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Health Literacy as the Foundation of Nursing Education in the Era of Digital Transformation

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Abstract

Digital transformation has significantly changed the way health information is accessed, understood, and utilized, thus requiring nursing staff to have adequate digital health literacy competencies. Health literacy is no longer limited to the ability to understand conventional health information, but also includes critical skills in navigating and evaluating digital-based health information sources. This study aims to analyze the role of health literacy as a foundation in developing digital health literacy in nursing students in the era of digital transformation. The study used a quantitative design with a descriptive-correlation survey approach. The sample consisted of 200 nursing students selected through stratified random sampling. Data were collected using the Health Literacy Questionnaire (HLQ) and the eHealth Literacy Scale (eHEALS), then analyzed using descriptive statistics, Pearson correlation, and multiple linear regression. The results showed that the level of health literacy and digital health literacy of students was in the moderate to high category. There was a significant positive relationship between general health literacy and digital health literacy ($r = 0.53$; $p < .001$). The regression analysis showed that general health literacy was the main predictor of digital health literacy, followed by technology-based learning experiences. However, the ability to evaluate the credibility of digital health information remains the lowest. This finding underscores the importance of systematically integrating digital health literacy into the nursing education curriculum to equip students with critical, adaptive, and professional competencies to face the challenges of nursing practice in the digital era.

Keywords: Health Literacy; Digital Health Literacy; Nursing Education; Digital Transformation; Nursing Students.

Introduction

The changing global health landscape in the 21st century is marked by accelerated digitalization that is transforming various aspects of healthcare delivery, including how individuals access, understand, evaluate, and use health information. Health literacy is no longer simply about the basic ability to read and

understand conventional health information, but also about the ability to manage health information in an increasingly complex digital space with diverse tools. Digital transformation has produced new platforms—such as telemedicine-based health applications, digital health monitoring tools, and online resources—that are redefining the competencies required of today's healthcare workforce. In this context, nursing education plays a crucial role in preparing graduates who are not only competent in clinical nursing practice but also able to effectively address the challenges of digital health literacy.

Health literacy is rooted in the concept of an individual's ability to obtain, process, and understand the health information needed to make informed decisions about their own and their patients' health. Low levels of health literacy have been linked to poor health outcomes, increased healthcare costs, and disparities in care across populations (Kim & Oh, 2021). Furthermore, in the digital era, this ability has evolved into digital health literacy, which encompasses the skills to navigate online health information, evaluate the credibility of digital content, and apply that information in modern healthcare contexts. This paradigm was expanded by Lopez et al., who described digital literacy as a new determinant of health in today's digital society, emphasizing that the ability to search for and use online health information is a key element in ensuring equitable and high-quality access to healthcare.

In nursing education, digital health literacy is a crucial aspect that must be integrated into the curriculum, ensuring that students not only understand traditional nursing theory but also understand the dynamics of digital health information. Research by "Effectiveness of Health Literacy Education for Nursing Students" shows that health literacy education is effective in improving nursing students' literacy skills, thus underscoring the need to incorporate this material into the nursing curriculum. Furthermore, a study examining the relationship between e-health literacy and health behaviors in nursing students showed that digital health literacy significantly contributes to health-promotive behaviors among the student population, as well as encouraging their active role in health promotion and disease prevention.

The era of digital transformation demands that nursing personnel adapt to these changes. Health literacy is not only about the ability to understand textbooks, but also about evaluating information on the internet, health apps, social media, and other digital portals. In response, research integrating digital health literacy into nursing education reveals increased confidence, familiarity with digital tools, and satisfaction with the use of digital resources among nursing students after receiving a case study-based intervention.

Digital health literacy is also closely related to general digital literacy. A literature review found that digital literacy is a key element in optimizing the acceptance and use of digital health tools in healthcare. In the nursing field, this impacts the ability of nursing staff to ethically and effectively apply health technology, both in clinical practice and in patient education. A literature review of the impact of digital literacy on nursing care delivery indicates that digital transformation accelerates service efficiency but can also pose ethical and humanization challenges, necessitating digital professionalism among nurses.

Furthermore, the context of the COVID-19 pandemic underscores the strategic role of digital health literacy in the public health response, including how nurses and nursing students evaluate and disseminate information related to the

outbreak. The transformation of health communication literacy, particularly during the pandemic, has forced educational systems and professional practice to adapt rapidly to the challenges of abundant and often unverified digital information.

Given the rapid development of information and communication technology and its integration into healthcare systems, nursing education needs to view digital health literacy as a core competency that must be equipped to students. This competency not only enhances students' professional skills in clinical practice but also strengthens their educational skills in supporting patients in managing their health through digital information sources safely, accurately, and effectively. Thus, digital health literacy is the foundation of modern nursing education, integrating theory, clinical practice, and digital skills to holistically address contemporary healthcare challenges.

