The synergy of digital knowledge and skills in forming digital citizenship: a comprehensive assessment on nursing students

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Article Info

ABSTRACT

Nurses play a pivotal role in improving the quality of healthcare services through innovation in the nursing care delivery system by using technological advancement. Digital knowledge and mindset are useful for further developing digital skills and literacy among future nurses to form digital citizenship. This study aimed to analyze the correlation between digital knowledge and mindset with digital skills, literacy, and citizenship among nursing students. The mind sponge theory was used in study conceptualization and results interpretation. This quantitative study utilized a cross-sectional design. The population was all nursing students in two private nursing institutions located in Bangkok, Thailand (n=476) and Surabaya, Indonesia (n=179). Samples were the total population. Self-developed, valid, and reliable instrument was used in data collection. Descriptive statistics and correlation test were used in data analysis (α<.05). Findings showed that digital knowledge did not correlate with digital mindset (p=.94), but it was weakly correlated with digital skills, literacy, and citizenship (ρ=.12-.16; p<.05). Digital mindset was strongly correlated with digital skills, literacy, and citizenship (ρ=.56-.60; p<.05). Digital skills had a strong correlation with digital literacy and citizenship (ρ=.58-.67; p<.05), while digital literacy was strongly correlated with digital citizenship (ρ=.59; p=<.05). The synergy of digital mindset, skills, and literacy are recommended to support the digital citizenship formation. We strongly recommend the implementation of collaborative learning method in nursing education. This method promotes the information filtering and exchanging behaviors among students important for digital nursing.

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1. INTRODUCTION

In today's digital age, efficiency is not solely about technology; it is about harmonizing the synergy between people and technology. For nursing students, developing a digital mindset is not just a skill; it is a mindset that propels them to incorporate technology into their daily roles seamlessly, extracting meaningful value and enhancing the overall quality of care [1]. By embracing these principles, nursing students can truly harness the power of the digital era, revolutionizing healthcare delivery and improving patient outcomes. A digital mindset is not just an essential tool; it is a transformative attitude, a way of thinking that empowers individuals and organizations to identify opportunities within the ever-evolving technological landscape [2]. This digital mindset comprises several key components [3], such as:

- Abundance mentality refers to the concept of viewing technology as an unlimited resource for innovation. It encourages nursing students to explore various digital solutions fostering creativity and out-of-the-box thinking.
- A growth mindset is the belief that skills and intelligence can be developed through dedication and hard work. Nursing students with a growth mindset are more inclined to embrace challenges, learn from failures, and continuously adapt to new technologies.
- The agile approach involves being flexible and responsive to changes.
- Comfort with ambiguity is the ability to navigate ambiguity, especially in the face of new digital tools and technologies. Nursing students should feel comfortable experimenting, learning, and adapting in uncertain situations.
- Explorer's mind is the proactively seek out new technologies, engage in continuous learning, and remain curious about how digital solutions can improve patient outcomes and streamline healthcare processes.
- A collaborative approach is a collaborative effort to work seamlessly with interdisciplinary teams, including information and technology (IT) professionals, to integrate technology into healthcare practices effectively.
- Embracing diversity is essential in the digital age. Nursing professionals should appreciate the variety of digital tools available, understanding that different patients and healthcare contexts may require tailored technological approaches.

Lecturers' teaching strategies can help nursing students get the right mindset as they begin their studies by encouraging them to move out of their comfort zones [4]. Thus, nursing lecturers play a crucial role in shaping the digital mindset of nursing students via the three learning modalities in nursing education, such as classroom meetings, skill laboratory practices, and clinical internships.

In today's rapidly advancing digital era, cultivating digital skills has become indispensable, particularly for nursing students who will play a pivotal role in enhancing the quality of healthcare through technology integration in the future [5]. Digital skills encompass two essential aspects: medium-related skills, which involve operational and formal proficiencies, and content-related skills, which encompass information and strategic capabilities. These skills are incredibly versatile and applicable across a broad spectrum of professions, constituting the most transferable generic skills. In the contemporary workplace, they are highly prized and relevant to approximately 90% of occupations [6]. Instrumental skills involve the adept operational manipulation of technology, while structural skills pertain to the understanding of information organization. Additionally, strategic skills encompass proactive information-seeking, decision-making based on gathered information, and the ability to scan for pertinent data [7].

