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Research Article

Assessment of Digital Capabilities among Nursing Students in UAE: A Quantitative Study

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Abstract

Background: Digitalization is emerging prominently in all educational environments across the globe. Accordingly, it is crucial to assess the level of digital capabilities among nursing students to be able to provide those students with the necessary support to succeed in the future of digital health. Therefore, we argue that digital literacy cannot be ignored and should be embedded in undergraduate nursing curriculum to empower students to be fully engaged in the future of digital health. **Objectives:** The aim of this study was to assess the level of digital capabilities among nursing students. **Methods:** The study was a quantitative study with cross-sectional design. 200 students were recruited using a systematic random proportionate sampling technique at Nursing Colleges, United Arab Emirates. Data were collected using a structured self-administered questionnaire Digital Capabilities and Self-efficacy. Univariate analysis, Mann-Whitney U, and Kruskal-Wallis H were used for data analysis according to the type and distribution of data. **Results:** Superior results are seen for digital learning and development, in which participating nursing students seem competent in everyday digital literacy such as accessing learning resources. The students are competent in using the technology to complete assignments and conduct online tests, but they scored low on using the tools to search the databases effectively and have to skills to take advantage. There was no significant difference between students' level of study, parents' education, the type of devices used by the students, and their digital literacy skills. This present study reports that the digital literacy skills among nursing students in urban and rural regions differ significantly. **Conclusion:** Overall, students did not report any problem being involved in a digital educational environment because they are already engaged with technologies in their personal life

Keyword: Digital capabilities; Literacy; Technology; Nursing education

Background

Technology has changed the roles of teachers and learners. However, access to information and educational opportunity has enabled the shifting of the teacher's role to the "guide on the side" as students take more responsibility for their own learning to gather relevant information using technology [1]. Besides the basic computer skills that students need, there are several other skills that students needed to have to succeed in an online environment such as being able to search the database, think critically, and analyze and use the content [2]. Hence, navigating online learning is not about knowing how to send emails, attend lectures and submit assignments [3]. It is crucial that the students must exhibit the ability to navigate the online system with critical thinking skills that allow them to analyze and comprehend the content. Additionally, such skills will be carried out with students in their careers [4].

Digital literacy, which is one of the challenges of the integration of technology in academic courses, has been defined as the competencies and skills required for navigating a fragmented and complex information ecosystem [5,6]. The concept of "digital literacy" was introduced in 1997 by Paul, He defined this concept as, "the ability to understand and use information in multiple formats from a wide range of sources when it is presented via a computer" [7]. The idea that digital literacy is not about, how to get around the internet rather it is important to evaluate and interpret the information being searched to be able to analyze it and use it effectively [7].

Nowadays, digital literacy is important more than at other times as the current healthcare system depends largely on [8]. Thus, healthcare providers including nurses have the urgency to be at the level where they can access online information and know how to use technology efficiently [9]. Hence, for nursing students to have the digital capabilities to be able to maintain a good level of digital literacy such practices should be introduced earlier in the program [10,11]. Without investing on our nursing students early in their undergraduate program, those students could experience a significant lack of digital competency [12,13]. This result could affect the quality of healthcare service delivery [14].

In the recent age, digitalization been clearly embedded in all aspects of life socially, economically, politically, and most important in educational organizations. From this end, digital capabilities frameworks are developed to help academic staff and students to cope with the highly demanding digital environments we are in. Joint Information System Committee framework is one of digital capabilities frameworks that developed by academic institutes, and universities. JISC framework embeds the capabilities and enablers into its six elements, which are designed mainly to help staff as well as students to recognize their strengthens and dimensions to be improved [15].

Digital capabilities are defined as, "those skills, competencies and capabilities which equip someone to live, learn and work in a digital society" [16,17]. Figure 1 depicts the six elements of digital capabilities framework. First item, digital proficiency, and productivity lies in the heart of the model, attached to it the five remaining domains as follows: Digital creation, problem solving and innovation; Digital learning and development; Digital identity and wellbeing; Information, data, and media literacies; Digital communication, collaboration, and participation [15].

