Survey of Awareness and Level of Digital Literacy among Paramedical Students: A Cross-Sectional Study

Abstract

Aims: Digital literacy is a set of skills that enables individuals to effectively use digital technologies for learning, communication, and knowledge creation. Therefore, the aim of this study is to investigate the level of awareness and digital literacy of paramedical students.

Methods: This cross-sectional study was conducted from October 2024 to February 2025. Data were collected using a previously questionnaire developed by Aydınlar et al. (2024). This questionnaire had 31 questions, and focused on topics, including, demographic data, level of familiarity with programming, opinion of digital literacy, software, hardware, network, ethics, security, artificial intelligence (AI), knowledge-interest. The face validity of the questionnaire was measured by faculty members, and its reliability was also measured using the test-retest method. SPSS software was used to analyse data.

Findings: A total of 105 students responded to the survey. 60% of the students were female, and 40% were male. Overall, more than half of the participants (51.4%) believed that digital literacy training was necessary but optional. In contrast, 30.5% stated that digital literacy training was necessary and mandatory. The domains of "interest-knowledge, AI, network, ethics, and hardware" had the highest average scores, and the domains of "software and security" had the lowest averages. In examining the relationship between digital literacy domains and gender, the scores of men in the domain of "software and Multimedia" were significantly higher than women (p-value = .021).

Conclusion: To improve digital literacy, it is necessary to design and implement targeted training and programs with a greater focus on weaker areas.

Keywords: Digital literacy, awareness, students, education

Introduction

In recent decades, the rapid advancement of digital technologies has fundamentally transformed education, communication, and healthcare [1]. Almost all the devices used in daily life are digital, so the 21st century is often referred to as the digital age [2, 3]. The term "digital literacy" was first introduced by Gilster (1997) [4], and it refers to the ability to effectively and critically navigate, evaluate, and create information using digital technologies. It combines the concept of "digital," referring to the symbolic representation of data, and "literacy," which involves the capacity to understand, write coherently, and think critically about the written world [5]. The American Library Association (2013) defined digital literacy as the ability to use information and communication technology to find, understand, evaluate, create, and communicate digital information [6]. The infrastructure in the healthcare sector is also rapidly digitizing, significantly improving the quality of diagnosis, follow-up, and treatment processes for patients [7, 8]. Digital literacy is essential for medical students to effectively access and interpret data, analyze medical images, and use technology to improve patient care. Additionally, it helps them understand the ethical implications of using technology in healthcare and its potential risks [9, 10].

In an era where artificial intelligence (AI) has become prevalent across many fields, it is vital that students pursuing medical sciences possess foundational knowledge of AI, and that this technology be integrated into their educational programs [11]. ChatGPT, one of the most widely used AI tools, is increasingly considered a practical online teaching assistant due to its immediate, accessible responses [12]. In Hamburg, Germany, digital health was included as an optional course in the medical curriculum. A survey evaluating the course revealed high overall satisfaction, demonstrating students' positive reception of digital literacy education [14]. Another study in Germany created separate modules in medical schools to teach digital skills, with a focus on digital challenges in medical applications, further highlighting the importance of digital literacy in medical education [15]. In 2024, Aydınlar et al. conducted a study to assess the digital literacy and awareness of health science students at their university. The results emphasized the need to evaluate students' computer skills across different areas and recommended the creation of educational environments that strengthen digital knowledge [16].

Overall, familiarity with digital skills has become a basic requirement for 21st-century students in light of advancements in the digital world. However, the digital literacy skills that students possess before entering university do not always translate into effective, purposeful use to support their learning [17]. Studies have shown that students' proficiency with basic digital tools, such as Microsoft Office, Word, PowerPoint, and Excel, is often lower than expected [18]. Administrators, teaching staff, and students need time to grasp the meaning and significance of digital literacy, which varies based on their roles, disciplines, and institutional priorities. Given the limited research in this field within Iran, this study aims to investigate the digital literacy awareness and levels among students at the Faculty of Paramedical Sciences and Rehabilitation at Mashhad University of Medical Sciences.