An initial study by Sari et al. [8], targeting nursing students in Bangkok, Thailand, and Surabaya, Indonesia, found that the basic digital skills were higher in Bangkok compared to Surabaya, but at the same high level. The digital skills were relatively at a more similar level in Surabaya compared to Bangkok. Results of the inferential analysis showed that there was no significant difference in basic digital skills between nursing students in both sites, as they reported high fluency levels in using digital devices (Bangkok vs. Surabaya=53.4% vs. 82.7%), and the digital problem-solving skills were proved to be the most difficult skill to master (Bangkok vs. Surabaya=2.3% vs. 14.5%). Results of this initial study urge us to conduct the current study because it was found that the digital skills among nursing students were not adequate in some aspects, raising the possibilities of impacts on digital literacy and citizenship in particular.

In the realm of healthcare, digital skills hold paramount importance. They empower the healthcare workforce to enhance existing processes and execute their primary responsibilities more effectively. This is particularly significant in-patient care, where professionals bear the accountability and responsibility for crucial aspects such as patient data and paperwork. These responsibilities demand meticulous handling, caution, and care [9]. Digital skills not only facilitate the seamless execution of these duties but also ensure their accurate and secure management. Mastering medium-related and content-related digital skills not only ensures proficient use of technology but also shapes the future of nursing education and practice, empowering nursing students to excel in their roles and contribute meaningfully to healthcare.

Digital literacy is the fundamental basics of digital tools and technologies. Nursing students need to be proficient in navigating digital interfaces, understanding data privacy, and utilizing software specific to healthcare settings. In the realm of nursing education, researchers have extensively explored the digital literacy of nursing students starting from their pre-registration period. Various studies consistently highlight the crucial role of digital literacy as a foundational element and a key determinant of academic success. Adequate digital literacy among nursing students significantly enhances their capabilities in electronic documentation, collaborative teamwork, and information retrieval to support evidence-based practice [10]. Digital citizenship encompasses a comprehensive set of skills essential for navigating the online world effectively with responsibility. There are eight components define a well-rounded digital citizen [11], such as:

−   Citizen identity is the cultivating a positive and truthful self-image on social media, being accountable for actions, and adhering to legal and ethical standards.
−   Screen time management is the striking balance between online activities and real-life responsibilities, demonstrating self-control in both online and offline contexts.
−   Cyber-bullying management is developing the ability to handle, prevent, and build resilience against cyber-bullying without succumbing to emotional reactions.
−   Cyber-security management is safeguarding against data theft and online attacks by implementing security measures such as robust password practices.
−   Privacy management is the ensuring personal and others' privacy online, emphasizing information security and responsible sharing practices.
−   Critical thinking is the analysing and discerning accurate information, applying judgment, and verifying the authenticity of content, including evaluating edited images critically.
−   Digital footprint awareness refers to recognizing that the digital world leaves traces and understanding the potential impact on future opportunities and lifestyle choices.
−   Digital empathy is the demonstrating compassion and fostering positive interactions online, promoting mutual assistance and understanding among peers.

The mindsponge theory (MT) was used in study conceptualization and results interpretation. MT is the human mind's information-processing theory which consists of five core pillars, such as: i) mindset, ii) comfort zone, iii) multi-filtering system, iv) cultural and ideological setting, and v) cultural values [12]. MT relates to self-affirmation theory, 3D multi-filtering process, information processing model, inductive attitude, and model of acculturation, which may explain many socio-cultural issues and various mental products leading to complex human behavior and sociopsychological phenomena [13]. In this study, MT views the digital mindset as a set of core values related to digital technologies. New technology information will be proceed by a collection of information cum processor in the human mind. The subjective benefit-cost judgments are used to filter the new information on new/existed technologies which catalyzing the technology adoption-ejection processes. The aim of this study was to analyze the correlation between digital knowledge and mindset with digital skills, literacy, and citizenship among nursing students. MT will be useful for explaining the phenomena of digital knowledge, mindset, skills, literacy, and citizenship among nursing students in the era of healthcare IT advancement currently.