The first element of the framework has two parts, digital proficiency referring to the accessibility to technologies, and productivity meaning the desire to use technology to meet needs. Second, digital creation, problem solving, and innovation is meant with the capacity to create, solve problems, and adopt new practices using new technologies [17]. Third, digital learning and development refer to the capacity of turning digital learning opportunities to gain and accordingly support others in digital settings. Fourth, digital identity and wellbeing concerned with the capacity to manage digital reputation and simultaneously the ability to maintain work-life balance in digital organizations. Fifth, information, data and media literacies the power to find information and handling data in a customized form of information. Final component, which is digital communication, collaboration and participation meaning the ability to communicate well, and efficiently collaborate and participate in a build digital network [15]. The previous explanation of the JISC digital capabilities framework magnitude the fact that the importance of digital capabilities lies on the ability to navigate the complex health care system [17].

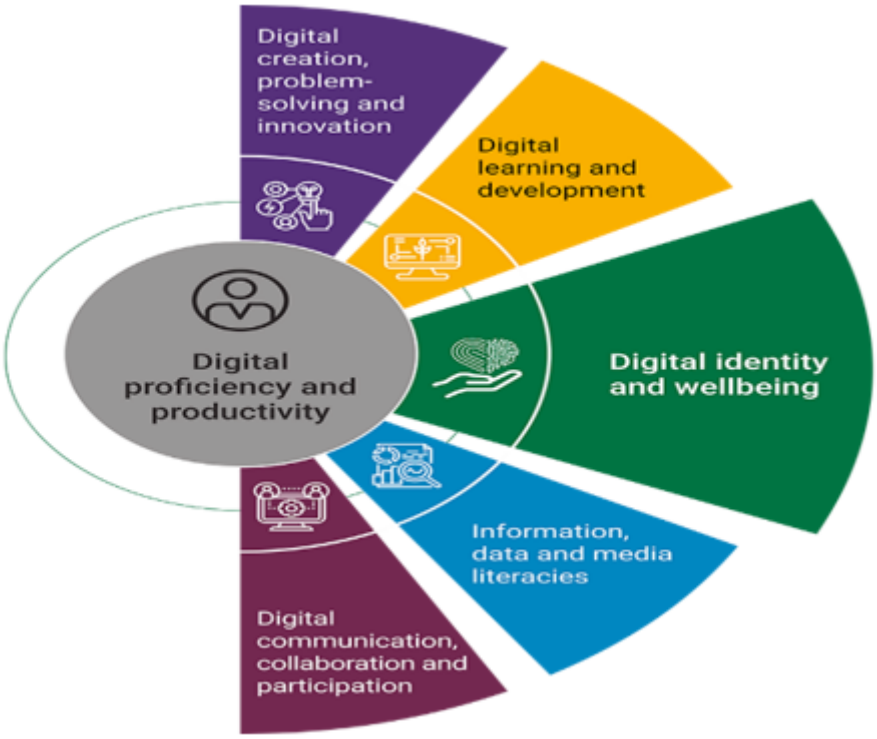

Figure 1: Building digital capabilities: the six elements defined.

However, nursing students are exposed to such concepts only when they start training in the hospital settings. This, consequently, has created challenging moments where those students start feeling incompetent about their digital skills [19]. Previous study explored the views and experiences of university students, including nursing students about digital competency. According to the study, most of participating students reported that they had no training nor support on digital literacy in the school. The study recommended universities to prepare their own students to be at an appropriate level of digital literacy to be able to succeed in the future [19,20].