Materials & Methods

Study design

This cross-sectional quantitative study was conducted from October 2024 to February 2025. All ethical principles in research were observed in this study according to the Hellenic Declaration [19]. In this regard, students were informed about the objectives, methods, possible benefits and potential risks of the research and the discomforts that may result. Participation was voluntary, and informed consent was obtained from all participants. As an incentive for participation, the objectives of the study were explained at the beginning of the questionnaire, and participants were informed that they would receive a general feedback on the results upon completion of the study. All personal information was kept confidential and anonymized for research purposes only. This study was approved and adhered to by the ethics committee of Mashhad University of Medical Sciences (Ethics Code: IR.MUMS.FHMPM.REC.1403.144).

Sample size

The study population included all students enrolled in the School of Paramedical Sciences and Rehabilitation at Mashhad University of Medical Sciences during the 2024 academic year. These students were from eight disciplines: Health Information Technology, Laboratory Sciences, Optometry, Radiology, Speech Therapy, Occupational Therapy, Physiotherapy, and Social Work, and were studying at undergraduate, master's, and doctoral levels. Stratified proportional sampling was employed: students were first categorized by discipline and academic level, and then a proportionate sample was selected from each stratum based on Cochran's formula (with a confidence level of 95% and α = 0.05). The initial sample size was 87; however, to enhance accuracy and generalizability, a total of 105 participants were ultimately included.

$$n = \frac{NpqZ^2}{Nd^2 + pqZ^2} = \frac{913 * \frac{1}{2} * \frac{1}{2} * 1/96^2}{913 * \left(\frac{1}{10}\right)^2 + \frac{1}{2} * \frac{1}{2} * 1/96^2} \cong 87$$

Z = The value of the statistic equivalent to the area under the standard normal curve
P and q = The frequency ratio of the desired attribute in the target population
d = Effect size or precision

Inclusion criteria were all students actively enrolled at the School of Paramedical Sciences and Rehabilitation at the time of the study. Exclusion criteria included transfer or visiting students from other universities, students on academic leave during data collection, international students, and those unwilling to participate.

Participation was entirely voluntary and based on informed consent. Participants were assured that their information would remain confidential and be used solely for research purposes.

Data collection

A pre-designed standard questionnaire by Aydınlar et al. [16] was used to assess the level of awareness and digital literacy of paramedical students. The face validity of the questionnaire was reviewed by five faculty members, and after incorporating their suggestions, the final version was approved. Its reliability was assessed using the test-retest method with a 10-day interval (Cronbach's alpha: 78%).

This questionnaire had 31 questions, including multiple-choice questions, 5-point Likert scale items, and one open-ended question, and focused on 11 general topics, including, demographic data (age, gender, field of study, level of education, and semester), level of familiarity with programming, the respondent's opinion on digital literacy education for paramedical students, software and multimedia, hardware, network, ethics, security, artificial intelligence (AI), knowledge-interest, and one open-ended question to examine student opinions and suggestions. (Table 1). The questionnaire was designed electronically, and an email with the survey link was sent to eligible students willing to

participate. Two reminder emails were sent at one-week intervals. Participation was voluntary, and responses were anonymous.

