quo and improve the quality of nursing education and practice to stay up-to-date with current developments and challenges, through integrating information and communication technologies (ICTs) in healthcare delivery.[1,2] ICT contains a wide variety of components and digital technologies, such as computers, intranet platforms, smartphones, decision support tools, email, and electronic health records,[3] which enhance the electronic capture, storage, processing, and exchange of information to prevent illness, treat disease, promote health, manage chronic illness, increase efficiencies, and improve workflows and knowledge transfer, as well as provide safety and quality in care delivery.[4]

Nurses comprise the majority of health professional groups in all healthcare systems, are the frontline of care, and are major digital technology users, whose roles and capabilities are essential in providing quality care in a dynamic healthcare environment.[5] They deal with a variety of complex clinical technologies such as clinical decision support, clinical information systems, telehealth applications, and clinical data repositories that are used to support interdisciplinary collaboration to coordinate care and guide practice,[6,7] which necessitates the possession of advanced skills and knowledge in informatics.[8] So, nursing education must prepare nursing students with the necessary knowledge, skills, and competencies to utilize ICT effectively and efficiently in the technology-enabled healthcare environment,[9–11] by integrating nursing informatics (NI) into the nursing curriculum and engaging the students in the learning process.[12,13]

The science of NI is the processing and management of health and nursing data and information through the application of computers and ICT.[14] It was established through the integration of nursing science, information science, and computer science to facilitate the delivery of nursing care, administration, and education.[15,16]

BACKGROUND

NI is a part of health informatics, and both of them support the use of technology in clinical settings.[17] Health informatics is defined as the merging of health science, cognitive science, and information science to help the management of healthcare information,[18] whereas NI is defined as the specialization that merges nursing science with multiple information and analytical sciences to identify, define, manage, and communicate data, information, knowledge, and wisdom in nursing practice.[19]

Author Affiliations: Department of Nursing, Faculty of Health Professions, Al-Quds University, Jerusalem, Palestine (Dr Jallad); and Healthcare Management, Public Health Department, Faculty of Medicine and Health Sciences, An-Najah National University, Master program of public health and public health management, Faculty of Graduate Studies, An Najah National University Nablus, Palestine (Dr Sawalha); and Department of Business Administration, Faculty of Business, Amman Arab University, Amman, Jordan (Dr Awamleh).

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Corresponding author: Samar Thabet Jallad, PhD, RN, Department of Nursing, Faculty of Health Professions, Al-Quds University, Jerusalem, Palestine (sgalad@staff.alquds.edu).

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In nursing education, NI is used as part of teaching and learning capabilities.[20] According to the American Association of Colleges of Nursing, the NI was defined as an informatics process and technologies used to improve and manage the delivery of high-quality, safe, and effective healthcare in education and clinical practice.[21] So, integrating NI into undergraduate nursing education is essential to producing competent nurses who are capable of using technology to provide high-quality care, promote evidence-based practice, improve documentation, and reduce medical errors.[22] In addition, it transforms the learning environment and encourages a student-centered teaching approach,[23] and it trains students with digital health knowledge and the skills needed to direct health information systems and technological advancements, thus improving their academic and clinical education.[24]

Nursing students utilize in their learning and practice several NI tools, including e-learning and distance learning, course management systems, clinical information systems, information technology (IT) applications, and health informatics,[25,26] such as database use, podcasts, and social media,[27]as well as simulation scenarios and clinical experiences, electronic health records, smartphones, personal response systems, and incident event reporting systems for use in clinical practices.[28,29]

Furthermore, there are numerous challenges related to technological, financial, and organizational factors faced by NI in nursing education, such as a gap in informatics expertise among nursing students, faculty, and practicing staff[30]; a lack of nursing faculty knowledge, skills, and motivation about its suitable integration into the curriculum, a misunderstanding of the nurse's role[31]; and a deficiency of infrastructure, financial constraints, and resources as a need for specialized personnel who develop and maintain software.[32] In addition, there is a deficit of guidelines for developing NI content and a noncommitment to standards and criteria for teaching NI.[33] There are coercions related to cyber viruses and harm attacks, the unethical use of social media, and the lack of accountability by nursing students.[34] On the other hand, breaching individuals' rights to privacy and confidentiality by posting and sharing private and sensitive information without consent exposes the healthcare practitioner and institution to litigation.[35] Thus, students must be confident and comfortable using ITs safely and effectively to access and use evidence-based data to improve nursing care in the clinical environment.[36]

The Institute of Medicine (2011) recommended that it is important to apply NI in the nursing curriculum by evolving and incorporating it within the healthcare system and providing hospitals with competent nurses who have adequate informatics skills that are already taught at the academic level to ensure the practice of quality and safe patient care.[37] So, this study is aimed to examine the usefulness and ease of use (UEU) and human, technological, and organizational factors that may impact NI acceptance into the nursing curriculum among nursing students.