Digital literacy should be embedded in the nursing curriculum to prepare students to the future of digital health. In a recent study titled, "Are Future Nurses Ready for Digital Health?", the significant gap that exists in the undergraduate nursing education where nursing students are not prepared to transfer their digital skills into nursing practice if they have any been addressed [20]. The authors concluded that nursing students are confused with digital literacy knowledge [20,21]. Therefore, incorporating digital literacy in the nursing curriculum is paramount. Digital technology can be integrated as a part of the study program in nursing if it is based on educational principles and structural factors [22,23]. Therefore, digital literacy cannot be ignored and should be a core component of the undergraduate nursing curriculum [24,25]. Preparing nursing students to enter the workforce with informatics competencies already taught at the academic level could help improve the quality and safety of patient care, as well as be critical for ensuring career progression [13]. Providing nursing students with sufficient experience early in the program has been associated with a high competency level of digital literacy.

The literature shows that there are a few studies that aimed towards assessing the level of digital competency among university students and those studies showed that the digital competency levels among students are highly rated as good or satisfactory [26]. For instance, one study in Amman investigated the level of digital skills among students at Amman Arab University to answer the research question, what is the level of digital skills among Aman Arab University students? The results of this study showed a moderate level of digital skills for the study sample [27].

However, the important question remains unanswered, does knowing how to navigate the digital world reflects student's competency level on digital literacy? Nowadays, we take for granted that the new generation excel at using the digital world. However, in fact students feel comfortable in using social media

and searching the website, however, when it comes to learning, they have a huge gap [28].

Purpose

The purpose of this study aims at assessing the level of digital capabilities among nursing students. The term "digital literacy/digital competence" is used to denote the application of information technologies in the educational environment.

Methods

Study Design

The study employed a cross-sectional, descriptive, quantitative study that was done at Nursing college in United Arab Emirates.

Samples/Participants

The study employed a systematic random proportionate sampling technique in selecting the respondents. Epi-Info program was used to estimate the subject size; the minimal sample size was estimated to be 108. The research sample was composed of 200 undergraduate female nursing students for better results and statistical analysis. Among them, 131 of them live in urban areas and 69 live in rural areas and use either a laptop, tablet, smartphone, or a combination of these for e-learning. The data was collected from level 2 and 3 students. The pedagogical approach to the students in both levels was similar since they attended the completely theoretical curriculum using the same applications and had a similar pattern of clinical and theoretical courses in their study plan for the semester.

Instrument

A structured self-administered questionnaire (Digital Capabilities and Self-efficacy (DCSE) was used to collect the data located at the ZENODO repository (http://doi.org/10.5281/zenodo.3900607) [29]. The researcher modified section 1 in the tool based on the setting, related literature, and guidance from the experts in the field. In this study. The validity was 96% and reliability of the tool was ascertained using Cronbach's coefficient alpha test which was 0.90. Whereas undergraduate nursing students completed a 25 items questionnaire regarding digital capabilities. Each student spent approximately 10 -15 minute. First section contained 6 questions, of which 3 items refer to socio-demographic characterization (residence, level of education, and parents' highest level of qualification). The remaining are 3 multiple-answer questions about the types of devices predominantly used for academic tasks, applications that students used, as well as their behaviors over their independent study period. Section 2 of the questionnaire contained 19 single-answer statements with responses stated on a seven-point Likert scale: 1 depicted Not at all; 2- Very small extent; 3- Small extent;4- Moderate extent; 5- Fairly great extent; 6- Great extent; 7- Very great extent. The sample size was calculated to be 160, using the G*Power 3.1.9.2 program, with a median effect size of 0.25, significance level of 0.05, and power of 0.90 for F tests. In total, 220 students were surveyed, considering a 20% dropout rate. Finally, data from 200 students were analyzed.

Data Collection

The study utilized an online survey to determine how students' digital literacy-related attitude influenced their Independent E-learning, which was delivered to students during the period between December and March 2021. The online survey was created in Google Forms and sent to students through emails after confirming that the participants' identities would be kept anonymous. Prior to the commencement of the survey, students were made clear about the objectives of the study as well as, and the potential participants were asked to click either on the agreement or refusal button to indicate their approval or refusal to participate. The researchers' contact information was provided, and the participants returned the survey by clicking the "submit" button at the end of the survey. Before the actual data collection, the principal researcher got the approval to conduct the study from College Ethical Committee.