Table 1. Questionnaire evaluating digital literacy in 7 domains

Domain	Questions
Software and Multimedia	1. I can learn new technologies easily.
	2. I have the technical skills to use information and communication technologies for learning purposes and to develop digital teaching materials (For example, presentations, digital stories, wikis, and blogs) to showcase what I have learned.
	3. I can easily communicate with others through platforms such as Zoom, Microsoft Meeting, and Outlook.
	4. I know computer languages (such as Python, C++, and visual basic).
Hardware	5. I know how to solve technical problems I encounter with the technologies I use.
	6. I know the essential parts of the computer (such as motherboard, memory, computer case, power supply, and hard disk), and their functions.
	7. I know and can use wireless communication modules such as wifi and Bluetooth.
Network	8. I am confident in my searches and evaluations to obtain information on the Internet.
	9. Information and communication technologies allow me to better collaborate with my peers on working on a project and other learning activities.
	10. I often help out with my friends over the internet in my studies at University (e.g., via Skype, Facebook, and Blogs).
	11. I use professional media platforms such as LinkedIn to take steps toward my career goals and to find or reach people related to my profession.
Ethics	12. I do not get stolen information from other works during my research and presentations. I cite
	13. I have an idea about digital copyrights and licenses.
	14. I am aware of the Personal Data Protection Law.
	15. I am aware of the Ethics Committee processes and conditions that control under which conditions and with whom I can share consented patient information and data.
Security	16. I am familiar with topics related to internet activities, such as cyber security, web search, and internet fraud.
	17. I know how the information I enter on the technological devices and applications I use is stored, and I am aware of who can see and use it.
AI	18. I am aware that artificial intelligence is included in the technologies we use in our daily lives.
	19. I am aware that there are lectures in our University on integrating artificial intelligence into the medical field.
	20. I know the areas where artificial intelligence is used in medicine.
Interest-Knowledge.	21. I follow important new technologies.
	22.I am familiar with many different technologies
	23. The skills I have in information and communication technologies are sufficient.
	24. I use the Internet to access medical information and check the reliability of sources.

Statistical analysis

SPSS statistical software was used to analyze the data. Descriptive data was examined using frequency and percentage, while continuous variables were characterized by their mean and standard deviation. Chi-square, t-test, and Spearman correlation coefficient were used to analyze the

relationship between categorical variables and a P-value of 0.05 was used to determine the level of statistical significance.

Findings

According to Table 1, a total of 105 students from various paramedical fields responded to the questionnaire. 60% of the students were female, and 40% were male. Their mean age was 23.04±2.15 years. The frequency of the fields of study is as follows: Health Information Technology (23, 21.9%), Laboratory Science (13, 12.4%), Optometry (10, 9.5%), Radiology (10, 9.5%), Speech Therapy (14, 13.3%), Occupational Therapy (10, 9.5%), Social Work (16, 15.2%), and Physiotherapy (9, 8.6%). Health Information Technology accounted for 21.9% of the participants, while the participation rates in the other seven disciplines varied, ranging from 8.6 to 15.2%. The largest number of students participating in the study (24.8%) were in their third year of study. More than half of the participants (51.4%) believed that digital literacy training was necessary but optional for paramedical students. In contrast, 30.5% stated that digital literacy training is necessary and mandatory for paramedical students, and only 19 students (18.1%) believed that digital literacy training was unnecessary. 32.4% of students had not received any training in programming. 12.04% of students had learned programming at university, and 4.8% had trained independently (Table 2).

Table 2. Demographic features of participants (N=105)

Features	Subclass	Total, n	(%)
Gender	Male	42	**(40%)**
	Female	63	**(60%)**
Year	1	8	**7.6**
	2	23	**21.9**
	3	26	**24.8**
	4	23	**21.9**
	5	10	**9.5**
	6	8	**7.6**
	More than 6	7	**6.7**
Initial Coding Education	No education	34	**32.4**
	Primary	19	**18.1**
	Middle	20	**19.0**
	High	14	**13.3**
	University	13	**12.4**
	Self-learned	5	**4.8**
View on Digital Literacy Education	Not Necessary	19	**18.1**
	Necessary but Not Essential in Health Based Education	54	**51.4**
	Necessary and Essential in Health-Based Education	32	**30.5**

In examining the relationship between the level of programming education and gender, there was a significant difference between the average responses obtained in the two gender groups (male and female), and the p-value was 0.004. (Significance level 0.05). Also, no significant difference was observed between the average responses obtained regarding the necessity of learning digital literacy for paramedical students in the two gender groups, and the p-value was calculated as 0.955. (Table 3)