2.   METHOD

This study employed a quantitative research paradigm, employing an observational analytical approach through a cross-sectional survey. This study focused on capturing the phenomena of the digital knowledge and mindset implicating on the digital skills, literacy, and citizenship in nursing students' population by spreading questionnaires. The primary outcome of this study is the informative data of nursing students in digital perspective. The secondary outcome is the correlational analysis among important concepts of digital knowledge and mindset with digital skills, literacy, and citizenship in nursing students. Potential confounders were assessed through statistical analysis to adjust their potential impact on the study outcomes.

The study targeted all undergraduated nursing students whose status was active in the enrollment of 2022/2023 academic year. The data collection procedure was conducted between February-April 2023. There were two private nursing institutions in Bangkok, Thailand, and Surabaya, Indonesia, being the study sites. There were 655 respondents participated in this study; 476 respondents were Thai people, and 179 respondents were Indonesian. Respondents who denied informed consent were unable to fill in the questionnaires. Respondents who had participated in the on-campus try-out questionnaire testing were excluded. Additionally, discontinuation criteria were applied to respondents providing incomplete responses.

Self-developed instrument was used in data collection process. It was divided into six sections measuring the demography characteristics, digital knowledge, mindset, skills, literacy, and citizenship among nursing students. This instrument was meticulously crafted through an extensive literature review and the invaluable insights of three expert professionals. A five-point Likert scale ranging from 1 to 5, 1 for less confident to 5 for strongly confident, were used to differentiate responses among respondents in all sections, except for the first section of demography characteristics. Each response was categorized into less (scale 1 and 2), moderate (scale 3), and high (scale 4 and 5) levels for determining the degree of measured variables. The experts' evaluations were gauged by using the index of item objectives congruence (IOC), yielded a commendable score of .78, affirming the tool's validity. To assess reliability, the instrument underwent rigorous scrutiny. Employing the internal consistency method, specifically the Cronbach's alpha, the instrument demonstrated a high level of reliability, boasting a substantial score of .85. Furthermore, the

second section of digital knowledge displayed a reliability coefficient (KR) of .6, reinforcing the instrument's credibility and trustworthiness in capturing accurate data for the study.

Data analysis used descriptive statistics and correlation test. Missing data were managed using multiple imputation techniques, and sensitivity analyses were conducted to assess the robustness of the results. Data was analyzed for normal distribution by using Kolmogorov-Smirnov test (K-S Test), ended up with the data denied normal distribution (all p<.05). Descriptive statistics, including means and standard deviations (SDs), were calculated for continuous variables. Specify the inferential statistical tests employed in this study were Rank Spearman correlation test among variables of digital knowledge, mindset, skills, literacy, and citizenship to reveal significant correlations (α<.05). Subgroup analyses were conducted based on study site to explore variations.

This study protocol was approved by the Ethical Committee of Saint Louis College, Bangkok, Thailand, under reference number of E.017/2022 which was issued on July 14, 2022. Before participation, individuals were provided with detail information on the study aim, data collection procedures, and potential risks-benefits. The informed consent was obtained voluntarily through a signed consent form which did not affect any individual grading. Respondents were free to withdraw from participation due to personal reasons at any time with no consequence. Data confidentiality was strictly maintained. Information provided by respondents remained confidential unless explicit consent was given for disclosure. Respondents had the option to remain anonymous, and they could inquire, refuse, or agree to participate in this study. Those consenting to participate were required to sign a formal consent form or provide verbal consent which was recorded for documentation purposes.