Data Analysis

The IBM Statistical Package for the Social Sciences (SPSS), version 28 software (190) was used for statistical analysis. Normality of the data was tested to indicate the appropriateness of using parametric testing for normal distribution. The sample was found to be not normally distributed; a Shapiro-Wilk test showed a significant departure from normality ($W=.899$, p-value= $<.001$), based on an outcome we decided to use a nonparametric test. Therefore, Mann-Whitney U test was employed. Descriptive analysis was used to assess the characteristics of the study samples. The Chi-square was used to determine the association between residence and remaining sociodemographic data (student's level, parent education, and devices mainly used for studying). The Confidence Interval (CI) was established at 95%, whereas the statistical significance threshold was set at $P<0.05$.

Ethical Considerations

In this study, Ethical approval was obtained from the Faculty of Fatima College Ethics Committee (approval number: FCEC-1-21-22-BSN-3-SF on 30 November 2021). The Nursing students who participated in this study were aware of the purpose of the research by sharing the information sheet and information about the research team on the front page of the survey. Participants were voluntarily participated after confirming that necessary precautions were taken to protect the data confidentiality according to current European regulations on data protection (The European Parliament

and the Council of the European Union EU, 2016) [30]. Security measures were implemented when the data is stored and analyzed, for instance, student names and emails were kept anonymous.

Results

Table 1 describes the percentage distribution of the characteristics of the students from 4 campuses. Most of the students 131 (65.5%) were from the Urban area and the remaining were from rural areas. Most of the students 129(64.5%) were 2nd-year undergraduate students, while the remaining students were 3rd-year undergraduate students. Regarding the highest educational qualification of the parent, it was noted that more than half 121(60.5%) of them had secondary education or less. The students used multiple devices for their study and most of them used laptops or Personal computers for their study the usage of smartphones as the main device was noted among 48(24%) of the students.

Characteristics of the students		Frequency	Percentage
Residence	Urban	131	65.5%
	Rural	69	34.5%
Students level	2nd-year undergraduate student	129	64.5%
	3rd year undergraduate student	71	35.5%
Parent's level of qualification	Secondary education or less	121	60.5%
	University education or higher	79	39.5%
Devices mostly used for studying purposes	Laptop/PC	79	39.5%
	Tablet	73	36.5%
	Smartphone	48	24.0%

Table 1: Percent distribution of student profile (n=200).

Table 2 describes the students' responses to questions related to used applications and their behavior during their lecture and study time. Among the diverse types of applications or software available, a significantly high number of the students 163 (81.5%) used web configuring applications for studying and the use of spreadsheet software was reported as the lowest used.

Students exhibited multiple habits during the lecture time. Most of the students 140 (70%) reported the habit of keeping a notebook in hand, while a significantly similar number of students 129(64.5%) reported that they were just paying attention to the lecture. Comparatively a smaller number of students receive and send messages (12%) and check social media during lectures (11.5%).

Students normally use different habits during study time. While considering the habits exhibited during the independent study time, many students 131(65.5%) were reading their personal notes on a digital device and the least number of students 4 (2%) were playing games on the phone while studying the lecture material.

Online applications for studying purposes	Frequency	Percentage
Word processing software	112	65.0%
Spreadsheet software	31	15.5%
Presentation software	125	62.5%
E-mail packages	72	36.0%
Virtual Learning Environment	62	31.0%
Social media applications	64	32.0%

Web conferencing applications	163	81.5%
Behaviors during lecture time		
Just pay attention to the lecture	129	64.5%
Keep notes by hand	140	70.0%
Read PowerPoint slides on a digital device	64	32.0%
Type notes on a digital device	87	43.5%
Use digital device to be engaged with learning activities	54	27.0%
Receive and send messages	24	12.0%
Browse the Internet	63	31.5%
Check social media	23	11.5%
Behaviors during independent study time		
Just reading the lecture material online	116	58.0%
Accessing the lecture capture videos	99	49.5%
Searching the University Library	24	12.0%
Reading your personal notes on a digital device	131	65.5%
Comparing information from two or more sources to understand the topic	80	40.0%
Posting questions to your peers helps you understand better	66	33.0%
Search the Internet for reading around the lecture topic	97	48.5%
Remain online with your social media while studying	15	7.5%
Play games while studying your lecture material	4	2.0%

Table 2: Percent distribution of students' answers about platforms and their behavior during lecture time and study time (n=200).