Table 3. Proportion t-tests between genders

Category	Subcategories	p-value	Female %	Male %	Female (n)	Male (n)
Initial Coding Education	No education	**0.004**	20.4	13.6	25	9
	Primary		11.4	7.6	14	5
	Middle		12.0	8.0	12	8
	High		8.4	5.6	4	10
	University		7.6	5.2	6	7
	Self-learned		3.0	2.0	2	3
	Not Necessary	0.955	11.4	7.6	11	8

View on digital literacy education	Necessary but Not Essential		32.4	21.6	33	21
	in Health Based Education		19.2	12.8	19	13

Comparison of domains in digital literacy

The average scores in domains of digital literacy were between 3 and 4 on a 5-point Likert scale. This indicates a relatively favorable state of knowledge and awareness in digital literacy, but there is still room for improvement in some areas. The "interest_knowledge, artificial intelligence, network, ethics, and hardware" areas with the highest average scores (3.688, 3.682, 3.682, 3.682, 3.682) indicate greater awareness in these areas. On the other hand, the of "Software and multimedia, and Security" areas with the lowest average scores (3.38 and 3.55) indicate that these areas require more attention to increase student awareness. (Appendices 1)

In examining the relationship between domains of digital literacy and gender, the scores of male in "Software and Multimedia" area were significantly higher than those of females (p-value=.021). There was no significant difference in the remaining areas. (Table 4).

Table 4. Comparison of scores between genders

Field of digital literacy	**p-value**	**Female Mean (SD)**	**Male Mean (SD)**	**All Data Mean (SD)**
Software and Multimedia	**.021**	3.21 (.94)	3.63 (.86)	**3.38 (.93)**
Hardware	.316	3.60 (.81)	3.76 (.83)	**3.66 (.82)**
Network	.316	3.60 (.81)	3.76 (.83)	**3.66 (.82)**
Ethics	.631	3.63 (.93)	3.72 (.81)	**3.66 (.88)**
Security	.118	3.48 (.97)	3.77 (.84)	**3.60 (.92)**
AI	.343	3.61 (.86)	3.77 (.79)	**3.68 (.83)**
Interest-Knowledge	.233	3.60 (.80)	3.79 (.71)	**3.68 (.77)**

Spearman correlation tests were conducted between the various domains of digital literacy, academic fields, and gender. A significant and negative relationship was observed between gender and the software and multimedia area ($r = -0.272$ $p = 0.0049$). This finding indicates that gender may affect the level of software skills. Other domains, including security ($p = 0.0791$) and hardware ($p = 0.0894$), had weak correlations with gender that were not statistically significant. A significant relationship was also observed between field and the hardware area ($r = -0.232$ $p = 0.0171$). This finding indicates that students from different fields may have differences in hardware and multimedia knowledge. The relationship between field and other domains was also not significant. (Appendices 1)

Also, an analysis of gender differences in domains of digital literacy was conducted among different academic fields. The boxplots presented in Figure 1 compare the distribution of digital literacy domains, including software and multimedia, hardware, network, ethics, security, AI, and interest/knowledge, between female and male students in different majors.