METHODS

Study Design

A cross-sectional design was utilized.

Setting

The study was conducted in the Nursing Department of the Health Professions Faculty at Al-Quds University. Data were collected from participants via Google Form from November 25 to December 5, 2023, by researchers.

Participants

The whole population was 200 fourth-year undergraduate nursing students who enrolled in the 2-hour-per-week "health informatics" course in the fall semester of the 2023-2024 academic year. Using a medium effect size, $\alpha = .05$, a 5% margin of error, and a 95% confidence interval, the sample size was determined using G*Power analysis 3.1 (Heinrich Heine University, Dusseldorf, Germany). With 125 undergraduate nursing students, this produced a sample size of N = 155, but was a larger sample size than was required.

Inclusion Criteria

All of the students enrolled in health informatics in nursing, in the nursing program at Al-Quds University, in the fall semester 2023-2024 academic year.

Exclusion Criteria

Students who did not enroll in a health informatics course in a nursing program were excluded.

Instrument

The study-based survey examines factors influencing acceptance of the NI system among nursing students, which includes two parts:

Part 1: Sociodemographic Characteristics

This questionnaire was designed by the researchers to include questions relating to gender, age, grade average, IT skill level at enrollment, digital tools used during coursework, whether they have computer skills, and whether they used or tried health information systems or NI in a clinical setting.

Part 2: Technology Acceptance Model

The questionnaire consisted of five sections that were derived from the Technology Acceptance Model (TAM), which was developed by Davis et al.[38] The Unified Theory of Acceptance and Use of Technology, one of the theories and models discussed, was also included. According to Al-Nuaimi et al, TAM is the most often used and significant in technology acceptance research in the healthcare sector.[39] These parts include usefulness and UEU (eight items); distribution of users' responses to NI system human factors, which

have compatibility (eight items); self-efficacy (three items); and social influence (three items); technological factors having information quality and system quality, each of them (four items); organizational factors include top management support (four items); participation of end-users in the NI system implementation process (five items); and the responses of the participants to the NI system acceptance (four items). All of these items are in the form of a five-point Likert scale ranging from 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

Three experts in the domains of administration, nursing leadership and management, health policy, and nursing education reviewed the questionnaire used in this study to assess its structure, synthesis, and content validity.[40] They established that to align the questions with the nursing program's NI curriculum, they had to rephrase the questions into simple sentences without altering their meaning. As a result, meaning equivalence was ensured by contrasting the questions in the existing questionnaire with those in the original.[40] Furthermore, the researchers used theories and prior instruments that were applied in comparable circumstances in several courses and educational institutions to do a thorough literature search and confirm the content validity.[41–43] SPSS (IBM Inc., Armonk, NY, USA) was utilized to examine the reliability of the questionnaire and determine its Cronbach's α value, which was found to be .95; this indicated that the questionnaire has a high degree of reliability.[44]

Ethical Considerations

Before data collection, approval from the Scientific and Ethics Research Committees of Al-Quds University was obtained (RESC/2024-12). Students were informed about the purpose of the study and that participation in the study was voluntary; they had the right to accept or refuse to participate. Confidentiality was ensured during the study. Data were coded with numbers for identification; names were not used. No one other than the researcher had access to the codes. In addition, participants were informed that filling out a questionnaire would be considered informed consent, and they had the option to withdraw their consent.

Data Analysis

IBM SPSS Statistics version 27 (IBM Inc.) was used for all statistical analyses.[45] The means, SD, and frequencies of the study's variables were determined using descriptive statistics. In addition, the internal validity of each variable and the usefulness and UEU of NI systems, as well as technological, human, and organizational factors, were examined using the Pearson correlation test.

RESULTS

Table 1 shows a total of 155 fourth-year undergraduate students in a nursing department who participated in the study. The results showed that 139 participants, or 89.7% of the total, were between the ages of 25 and 29 years; 72.3% were female. As shown, 96% of participants had a grade point average between 70% and 89%. The majority of students (86.5%) have computer skills and a basic level of IT. The digital tools used during coursework were computers and mobile phones. The majority of respondents used or tried health information systems or NI in a clinical setting. Also, this table showed the tests' between-subjects effects of demographic characteristics showed that there are no statistically significant differences between all variables and NI acceptance at a statistical significance level of $P \leq .05$, except for gender, which proved that there are statistically significant differences at a level of $P \leq .05$. R^2 also showed that all demographic variables could explain nursing informatics acceptance by 14%.