JISC framework was used to assess the information literacy skills among students based on a 7-point rating scale. Table 3 describes the details of this. All 200 students gave their opinion all each of the components. Among the skills related to digital independent learning, the highest mean score (6.06±1.3) was noted in accessing the learning resources and the lowest mean score (5.10±1.9) was reported in reading the journal articles and other relevant material provided to the students by the teachers. The highest mean score (5.88±1.3) was reported for the skill in completing the assignments and /or completing online tests/tasks while the least (4.87±1.8) was noted for using tools of database e arch.

Digital communication and collaboration skills were analyzed to see how the students use their digital skills to collaborate with others they come across. The mean scores were noted almost the same between having good contact with their lectures (5.60 ±1.5) and their practice of communicating the study or learning-related matters (5.66 ±1.5) with their students. The practice of posting comments on other people's work was noted to have the lowest mean score (4.49±1.98). Digital creativity skills were noted to have the lowest mean score reported by the students. The mean score (4.97± 1.9) of skills in collaborating online with fellow students for learning processes is higher than the mean skill score (4.02±2.2) in keeping a self-log or contributing to the development of the wiki. Skills in digital identity were reported to be the second highest mean score with a high mean value (5.06±1.8) as reported in building and or participating in digital online groups like Facebook or What's app group, while the mean score (5.01±1.8) was noted in actively involving relevant professional networks.

	N		Mean	Median	Mode	Std. Deviation	Sum
	Valid	Missing					
Digital independent learning (5 Items)							
Access Learning resources	200	0	6.06	6.00	7	1.281	1211
Supplement lecture notes	200	0	5.69	6.00	7	1.502	1137
Access course/module information	200	0	5.56	6.00	7	1.496	1112
Read learning material provided by my teachers.	200	0	5.10	6.00	7	1.857	1020
Browse webpages related to lecture topic.	200	0	5.52	6.00	7	1.582	1104
Digital information/data management (4 Items)							
Use searching database tools	200	0	4.87	5.00	7	1.834	973
Browse and watch videos related to the lecture	200	0	5.66	6.00	7	1.488	1132
Complete assignment(s) /complete online tests/ tasks	200	0	5.89	6.00	7	1.300	1177
Be involved in online learning activities	200	0	5.24	6.00	7	1.648	1048
Digital communication and collaboration (6 Items)							
Create my own digital material related to module topic	200	0	4.83	5.50	7	1.995	966
Have contact with my lecturers	200	0	5.60	6.00	7	1.510	1120
Communicate with my peers on learning related matters.	200	0	5.66	6.00	7	1.545	1131
Share learning resources with my peers and/or my teacher.	200	0	5.38	6.00	7	1.724	1076
Use social media networks	200	0	4.90	6.00	7	1.965	980
Post comments on other people's work.	200	0	4.49	5.00	7	1.980	897
Digital creation (2 Items)							
Collaborate online with fellow students for learning purposes.	200	0	4.97	5.00	7	1.852	993
Keep my own blog and/or contribute to the development of a wiki	200	0	4.01	4.00	1	2.243	803
Digital Identity (2 Items)							
Build and/or participate in digital online groups (e.g, Facebook/WhatsApp group).	200	0	5.06	5.50	7	1.846	1011
Be actively involved in relevant to my profession social network(s).	200	0	5.01	6.00	7	1.843	1002

Table 3: JISC framework to assess information literacy skills level among nursing students (n=200).

