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Assessing Digital Literacy Across Seven Domains Among Undergraduate Medical and Dental Students: Implications for Curriculum Reform

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ABSTRACT

Objective: To Evaluate the digital literacy of undergraduate health profession students and determine the gaps in digital skills within the specific domains of digital literacy to guide future curriculum development.

Methodology: The methodology used was descriptive and cross-sectional study, which were conducted in Avicenna Medical and Dental College on 309 students of MBBS and BDS classes on purposive sampling. A pre-tested, 24-item self-report instrument was used to gather data on digital literacy in seven areas: software and the answers were scored on a 5-point Likert scale. The internal consistency was satisfactory (Cronbach's alpha coefficient = 0.80). The differences between groups were examined by year of study and gender with independent samples t-tests and Mann–Whitney U tests respectively. Spearman's rank correlation coefficient was used to explore the relationships between digital domains.

Results: Out of 309 participants 77.7% were MBBS students and 22.3% were BDS students, while 60.9% were female students. There were no statistically significant differences between digital literacy scores for male and female students. The mean domain score for each domain was between 14.40±2.72 (Network) and 7.36±1.69 (Security). No difference between first- and second-year students was found in any of the domains, except for Security (mean difference=0.54, p=0.002). Pupils reported their moderate ability to use basic software and collaborative tools, but lower confidence in areas of AI and cyber security. The overall level of digital literacy among medical and dental students was considered to be 'moderate', but there were significant areas of weakness in critical skills, including AI and cybersecurity.

Keywords*: Digital literacy, medical education, Artificial intelligence, medical cybersecurity, Undergraduate healthcare curriculum.*

INTRODUCTION

In the last 10 years, digital transformation has impacted healthcare. Recent digital transformation has transformed healthcare. It has revolutionized the teaching of clinicians. This has transformed the way patients are diagnosed, treated, and followed up. [1] Digital tools have enhanced infrastructure, diagnostic accuracy and treatment quality. [3], [4] Digital literacy is now a key clinical competency and not an optional one. [2] This has also permeated the educational landscape. The training of health professionals has been influenced by digitalization and digital platforms play an important role in learning, collaboration and exposure to new medical technologies. [7] Digital skills are essential for students to operate in the modern healthcare environment.

In Pakistan, this shift is visible in curriculum reform. The University of Health Sciences (UHS) recently introduced computer skills training into its undergraduate MBBS program. Students learn to use medical software and electronic health records. The goal is to prepare graduates for a digitized, innovation-driven healthcare system. [8]

Still, gaps in digital literacy persist. De La Hoz et al. called for new undergraduate programs that build digital and scientific competencies, particularly e-health literacy. [9] Elective courses in digital literacy offer one practical solution.[10] Technology use has grown, but competency has not kept pace.[11] A Japanese study found that first-year students owned computers and smartphones, yet used them only for basic functions.[10] Simon et al. called for structured training programs to close this gap across fields.[2]

Artificial intelligence adds a new layer to this challenge. Students now need basic AI literacy alongside digital literacy. [1]fields. [2]such as ChatGPT already support recall, interpretation, analysis, and other cognitive tasks in medical education. [13] But AI use carries risk. Patient privacy must be protected. Ethical and legal safeguards are essential. [14]

Given this shift, assessing students' digital competence has become essential. This study measures digital competence and knowledge among health profession students at our institution. The findings will be used to design curriculum, to determine curriculum gaps, and to inform for targeted digital-competence courses. This aims to build future health-care practitioners' competence in digital skills required for the modern practice.

METHODS

This study was descriptive cross-sectional. It evaluated the digital literacy of undergraduate students of Avicenna Medical College and Avicenna Dental College, Lahore, Pakistan. The objective was to pinpoint areas in digital domains where more integration was required in the medical and dental curriculum.

The study population consisted of all the registered students studying MBBS (5 Year) and BDS (Four Year) in the college. The survey was conducted at the campus.

The students who were enrolled in MBBS and BDS and had a habit of using internet were eligible for the study. Students who did not use the Internet and those repeating a grade were omitted. Sample size was determined using OpenEPI which confirmed the minimum sample size of 278 participants. A final number of 309 students were used. Purposive sampling was used to ensure that there was representation across academic years and across the two programs. This method enabled a variety of viewpoints to be included for the study's goals.

Data gathered through a 24 item, pre-tested and validated self-administered questionnaire on 7 digital literacy domains: software and multimedia, hardware, network and communication/collaboration, ethics, security, AI and interest and knowledge. Items were rated on a 5 point Likert-type scale from "Strongly Disagree" (1) to "Strongly Agree" (5). The instrument had an acceptable internal consistency with a Cronbach alpha of 0.80 in this sample. Data on the demographics was also collected via the questionnaire including gender and academic program.