3.   RESULTS AND DISCUSSION

Among 655 respondents, the majority was female with Mean age of 20.85 years old who used two gadgets in average for accessing and exchanging digital information. Results showed that the data group of both sites was not differ in terms of digital knowledge, mindset, skills, literacy, and citizenship so that we combined all data and analyzed them altogether. Table 1 explains the results of descriptive statistics.

Table 1. Results of descriptive statistics

	N	Minimum	Maximum	Mean	SD	Interpretation
Digital knowledge	655	.00	9.00	5.12	1.77	moderate
Digital literacy	655	62.00	160.00	123.49	18.49	high
Digital mindset	655	37.00	105.00	79.47	9.21	high
Digital skills	655	9.00	30.00	24.49	3.65	high
Digital citizenship	655	30.00	105.00	67.24	12.55	moderate

Table 1 showed that most respondents had a moderate level of digital knowledge and citizenship, and a high level of digital mindset, skills, and literacy. Based on SD value, the most varied data was the digital literacy, while the most homogenous data was digital knowledge. Table 2 explains the results of correlation test.

Table 2. Results of rank spearman correlation test

	Digital knowledge	Digital mindset	Digital skills	Digital literacy	Digital citizenship
Digital knowledge	ρ=1.00; p=NA#	p=.94'	ρ=.13; p=.00*	ρ=.12; p=.00*	ρ=.16; p=.00*
Digital mindset	p=.94'	ρ=1.00; p=NA#	ρ=.58; p=.00**	ρ=.60; p=.00**	ρ=.56; p=.00**
Digital skills	ρ=.13; p=.00*	ρ=.58; p=.00**	ρ=1.00; p=NA#	ρ=.67; p=.00**	ρ=.58; p=.00**
Digital literacy	ρ=.12; p=.00*	ρ=.60; p=.00**	ρ=.67; p=.00**	ρ=1.00; p=NA#	ρ=.59; p=.00**
Digital citizenship	ρ=.16; p=.00*	ρ=.56; p=.00**	ρ=.58; p=.00**	ρ=.59; p=.00	ρ=1.00; p=NA#

Notes: 'means no correlation; *means weak but significant correlation; **means strong and significant correlation; #means absolute correlation.

Table 2 showed that digital knowledge had no correlation with digital mindset (p=.94), but it was weakly correlated with digital skills, literacy, and citizenship (ρ=.12-.16; p<.05). Digital mindset was strongly correlated with digital skills, literacy, and citizenship (ρ=.56-.60; p<.05). Digital skills had a strong correlation with digital literacy and citizenship (ρ=.58-.67; p<.05), while digital literacy was strongly correlated with digital citizenship (ρ=.59; p=<.05). The strongest correlation was found between digital skills and digital literacy (ρ=.67; p=<.05), while digital literacy had the strongest correlation with digital citizenship among others (ρ=.59; p=<.05). As the digital mindset and skills had a strong correlation with digital literacy

(ρ=.60-.67; p=<.05), it means that the synergy of digital mindset, skills, and literacy were powerful in the formation of digital citizenship among nursing students.

The data from both sites demonstrated uniformity in aspects of digital knowledge, mindset, skills, literacy, and citizenship. This suggests a common baseline of digital competency among nursing students from these two regions and also suggests that certain digital skills and attitudes are universally prevalent among nursing students, transcending regional differences. This highlights the universality of certain digital skills and attitudes within this demographic. By analyzing a dataset of 655 nursing students, we were able to discern patterns and correlations related to digital knowledge, mindset, skills, literacy, and citizenship in this population. The findings shed light on the interconnections between these variables, offering valuable insights into the digital landscape of nursing students.