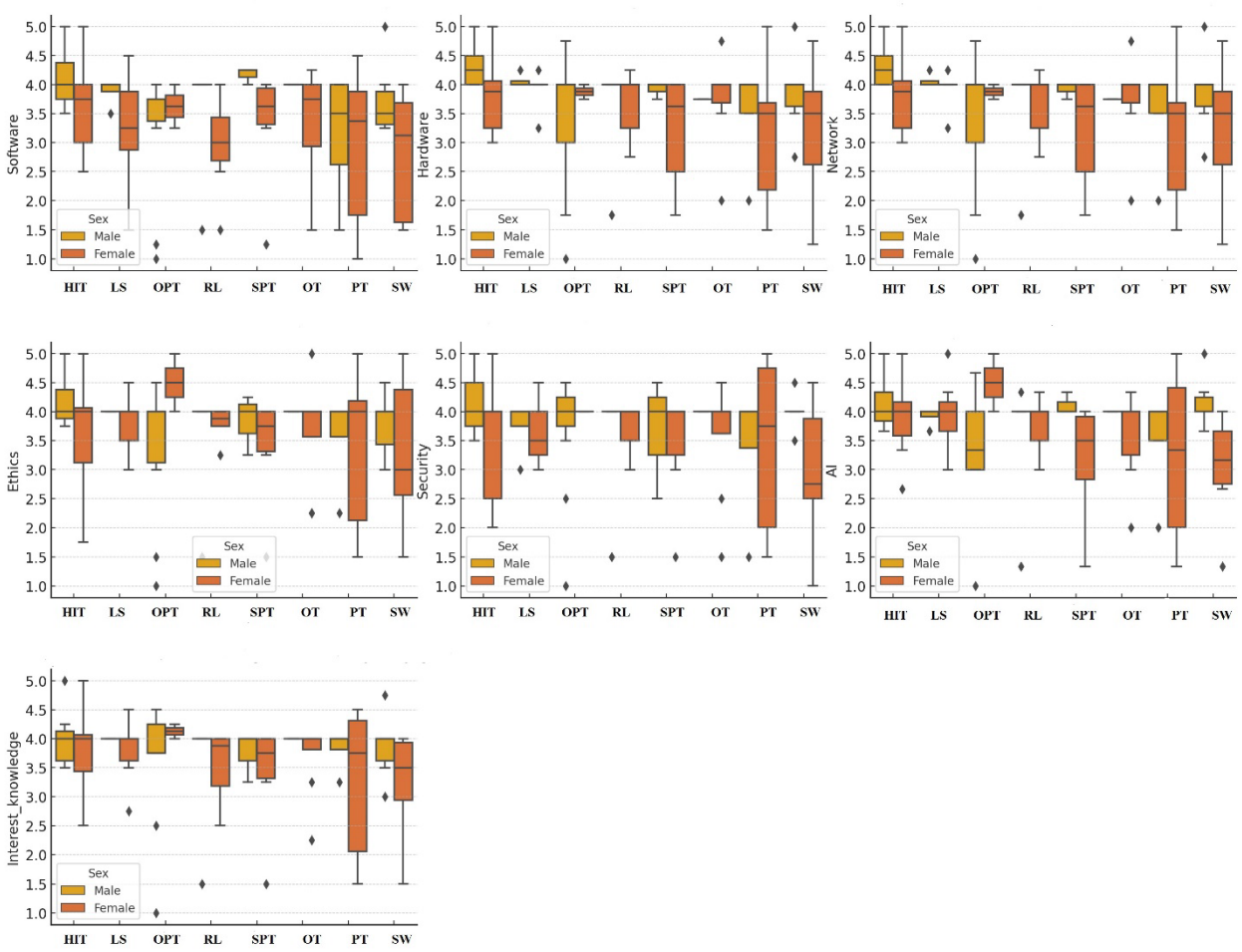

Figure 1. Comparison of mean scores in domains according to field and gender

According to the boxplots presented in Figure 1, health information technology students have the highest level of knowledge in the software and multimedia domain. Social work and occupational therapy students also showed the lowest level of knowledge. In most majors, male students had higher scores than female students, but the difference is smaller in some majors, such as optometry and radiology.

Familiarity with hardware skills is higher among health information technology and laboratory science students than in other majors. Social work and speech therapy majors have the lowest level of knowledge in the hardware domain. In most majors, male students perform better, but in laboratory science, the difference between male and female students seems to be smaller.