Table 2 shows that the data were normally distributed. The impact factor factor revealed that no problem needs to be solved in the absence of overlapping data because all the data are less than 5. The average score of NI acceptance for the whole group was 3.51 ± 0.76 out of 5. The averages were similar across the factors. The average usefulness and UEU (3.87 ± 0.70), the human factor (3.40 ± 0.56), the technological factor (3.47 ± 0.67), and the organizational factor (3.26 ± 0.70).

Table 3 shows the correlations between NI acceptance and the four factors influencing it. Generally, the analysis showed significant relationship between NI acceptance and factors ($P < .001$). Pearson correlation coefficient showed that all numbers fall between $20 \leq R \leq 80$ and that the variables have no weak correlation less than 0.20, and there is no multicollinearity because all numbers are less than 0.80. It also showed that the technological factor achieved the strongest correlation $R = 0.732$, whereas the organizational factor achieved the lowest correlation $R = 0.563$ from the independent variable NI acceptance.

DISCUSSION

To develop competent nurses who can use technology to advance evidence-based practices, improve healthcare documentation, and increase patient care quality while reducing medical mistakes, NI integration into undergraduate nursing education is essential. This study sheds light on the variety of factors influencing the incorporation of NI into the nursing curriculum among Al-Quds University's nursing students.

Because Generation Z grew up with Internet access, the majority of students in this study were between the ages of 25 and 29 years. However, there are no statistical differences between students' age and their acceptance of NI, which is consistent with studies by Buchanan et al and Hernandez-de-Menendez et al that demonstrated those students are prepared to use technological advancements in educational settings.[46,47] However, there are statistically significant differences among

Table 1. Demographic Characteristics and Nursing Informatics Acceptance (n = 155)

Variable	Categories	n (%)	Mean Square	*F*	*P*
Gender	Male	43 (27.7)	2.517	4.411	**.038**
	Female	112 (72.3)			
Age, y	<20	9 (5.8)	0.389	0.682	.565
	20–24	4 (2.6)			
	25–29	139 (89.7)			
	>29	3 (1.9)			
GPA	90%–100%	2 (1.3)	0.091	0.159	.924
	80%–89%	65 (41.9)			
	70%–79%	85 (54.8)			
	≤69	3 (1.9)			
Do you have computer skills	Yes	134 (86.5)	0.500	0.876	.351
	No	21 (13.5)			
IT skill level at enrollment	Non	4 (2.6)	0.103	0.180	.910
	Limited	39 (25.2)			
	Basıc	94 (60.6)			
	Advanced	18 (11.6)			
Which digital tool was used during coursework, you can select more than one	Computer	75 (48.4)	0.400	0.701	.553
	Mobile phone	69 (44.5)			
	Tablet	10 (6.5)			
	None	1 (0.6)			
Did you use or try health information systems/NI in a clinical setting?	Yes	124 (80.0)	1.130	1.980	.162
	No	31 (20.0)			

Significant differences at $P \leq .05$.

students' gender and NI acceptance that showed in this study among females more than males, which is similar to the findings of Ahmed et al, which showed that in learning contexts mediated by technology, females frequently exhibit greater capacities for cooperation, communication, and flexibility. These are critical competencies for successfully utilizing new technologies in educational settings.[48] Although there was no significant difference between utilized digital tools, GPA, having computer skills, and using NI in clinical setting variables and students' acceptance of NI, this study demonstrated that students have used several digital tools, including computers and mobile phones, in their courses and possess a basic level of technological skills. This is consistent with the study by Buabeng-Andoh, which found that students used various digital tools, including mobile phones, for a range of educational purposes. These include improved chances to access resources in actual nursing context and practical nursing learning at any time and from anywhere, as well as communication and information services.[49] As a result, technical expertise can help NI systems be used in clinical settings.[50]

Table 2. Students' Responses Averages of Nursing Informatics Acceptance and Influencing Factors (n = 155)

Item	Impact Factor	Tolerance	Mean	SD
Usefulness and UEU	2.59	0.39	3.57	0.70
Human factor	3.14	0.32	3.40	0.56
Technological factor	2.84	0.35	3.47	0.67
Organizational factor	1.89	0.53	3.26	0.70
NI system acceptance	—	—	3.51	0.76

The study reveals that technological factors significantly influence the acceptance and use of NI among nursing students. These factors include the quality of information systems and the ease with which students can navigate and utilize these systems. Previous studies support this finding, highlighting that technological advancements in healthcare require students to be proficient in using digital health tools and systems.[28,29] The quality of NI systems, including their user-friendliness and reliability, plays a crucial role in students' willingness to adopt these technologies. Therefore, it is essential for educational institutions to ensure that the NI systems integrated into the curriculum are of high quality and user-friendly.