To evaluate the difference between urban and rural for information literacy skills it was tested using Mann-Whitney U Test (Table 4). The test revealed significant differences between both (U=3397, Z= -2.959, P=003). On the other hand, it is clearly noticeable that p value =.355, thus, no significant difference was found between students in parent's level of education and their daughters' information literacy skills. Moreover, there is no statistically significant difference between students' undergraduate level and their literacy skills (p=.459). A Kruskal - Wallis test was conducted to evaluate differences among the three types of devices (laptop, tablet, and smartphone)

on median change in JISC's Digital Capability Framework Score. H (2) = 2.299, p=.317 Indication no difference between type of devices and students' attitudes.

	Variables	N	Mean Rank	Test statistics
JISC's Digital Capability Framework Score	**Residence**			**Mann-Whitney U**
	Urban	131	91.93	U= 3397.000
	Rural	69	116.77	P=.003*
	Parent's highest level of qualification			
	Secondary education or less	121	97.52	U= 4418.500
	University education or higher	79	105.07	P= .355
	Students level			
	2nd Year undergraduate student	129	98.31	U= 4418.500
	3rd Year undergraduate student	71	104.48	P= .355
	Devices do you mostly student for studying purposes			**Kruskal-Wallis H**
	Laptop/PC	79	103.51	X2 = 2.299
	Tablet	73	104.31	P=.317
	Smartphone	48	89.75	df=2
*Significant at p <.05				

Table 4: Difference between students' information literacy skills and their sociodemographic profile (n=200).

Discussion

This study aimed to assess the level of digital capabilities among nursing students enrolled in undergraduate nursing program in the UAE. The obtained results allowed us to get a deeper understanding of the information literacy skills nursing students possessed; namely, digital learning and development, digital information (data management), communication and collaboration, digital creation, and digital identity according to JISC (Joint Information System Committee) [15,16]. We validate the hypothesis of this study: There is a positive association between students' information literacy skills and their sociodemographic profile.

Acquiring digital literacy skills in nursing is the cornerstone to successfully being involved in the digital learning community [31,32]. From this perspective, we found that assessing the level of students' skills in utilizing technology is a good starting point. This will help graduating students with a high level of digital literacy skills to be able to navigate the digitalization of the healthcare system [24,33,34]. Moreover, introducing it early in the nursing education program could help students to improve their knowledge and have the skills necessary to deliver effective patient care [18,21].

Digital competence goes beyond operational skills and knowledge about how to use a certain technology [13,35]. Our results demonstrated that students have a high level of engagement in various digital activities during their study period following JISC's framework [13,15,36]. Superior results are seen for digital learning and development, in which participating nursing students seem competent in everyday digital literacy such as accessing learning resources. This could be attributed to the fact that we are living in a cyber-world, and they tend to use the internet in their daily activities unintentionally reflected in their learning capabilities. A further interesting finding mentioned by most students is that they prefer to take notes using their devices. We speculate that this might be due to their positive perception of the importance of using digital devices (laptop, tablet, and smartphone) to enhance their independent learning and it means that student's independent learning is influenced by their attitude either cognitive or affective.

However, when it comes on data management, they are incompetent in reading journals and searching the database and lack the skills to efficiently use university library and professional engine, as well as tend to use only common engine [1-3]. This interesting finding could be attributable to a smaller number of assignments that required the integration of digital devices into the nursing curriculum. The implication of this finding was that instructors not only need to expose students to information activities; however, most importantly they need to support and

guide students in developing such activities by making learning more constructive and enjoying.

It is important to highlight that research skills and having the critical thinking skills to analyze digital content are the key components of digital literacy [4]. Hence, this present research shows that students had a prominent level of digital communication and collaboration skills especially in using Facebook and what's app. All the above competencies reflect that student have basic skills on how to get around the internet. However, they do not have the digital literacy skills that enable them to evaluate and interpret information. This finding is congruent with multiple research that found university students are confident in using basic computer skills, but they lack knowing how to access reliable data and using that data too [2]. This may explain the fact that students with high digital competencies have greater acceptance to digital learning.