In examining the level of students' awareness in the field of network, students of health information technology and laboratory sciences showed the highest level of awareness in this area, which indicates the high need of these fields to be familiar with network systems and databases. In contrast, students of social work and occupational therapy reported the lowest level of awareness. In this area, the gender gap between male and female students is significant in most fields.

Compared to other fields, the gender difference in ethics area is smaller. The two fields of social work and speech therapy had the highest level of awareness of issues related to ethics in research.

In security area, students of health information technology and laboratory sciences had the highest level of awareness, because these fields need to protect patient data. On the other hand, the two fields of social work and optometry had the lowest level of awareness. The gender gap in this area is large and male students performed better in most fields.

According to the results, health information technology students had the highest level of proficiency in AI, which is due to the widespread use of AI in medical data analysis and e-health systems. Laboratory science and radiology majors also have relatively high scores in this area. Social work and speech therapy majors have the lowest level of proficiency in AI, which seems to indicate that AI

applications in these majors are not very common from the student's perspective. Male students generally perform better in this area than female students.

Health information technology, laboratory science, and radiology students showed the highest level in the interest-knowledge area. This finding suggests that students in these majors are more aware of digital technologies and are likely to work more with technological tools. Social work and speech therapy students showed the lowest level of interest-knowledge, which could be due to the lower focus of these majors on technology. The gender gap in this area is smaller than in other skills, but male students still have higher scores in most majors.

Discussion

In the digital age and with the rapid advancement of technology, digital literacy has become one of the basic and essential skills for individuals in different societies [20]. However, the level of knowledge and mastery of individuals in different areas of digital literacy can vary, and this requires a detailed and targeted study. In this study, an attempt has been made to use statistical tools to assess the status of students' digital literacy in different areas and to identify existing strengths and weaknesses to take a step towards improving related training and planning.

The findings of the current study revealed a noticeable gender gap in prior exposure to programming, with female students less likely to have received formal training. This aligns with global trends reported in previous research, which highlight persistent challenges in achieving equal access to digital education opportunities. [21]. While some studies suggest early-stage performance in coding may not differ significantly between genders, more advanced competencies tend to show male-dominated outcomes. These findings underscore the need for more inclusive training strategies that empower all students—particularly women—to engage confidently with coding and digital technologies. [22].

The results of the present study showed that although female students had received less prior training in programming than male students, their views on the importance of digital literacy education were equal to those of male students. In statistical analysis, no significant difference was observed between gender and students' perceptions of digital literacy, indicating a common belief in the necessity of digital literacy education among students.

Students demonstrated the strongest familiarity in areas such as wireless connectivity, responsible citation practices, and use of online platforms for accessing medical information. The results of a study conducted by Ayenew entitled "Investigation of Internet Use for Health Information Search and Factors Affecting It among Medical Students in Ethiopia" show that 67.4% of health science students use the internet for health information, indicating a high reliance on digital resources for health-related queries [23]. This suggests a baseline competence in practical digital skills commonly used in academic settings. However, deeper technical aspects, including problem-solving with technology and familiarity with programming languages, emerged as areas requiring targeted educational support.

Lazaridou et al. [24] also stated in their study aimed at investigating the level of medical students' knowledge of the rules and ethics of scientific writing that medical students' knowledge of publication ethics was relatively good. On the other hand, many medical students have limited knowledge of the ethical principles of scientific publication, and there is a need for further training in this area. In general, it can be said that including training related to publication ethics in the curricula of medical students seems important and necessary to prevent unethical behavior in future research. The lowest frequency of knowledge of various components of digital literacy is also related to the components "I know how to solve technical problems that arise while working with the technologies in use", "I am familiar with computer languages such as Python, C++, and Visual Basic", and "I can easily communicate with others through platforms such as Zoom, Microsoft Meeting, and Outlook". Studies show that a lack of awareness in these areas can lead to reduced productivity in educational and professional environments, so to improve this situation, it is necessary to integrate training related to digital technologies into university curricula [25]. For example, Barteit et al. found in their study that 70% of medical students use learning management systems such as Moodle or Blackboard, but many of them lack the skills to troubleshoot technical issues [26]. Also, the results of a study conducted by Krishnamurti aimed to determine the level of literacy in the use of digital resources by female students. The study showed that the Google search engine is the most common search engine from the perspective of students; most respondents (68.83%) were aware of the use of the Google Scholar search engine, followed by ResearchGate, Twitter, Slideshare, and