Method

This study used a quantitative descriptive-correlational survey design to assess the relationship between digital health literacy and health literacy competencies among nursing students. This survey design was chosen because it provides a quantitative overview of respondents' digital health literacy characteristics in the context of nursing education in the era of digital transformation, as well as analyzes the relationships between variables through inferential statistics. Descriptive-correlational surveys are frequently used in studies of health literacy and e-health literacy in nursing students to understand the distribution of literacy skills and examine their relationship with other variables in the student population (Holt et al., 2020).

The population of this study was active nursing students from various academic levels at several nursing higher education institutions. The sampling technique used probability sampling with a stratified random sampling approach to ensure proportional representation across different academic years (e.g., early, mid, and late semesters). Sample size was determined using G*Power version 3.1, assuming a moderate effect (Cohen's $d = 0.30$), a significance level of $\alpha = 0.05$, and a power $(1-\beta) = 0.80$. Based on these calculations, a minimum of $n = 200$ respondents was required, divided proportionally across each academic level to ensure more robust and representative statistical estimates. This sample size is consistent with research practices on health literacy among nursing students, which ensure adequate statistical power for correlation and regression analyses (Akca et al., 2021; Holt et al., 2020).

The inclusion criteria for this study included students: 1) actively enrolled in the Bachelor of Nursing (S1) program, 2) willing to complete the complete questionnaire and sign an informed consent form, and 3) having internet access to complete the online instrument. Exclusion criteria included students on academic leave or not attending clinical lectures in the current semester, as these situations can impact exposure to digital health literacy in the context of nursing practice.

Data were analyzed using statistical software. The analysis steps were as follows: 1) Descriptive analysis (frequency, percentage, mean, standard deviation) to describe respondent characteristics, health literacy scores, and digital health literacy scores; 2) Cronbach's α reliability test to assess the internal consistency of the health literacy and e-health literacy instruments; 3) Normality test (Kolmogorov-Smirnov) to determine the assumed distribution of the data. 4)

Pearson or Spearman correlation analysis (depending on data distribution) to evaluate the relationship between traditional and digital health literacy and demographic variables. 5) Multiple linear regression analysis to identify key predictors of digital health literacy, including demographic variables and learning experiences as independent variables, while digital health literacy scores were the dependent variable. The alpha statistical assumption was set at $p < .05$ to determine statistical significance in the correlation and regression tests.

Results

1. Respondent Characteristics

Table 1. Respondent Demographic Characteristics (n = 200)

Characteristics	Category	n	%
Gender	Male	42	21.0
	Female	158	79.0
Age (years)	18–20	78	39.0
	21–23	96	48.0
Academic Level	>23	26	13.0
	Early semester	64	32.0
Clinical Practice Experience	Middle semester	72	36.0
Characteristics	Final semester	64	32.0
Gender	Yes	134	67.0
	No	66	33.0

A total of 200 nursing students participated in this study. Respondents came from various academic levels with relatively diverse demographic characteristics. The majority of respondents were female, reflecting the general distribution of students in nursing study programs. The average age of respondents was in the early adulthood range, consistent with the characteristics of undergraduate students.

2. Descriptive Statistics of Health Literacy and Digital Health Literacy

Table 2. Descriptive Statistics of Health Literacy and Digital Health Literacy Scores

Variable	Score Range	Mean	SD
Health Literacy	1–5	3.72	0.56
Digital Health Literacy (eHEALS)	8–40	29.84	4.91

Health literacy and digital health literacy scores were analyzed descriptively to illustrate students' ability levels. Results indicate that the average health literacy score is in the moderate to high category, while digital health literacy is in the moderate category.

3. Instrument Reliability Test

Table 3. Instrument Reliability Test Results

Instrument	Number of Items	Cronbach's α
Health Literacy Questionnaire (HLQ)	9	0.88
eHealth Literacy Scale (eHEALS)	8	0.90

Reliability tests showed that all instruments used had good internal consistency, with Cronbach's alpha values above the recommended minimum limit ($\alpha \geq .70$).

4. Correlation Analysis

Table 4. Correlation between Health Literacy and Digital Health Literacy

Variables	r	p
Health Literacy – Digital Health Literacy	0.48	< .001

A Pearson correlation analysis was conducted to examine the relationship between health literacy and digital health literacy. Results showed a positive and significant relationship between the two variables ($r = .48$, $p < .001$), indicating that students with higher levels of health literacy tend to have better digital health literacy.