The significant correlations found between different aspects of digital competency are particularly illuminating. Digital knowledge has a weak correlation with digital skills, literacy, and citizenship among nursing students. This implies that nursing students with a very diverse backgrounds might have various levels of digital knowledge influencing their overall digital capabilities in terms of digital skills, literacy, and citizenship. Nursing students with higher digital knowledge are more likely to possess advanced digital literacy and skills. Overall, digital knowledge was found in a moderate level in the majority. Teaching of digital knowledge and competencies should be firmly implemented in nursing education to form digitally competent future nurses [14], but it is important to lay more emphasis on teaching the required digital competencies [15]. Digital health module may be an effective media for learning because it was proven to sufficiently transfer knowledge about digital health [14]. Other than digital health, the nursing informatics module can equip the students with digital health knowledge and navigation skills of health information systems and technological advancement [16].

Unfortunately, digital knowledge cannot determine the digital mindset, as both variables were not significantly correlated. There is a possibility that this was caused by the inconsistent alignment between personal, academic, and professional digital spaces among nursing students [17]. To form a specific mindset, the possessed knowledge needs to be relevant. The insignificant correlation between digital knowledge and mindset here means the fixed knowledge has resulted in a diverse digital mindset. This was proved by comparing the SD values (digital knowledge<digital mindset: 1.77<9.21). Another reason is that the respondents have more focus on the ease of use aspect than the benefits of adopting technology. A study on 702 Moroccan nursing students showed that the effect of perceived benefits is conditional on the ease of use aspect in determining technology adoption intention, thus recommending the communication of perceived benefits overexposing the ease of use aspect [18].

In digital teaching and learning formats into university teaching, not only technical, financial, and structural prerequisites must be created, but also competence-related prerequisites that enable students to deal with the new formats in computer usage among nurses in rural healthcare facilities. A pronounced digital mindset emerges as the most important component [3]. Moreover, digital mindset may increase the digital health development [19]. A digital mindset also leads to a digital transformation effect on the success of the organization [20], [21]. Therefore, hospitals today require nurses with a digital mindset which characterized by the ability to understand the power of technology to democratize teams and processes [21].

The strong correlation between digital mindset and digital skills in nursing students underlines the importance of maintaining a positive attitude toward technology will be beneficial in developing practical skills. This finding suggests that individuals with a positive mindset towards technology are more likely to acquire and excel in digital skills. This finding also indicates that nursing students with a positive attitude toward digital technology are more likely to have higher digital skills. A positive attitude on technology can foster curiosity, openness to learning, and adaptability, which are crucial traits for mastering various digital tools and technologies. In practical terms, this strong correlation underscores the importance of nurturing a positive digital mindset in educational and professional settings. Encouraging individuals to embrace technology with enthusiasm and confidence can enhance their capacity to acquire new digital skills. Moreover, it emphasizes the need for educational programs and workplaces to focus not only on technical training but also on cultivating a positive and receptive mindset toward digital advancements [22], and those abilities can be developed and improved while utilizing hard work and effort to learn more [21]. Cultivating an abundance mindset as opposed to scarcity is a valuable practice, especially for those working in the healthcare sectors. Evidence suggests that maintaining a scarcity mindset stifles creative solutions to challenges and may even constrain empathy. Purposeful practices that encourage the development of an abundance mindset are recommended [23].

The strong correlation between digital mindset and digital literacy means that nursing students with a positive digital mindset are more likely to possess higher levels of digital literacy. This could also mean that individuals who have an optimistic attitude toward digital technologies are more adept at using and understanding them. Digital literacy is essential in the modern age, especially in the field of nursing, where technology plays a significant role in healthcare practices. Digital literacy is an essential requirement for nursing students and nurses in general because it links to safe and evidence-based patient care, but exposure to digital technology does not equate to digital literacy and has resulted in deficits in nursing education program [24]. In higher education, digital literacy is mostly approached by technical skills and knowledge, but today it is embedded in everyone's life and learning contributing to individual well-being [25]. Therefore, it is necessary to integrate digital literacy skills into nursing education curricula to overcome the lack in nursing education programs and to increase the exposure to nursing students important for developing a positive digital mindset.