Academic.edu databases, respectively. Among them, LinkedIn, SciSpace, and Research ID had the least use among academic social networking sites [27].

Although overall digital literacy levels were relatively high, a closer look revealed domain-specific differences across genders. Male students tended to score higher in software-related competencies, whereas other domains such as hardware and network skills showed more balanced performance..

The results of a study titled "Investigating the level of students' awareness of computer software" showed that the average computer literacy of male students was higher than that of female students [28]. On the other hand, another study showed that in the online education method, the satisfaction and average scores of female students were higher than those of male students [29]. In general, it can be concluded that although there may be differences in the level of familiarity and use of software and multimedia tools between female and male students, these differences vary depending on the context and type of technology, and a definitive conclusion cannot be drawn in this regard.

Security awareness, though critical, appeared to be underdeveloped among participants. This resonates with research indicating that students often lack sufficient knowledge about data protection and cybersecurity best practices [30-32]. Meanwhile, high scores in AI awareness reflect a growing interest and recognition of its relevance in modern healthcare—a trend seen across multiple health education contexts [33]. Despite this, formal integration of AI topics into curricula remains limited, indicating a potential area for development [34].

The study revealed that students confidently explore the internet to acquire new knowledge, and interact with their peers through applications such as Skype and LinkedIn. Similarly, a cross-sectional study also showed that health information technology students, due to the nature of their field and the availability of course units, use mobile phones for their educational purposes more than students in other fields [35]. Also, in a study conducted by Lin et al., a questionnaire was administered to first-year nursing students to assess their computer literacy level, and the highest score was obtained in the field of familiarity with the Internet [36].

It can also be said that the importance of being familiar with ethical issues in research is becoming more complex with the rapid development of technologies. For example, the results of a study conducted on Indian students showed that there is a lack of awareness among students about using different search strategies for efficient information retrieval, and only 43 (55.84%) of the respondents were aware of copyright issues [27]. Another study titled “Knowledge, Awareness, Attitudes and Practices towards Research Ethics and Research Ethics Committees among Postgraduate Students in Myanmar” showed that there are significant gaps in students’ knowledge and awareness about research ethics and the functioning of research ethics committees. Also, students who had a PhD or were familiar with research ethics showed a more positive attitude towards these issues [37].

Limitations and Suggestions

This study has limitations that affect the interpretation of the results. The sample size of 105 represents a small proportion of eligible healthcare students, which may affect the generalizability and comparability of the results. In addition, the study focused on specific paramedic students at a single university, which limits the applicability of the findings to other universities or countries. Some important aspects of digital literacy may not have been covered in this study and require further investigation. This study was cross-sectional and did not assess changes in digital literacy over time. It is recommended that research be conducted in larger and more diverse populations to increase the accuracy and generalizability of the results. It is also recommended that longitudinal studies be conducted to examine changes and trends in digital literacy over time.

Conclusion

This study highlights both strengths and gaps in digital literacy among paramedical students. While female participants reported less prior exposure to computer skills and coding, their perception of the importance of digital literacy was comparable to that of male students. Overall, students exhibited moderate to high competency in several key areas, particularly in AI awareness, network, hardware, and ethical considerations.

Nonetheless, the relatively lower scores in software proficiency and cybersecurity signal the need for more focused and practical training in these domains. To better prepare future healthcare professionals, educational institutions should consider integrating tailored digital literacy modules that address both technical skills and ethical responsibilities in digital environments.