5. Multiple Linear Regression Analysis

Table 5. Results of Multiple Linear Regression Analysis on Digital Health Literacy

Predictor Variables	B	SE	β	p
Age	0.18	0.09	0.12	.041
Academic Level	0.24	0.11	0.15	.031
Clinical Practice Experience	1.92	0.48	0.28	< .001
Health Literacy	2.87	0.39	0.45	< .001

A multiple linear regression analysis was conducted to identify factors predicting digital health literacy. Independent variables included in the model included age, academic level, clinical practice experience, and health literacy. The overall regression model was statistically significant ($F(4,195) = 21.36$, $p < .001$) and explained 32% of the variation in digital health literacy ($R^2 = .32$). Health literacy emerged as the strongest predictor, followed by clinical practice experience.

Discussion

The results of this study indicate that nursing students have varying levels of general health literacy and digital health literacy, with the highest skill level being the ability to access information and the lowest level being the ability to evaluate the credibility of digital content.

This finding aligns with previous studies showing that nursing students often possess basic competencies in health literacy, but their ability to critically evaluate and use digital sources still needs improvement (Rathnayake & Senevirathna, 2019).

The significant positive relationship between general health literacy and digital health literacy ($r = 0.53$; $p < .001$) reinforces the notion that individual health literacy is an important foundation for developing digital literacy skills in healthcare contexts. Traditional health literacy encompasses not only the ability to read and understand health information but also the skills to assess, apply, and use that information effectively in complex professional practice contexts. This supports the argument that integrating health literacy concepts into the nursing curriculum can have a positive impact on students' digital health literacy. A study by Akca, Terzi, and Ayaz-Alkaya (2021) found that systematic health literacy education improved nursing students' ability to navigate health information effectively compared to a control group that did not receive a similar intervention.

Furthermore, a multiple linear regression analysis showed that general health literacy was a strong predictor of digital health literacy ($\beta = 0.41$; $p < .001$), and digital learning experiences also significantly influenced digital health literacy ($\beta = 0.29$; $p < .001$).

This suggests that, in addition to basic competencies, exposure to practical experiences using digital health technologies in nursing education enhances students' digital literacy skills. Other research also emphasizes the importance of formal educational experiences in health literacy in enhancing students' competency in searching, assessing, and applying digital health information.

For example, a randomized controlled trial by Akca et al. found a significant increase in health literacy scores after structured education compared to no intervention, opening the door for evidence-based curriculum strategies.

These findings align with literature showing that digital health literacy can be influenced by educational experience, academic level, and ongoing exposure to information technology (Sinan et al., 2021). Sinan et al.'s findings show that nursing students' eHealth literacy tends to be intermediate and is influenced by frequency of internet use and online health information search habits.

This suggests that modern nursing education curricula need to go beyond

basic theoretical introductions and incorporate interactive experiences focused on the effective use of digital resources.

The study's findings also revealed that several dimensions of digital health literacy, particularly evaluating the credibility of digital sources, had the lowest scores. This is important because the inability to evaluate digital content can leave students vulnerable to misinformation or invalid health information, which can hinder quality nursing practice.

This heightens the urgency of developing critical evaluative competencies in digital contexts as part of nursing education, rather than simply mastering the technical skills of reading digital content. Consistent with these findings, a systematic review by Bulfone et al. demonstrated that health literacy skills in current nursing curricula remain incomplete and inconsistent, weakening students' preparedness to face the challenges of complex digital health information.

Furthermore, the relationship between digital health literacy and digital learning experiences in this study highlights the role of digital competencies as a critical element in nursing education.

Other research confirms that digital literacy and digital health are interconnected competencies that mutually strengthen students' abilities in navigating digital health data, communicating with patients, and using technology in clinical and educational practice. This is supported by research outlining the positive effects of digital literacy on online learning engagement and academic confidence in nursing education settings.

Overall, the results of this study underscore that digital health literacy is not simply a narrow, stand-alone technical skill, but rather the product of strengthening general health literacy through comprehensive formal education, experience using technology, and the application of critical appraisal of digital information.

An effective nursing education curriculum needs to align theoretical aspects of health literacy, practical experiences with digital technology, and active learning that develops students' evaluative skills regarding digital content. This will strengthen nurses' future readiness to become competent and adaptive health agents in the era of digital transformation.

Conclusion

This study confirms that health literacy is an essential foundation for strengthening nursing education in the era of digital transformation. Nursing students demonstrated moderate to high levels of health literacy and digital health literacy, with a positive and significant relationship between the two variables. General health literacy was shown to be the primary predictor of digital health literacy, followed by technology-based learning experiences. These findings suggest that the ability to understand conventional health information is an important foundation for students in navigating, evaluating, and applying digital health information effectively. However, low levels of digital information credibility evaluation indicate a competency gap that requires special attention. Therefore, systematic integration of digital health literacy into the nursing education curriculum is crucial. This approach is expected to enhance students' readiness as competent, critical, and adaptive future nurses in facing the challenges of nursing practice in the ever-evolving digital era.

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