Digital creation is indeed a vital component of digital literacy skills [21]. Students also recognize that they have difficulty with creativity while using the internet as many of them did not know how to interpret information and assess the quality of websites. This basic finding was not consistent with research conducted by Eriksmo &Sundberg, 2016 as they reported that students had been encouraged to create their own digital resources to cover the learning needs of (pre)clinical sessions, and their digital learning opportunities were highly related to the class/seminar/laboratory environment [24]. A difference between these findings can only be due to the education programs, and training given to students to enhance their digital creativity.

This study found that students are competent in using the technology to complete assignments and conduct online tests, but they scored low on using the tools to search the databases effectively and have to skills to take advantage. This highlights the question of is the nursing college is doing enough to develop the level of students' digital literacy?

This study further highlighted the emerging trend for the preference of using devices. All nursing students who participated in this study owned electronic devices and used them for study purposes. Most students used laptops/PC followed by tablet than smartphones as means of studying purposes. This is consistent with what has been found in previous studies that nursing students use cell phones and laptops to engage in e-learning activities [26,35]. At this stage of understanding, we believe that the reason behind this is that we are currently living in a cyber-world where numerous applications are readily available for exploration, and it could be linked with taking notes using their devices is easier and more applicable than notes making in the paper.

Although several studies showed that digital literacy level among students varied significantly [31,33]. This finding contradicts the finding of this study in which there was no significant difference between students' level of study and their digital literacy skills. This could be attributed to the standardized nursing curriculum in the nursing college and the background knowledge of digital literacy among nursing students.

In addition, it was found that there was no significant difference found between student's parent level of education and their daughter information literacy skills. Nonetheless, we believe that it is well justified that the internet itself is considered a powerful educational material that enhances student attitudes toward digitalization and their ability to communicate and share their ideas with others without taking any other variable into consideration. Moreover, this present study reports that the digital literacy skills among nursing students in urban and rural regions differ significantly. This could be related to the resources available in each region. Such a finding was similar to the results of a previous study that students from urban areas were more digitally skilled than those from rural and semi-urban areas [13].

This study was largely influenced by the "female gender" which is inconsistent with the current literature as there is a contrast across published research studies. Mohamed et al., 2022 reported that there is no difference between both genders in digital literacy skills [33]. However, in other studies such as van Laar et al., 2019 men scored higher on all digital skills than woman while in other studies female was found to have a higher score on internet skills than males. These findings, however, could be contributed to the fact that 75% of participants were female [18].

Implications

Nursing colleges in the UAE need to invest in introducing digital literacy program in the nursing schools, particularly training the students and teachers as well to be able to implement strategies to develop digital literacy skills. Policymakers should equip nursing colleges with essential resources to help students develop digital skills such as workshops, seminars, and trainings that would focus on encouraging students to think critically about the digital world. In addition, the library should provide students with computers that they could use and have digital access that could help them in optimizing their digital literacy skills. Therefore, digital literacy skills should be integrated in every classroom not only embedded in one course such as nursing informatics. This will eventually help students to have continue practicing.

Conclusion and Future Research

In conclusion, this study explored the level of digital literacy among nursing students enrolled in undergraduate nursing programs in the UAE. There has not been a similar research study in the same community that the authors are aware of that addresses the association between demographic dispositions and digital literacy skills. After discussing the research findings, relevant implications

were provided. Overall, students did not report any problem being involved in a digital educational environment because they are already engaged with technologies in their personal life. Future research on this area is crucial to aid us to understand if digital literacy is applied to undergraduate nursing education, how it is being implemented, and where the gap exists especially here in the UAE. Based on research findings, future research can focus on exploring the influence of digital competencies and independent learning on students' motivation to follow digital learning. Moreover, we consider differences in demographics to extend our knowledge. For instance, assess the level of digital literacy among various study subjects or different genders.

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