The strong correlation between digital mindset and digital citizenship means that nursing students with a stronger digital mindset are more likely to exhibit positive digital citizenship behaviors. This could also mean that those who are open to embracing technology and digital innovation are more likely to engage in responsible and ethical online behaviors in the future. In the emergence of the society 5.0 era, positive digital citizenship behavior which is driven by digital ethics is important for avoiding issues of cybercrime, cyberbullying, fake news or hoaxes, and hate speech [26]. The current society is still lacking in these aspects so we can see many of those cases happening today. Study findings related to digital mindset indicate that we need to further explore the degree of digital mindset in our society to evaluate the public's digital citizenship behavior.

Nursing proficiency includes technological skills that are highly required in the contemporary healthcare environment [27]. The strong correlation between digital skills and digital citizenship means that individuals with higher digital skills are more likely to demonstrate positive digital citizenship. This suggests that competence in using digital tools and technologies is associated with responsible online behavior. Another study on nursing students showed that the respondents' digital skills were mostly developed via everyday life experiences and trial-and-error approaches [28]. Therefore, offering tailored digital skills enhancement to nursing students on campus can empower them to responsibly act in the digital landscape in everyday life.

The strong correlation between digital literacy and digital citizenship underscores the connection of understanding digital information and responsible digital behavior. Digital literacy refers to the ability to find, evaluate, and use digital information effectively, while digital citizenship involves responsible and ethical use of technology, encompassing areas such as online etiquette, privacy, and security. This strong correlation suggests that digitally literate individuals possess the skills to navigate and critically assess online information. They are more likely to engage in responsible digital citizenship. Digital literacy is a necessity in this era of disrupted society to become a smart and good digital citizen [29]. Understanding how to verify the credibility of online sources, distinguish between reliable and unreliable information, and use digital tools effectively can empower individuals to make informed and ethical decisions in their online interactions. Sometimes these abilities of information-filtering are lacking in university students because they are fast enough to forward unverified information [30]. This act may result in the spread of false news or hoaxes representing the digital citizen's unpreparedness in facing the disruptive era [29]. Case study methods and project-based learning are highly recommended at the university level because they are very effective in helping students build a critical attitude, be able to filter information better, and become appreciative and supportive in reacting to or managing social life problems [30].

Overall, results suggest that there are meaningful relationships between digital knowledge, mindset, skills, literacy, and citizenship among nursing students. These results will lead to the development of the role and transformation of nursing education [20], [21]. Strengthening digital skills and fostering a positive digital mindset may contribute to the development of responsible digital citizenship and literacy.

This study is not without limitations. Limitations of this study include its specific focus on the nursing student population in two private institutions in Bangkok and Surabaya. Nonetheless, the inclusion of a substantial number of participants from these regions has provided a rich dataset for comprehending the digital competency of nursing students. Findings have revealed intricate relationships between various aspects of digital competency, offering valuable insights into the digital landscape of nursing students. However, correlation does not imply causation, and other factors could be influencing these relationships, such as gender and income. Further study may investigate the significant factors influencing these correlations, providing valuable insights for future educational strategies and policies. Fully understanding these correlations is crucial for educational institutions and policymakers to develop targeted interventions and curriculum enhancements by aiming at improving digital competencies and fostering positive digital attitudes and behaviors among nursing students.

4.   CONCLUSION

This study's results underscore the positive interplays between digital knowledge, mindset, skills, and literacy in forming digital citizenship among nursing students. Digital knowledge is weakly correlated with digital skills, literacy, and citizenship, but it cannot determine the digital mindset. Digital mindset is strongly correlated with digital skills, literacy, and citizenship. Digital skills are also strongly correlated with digital literacy and citizenship. Finally, digital literacy is strongly correlated with digital citizenship. Among all, digital skills and literacy have the strongest correlation; but in forming digital citizenship, digital literacy has the strongest correlation among others. The synergy of digital mindset, skills, and literacy is recommended to support digital citizenship formation. The collaborative student-centered learning method facilitating the information filtering and exchanging behaviors among nursing students is encouraged more at the college-university level.

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