Participation was voluntary. All participants gave informed consent prior to data collection. No identifying information was gathered and confidentiality was assured throughout the study.

The SPSS 26 software was used to analyse the data. Descriptive statistics (mean, standard deviation, median, interquartile range, frequencies and percentages) were used to summarize the demographic characteristics and domain scores. Shapiro-Wilk test has been used to check the normality of the continuous variables.

Ethical Approval: The institutional review board gave ethical approval.

RESULTS

In this study 309 students were taken into consideration and among them 238 (77.6%) were studying MBBS and 71 (22.4%) were studying BDS. One hundred eighty-eight (60.9%) of the participants were female, while 121 (39.1%) were male.

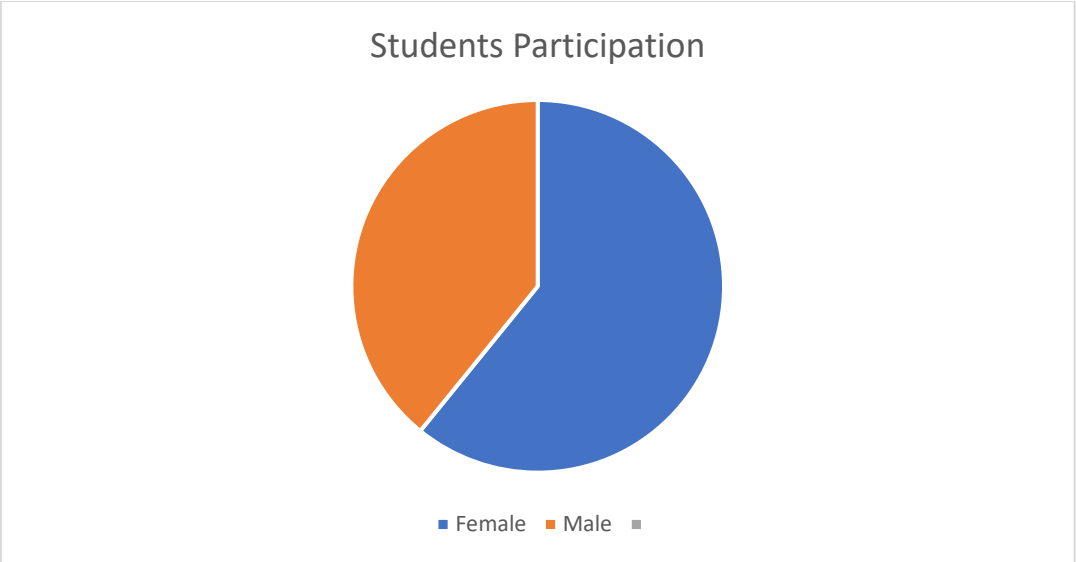

Figure I: ***Comparison of Digital Literacy Domain Scores between Male and Female students (n=309)***

Table I*: t-Test Results for Gender Differences Across Digital Literacy Components*

Component	**Female Mean±SD**	**Male Mean±SD**	**t-value**	**df**	**p-value**
Software & Multimedia	13.16 ± 2.73	13.22 ± 2.28	-0.23	306	0.91
Hardware	10.90 ± 2.11	11.02 ± 2.04	-0.52	306	0.69
Network	14.40 ± 2.72	14.19 ± 2.17	0.71	306	0.54
Ethics	14.04 ± 3.15	13.91 ± 2.80	0.73	306	0.55
Security	7.36 ± 1.69	7.22 ± 1.56	0.73	306	0.54
AI	11.26 ± 1.98	11.18 ± 2.04	0.41	306	0.77
Interest & Knowledge	13.88 ± 3.01	14.38 ± 2.50	-1.53	306	0.13

The distribution of participants in terms of academic year is given in Figure I.
The mean scores and standard deviations for digital literacy components across gender groups are presented in Table I.

An independent samples t-test was performed to check for significant differences in components of digital literacy between males and females. Table I summarizes the results.

Table II: Comparison of Digital Literacy Domain Scores

Component	**Overall Mean±SD**	**t-value**	p-value	**Interpretation**
Software & Multimedia	13.09 ± 2.59	-1.17	0.21	No significant difference
Hardware	10.85 ± 2.18	1.60	0.07	No significant difference
Network	14.24 ± 2.59	-0.86	0.30	No significant difference
Ethics	13.05 ± 3.01	0.61	0.46	No significant difference
Security	7.29 ± 1.65	3.07	0.002	Significant — Year 1 higher than Year 2
Artificial Intelligence (AI)	11.23 ± 2.05	0.53	0.52	No significant difference
Interest & Knowledge	14.07 ± 2.83	-1.00	0.24	No significant difference

A further t-test analysis based on the year of study revealed that students in their first and second years did not significantly differ in most digital literacy components. The overall findings suggest that there were no significant differences (p> 0.05)

between genders in terms of digital literacy. First year students, however, perceived a significant difference between their knowledge of Digital security and Second year students. These findings suggest that while digital literacy competencies are relatively consistent across demographics, certain areas such as security may require targeted interventions based on academic level.