Organizational support, particularly from top management, is critical in facilitating the integration of NI into the nursing curriculum. The study's findings indicate that students are more likely to embrace NI if they perceive strong

Table 3. Correlation Nursing Informatics Acceptance Toward Influencing Factors

		Usefulness and UEU	Human Factor	Technological Factor	Organizational Factor
NI acceptance	Pearson correlation	0.658[a]	0.617[a]	0.732[a]	0.563[a]
	P (two-tailed)	.000	.000	.000	.000
	n	155	155	155	155

[a]Correlation is significant at the .01 level (two-tailed).

support and encouragement from their institution's leadership. This support can manifest in various forms, including providing necessary resources, training, and continuous professional development opportunities for both students and faculty.[31] Furthermore, involving end-users, such as nursing students, in the implementation process of NI systems can enhance their acceptance and effective use of these technologies.[34]

Ensuring the continuity of using technology in nursing education is a critical factor in NI system acceptance.[51] Thus, the adoption of NIS promotes a student-centered approach, facilitating collaboration among nurse educators and healthcare professionals and improving the quality of nursing education and care.[23,52] Effective information sharing strengthens trust between students and their learning and practice in clinical settings and supports smoother transitions between learning and healthcare facilities, ultimately enhancing student outcomes that affect the quality of nursing education and patient care in clinical settings.[53,54] The level of knowledge and skills in informatics among both faculty and students significantly impacts the successful integration of NI through recommended training programs and curriculum enhancements that focus on developing informatics competencies and skills among educators and students to teach NI effectively.[23,55]

Limitation

The study's limitations include the possibility that the conclusions are specific to particular geographical areas and educational environments, which makes it difficult to extrapolate the findings to a larger group of nursing instructors and students. Moreover, the study may concentrate on a certain subset of characteristics impacting nursing students' acceptance of NI systems, therefore missing other significant elements that may influence the systems' future adoption and effectiveness. Furthermore, because the study's cross-sectional design may not be able to account for seasonal variations or capture changes over time, it may be more difficult to determine the causal linkages between variables and the use of NI systems. Because of the particular circumstances or environment in which the study was carried out, the results might not be as applicable in other educational contexts and have low external validity. To reduce the study's limitations, comparable studies should be done in the future using larger, randomly chosen sample sizes from other geographical areas. Teachers should be included as well to address any potential discrepancies between the two groups that would need to be interpreted from a different perspective.

CONCLUSION

This study underscores the importance of integrating NI into undergraduate nursing curricula to prepare future nurses for technology-driven healthcare environments. Based on the study's findings, key factors influencing the acceptance of NI among nursing students include technological aspects—such as the quality and UEU of information systems—and organizational support, such as management's role in endorsing and facilitating NI adoption. Human factors such as self-efficacy and compatibility with the system were also significant, as reflected in the TAM components assessed in the survey.

The results specifically highlight that technological quality and system usability are primary drivers of NI acceptance, as these aspects directly affect students' interaction with and perception of NI tools. Organizational support, particularly from faculty and administration, was shown to encourage system use and integration within the curriculum, further promoting the adoption of NI.

It is noteworthy that although sociodemographic factors, such as gender, demonstrated a relationship with NI acceptance in the analysis, other factors such as age, GPA, and prior IT experience did not show a statistically significant impact on NI acceptance within this sample. Thus, conclusions about sociodemographic influences are limited to gender-related insights as supported by the data.

Implications of Nursing Education

The findings of this study have several implications for nursing education and practice. First, educational institutions should prioritize the integration of high-quality, user-friendly NI systems into their curricula. Second, strong organizational support and the involvement of end-users in the implementation process are crucial for successful integration. Third, continuous training and development programs are essential to equipping both students and faculty with the necessary informatics competencies. Lastly, addressing ethical and privacy concerns through education can ensure that students use NI systems responsibly and effectively.

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