DISCUSSION

This study examined digital literacy among undergraduate health profession students at Lahore Avicenna Medical College and Avicenna Dental College As technology becomes central to healthcare delivery, understanding students' readiness for a digital environment is timely. Overall digital literacy was moderate and consistent across gender and academic year. Two domains, however, stood out as weak: cybersecurity and artificial intelligence (AI). Both need dedicated attention in the undergraduate curriculum.

Male and female students scored similarly across all domains. No statistically significant differences emerged. This mirrors findings from Aydınlar et al. (2024), who reported gender as a non-significant factor in digital competency among Turkish healthcare students.[15] A Bangladeshi study found the same pattern across seven digital domains, and called for curricular reform in weaker areas like ethics and AI, without compromising gender equity.[16] In our context, this likely reflects equal access to digital devices and platforms for male and female students at urban institutions. A related study at King Edward Medical University, using the Digital Health Literacy Instrument, found strong operational and privacy-related skills but weaker performance in evaluating data reliability and relevance. [17] Together, these findings point to a consistent need: Pakistani medical students require structured support to build critical digital competencies.[18]

Digital literacy also did not differ meaningfully between first- and second-year students, with one exception. First-year students scored higher on digital security. This is a counterintuitive result. It may reflect recent curriculum changes, such as expanded cybersecurity content in orientation or introductory computing courses. [19] Newer cohorts may simply be receiving more exposure. Alternatively, the drop-off by second year may signal a broader problem: digital ethics and safety training may not be reinforced beyond the first year. [20] If so, this points to a need for continuous reinforcement throughout training, not a one-time introduction.

The students' average competence in software and multimedia use, hardware knowledge and network collaboration was reported. This echoes the result of Zainal et al (2023) where junior doctors in Singapore reported moderate competence in basic digital skills but not in clinical or collaborative skills. [21] Again, the pattern is that students are constantly exposed to technology, in both academic and social settings, but have difficulties in translating this into clinical or collaborative skills.

AI scores were the lowest among the domains. This is indicative of a lack of generalizable AI instruction. AI is now being used in medical practice and has the potential to be widely adopted in diagnostics, decision support, and various teaching tools such as ChatGPT, with only a few medical students having a clear understanding of what AI is, how it is used, its limitations, and potential ethical issues. [22], [23] This is a serious issue that needs to be addressed urgently.

From this, it is clear that there are two implications. First, the efforts of institutions in promoting gender equity in digital access seem to be effective, there's little need for gender-specific interventions. Second, the performance of students in cybersecurity and AI indicates real gaps in curriculum content and/or faculty skills, not student attitudes. Digital literacy is now emerging as a health determinant by influencing health workers' access and use of credible information in their practice. This is echoed in a recent scoping review which suggests that digital literacy training is crucial to address inequity and enhance care. [23]

Prior work also supports specific solutions. Interactive teaching, gamification, and curriculum mapping have all shown promise in improving digital health literacy. [23] These methods help close the gap between knowing and doing. More broadly, digital literacy training has equity implications, it can help reduce disparities in healthcare access and prepare future clinicians to deliver more inclusive care. [12]

This is information that has implications for practice. Cybersecurity, data privacy, and the use of artificial intelligence in various contexts should be given attention in the curriculum, preferably in the form of interactive workshops or interdisciplinary integration. More regulators should require digital competency as part of the core of the undergraduate curriculum, like the PM&DC. Faculty training in digital tools would reinforce this from the teaching side as well.

This study has limitations. Self-reported data has an element of response bias. The cross sectional, single site design is not generalizable and cannot account for changes in digital skills over time.

CONCLUSION

This study found moderate digital literacy among healthcare students, with clear gaps in AI and cybersecurity. These gaps demand immediate response and intervention. Digital skills, including the ethical use of digital resources, data security and new technologies, must be part of the core of the undergraduate curriculum, not an afterthought.[24] It is a priority which

must be addressed now and students must be prepared to provide safe, efficient and ethical care using digital media. Future studies need to assess the long-term impact of the development of structured digital literacy modules on student results. Policymakers should think about requiring that all undergraduate health professions education programs have a digital competence outcome.[25]

Conflict of Interest: None Funding Disclosure: None

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