Research Article

Unveiling the Digital Deficit: Assessing Computer Literacy among Medical and Dental Students at a Private Institution of Pakistan: A Cross-Sectional Study

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Abstract

Background: This study explores the level of computer literacy among medical and dental students at a private institution in Pakistan.

Objective: To identify the discrepancies and address the need for technological proficiency in modern healthcare education.

Methods: This was an observational cross-sectional study involving 400 randomly sampled participants. The questionnaires consisted of demographic information, computer accessibility, and a pre-validated questionnaire to assess computer literacy, which comprised 24 items across six divisions. The data were gathered and analyzed using SPSS version 21.

Results: Results showed that while computer accessibility was high (84.5%), its primary use was personal, with limited application for academic purposes. Familiarity was highest with Microsoft Word (48.3%), contrasting with lower proficiency in Microsoft Excel (30%). Limited understanding of computer hardware (31.3%) was noted, reflecting a potential gap in computer literacy skills. The study identified a strong association between early computer access and prior education with current computer literacy. Deficiencies in computer literacy were highlighted during the COVID-19 pandemic, where inadequate skills hindered the abrupt shift to online learning. The study emphasizes the necessity for integrating computer literacy into medical education curricula, promoting structured training, and fostering the medical faculty.

Conclusion: The findings reflect limitations in computer literacy among medical and dental students. We explored the challenges and barriers and suggested strategies for improvement to prepare future healthcare professionals for the challenges of modern healthcare.

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Introduction

Computer literacy is a core skill for health professionals in modern healthcare. It bridges the gap between medical expertise and rapid technological advancements, fostering improved patient care. Computer literacy encompasses understanding basic technological concepts and computer operations for creating and communicating using word processing and data management. It differs from digital literacy, which has a wider scope and involves using various devices and programs to access digital information.[1] The Topol

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Review studied the digital health competency frameworks, highlights the relevance of computer skills for health professionals, and underpins the inclusion of computer literacy training in healthcare curricula.[2]

Among health professionals, computer literacy competencies are indispensable for physicians and dentists to enable them to effectively utilize computer-aided healthcare and health educational software programs and informational technology (IT) models.[3] This necessity is evident in medical and dental education, where computer-assisted learning (CAL) is widely used for online learning resources, lectures, assignments, simulations, and assessments. Furthermore, computer-aided programs are increasingly utilized in clinical medical and dental practice for problem-solving, data management and healthcare research.[4] At the same time, computer literacy is recognized as one of the foremost healthcare challenges of the 21st century.

These challenges manifest in various forms, such as inadequate resources, infrastructure, availability, accessibility, and training in medical and dental institutes, especially in low-middle-income countries (LMIC) like Pakistan. This deficit was evident during the COVID-19 pandemic when medical students and faculty were ill-prepared for the sudden shift to virtual learning.[5] Moreover, technology assumes a critical role in modern healthcare practices such as telemedicine and online consultations. The proliferation of information and communication technology (ICT), including computer software and electronic health records (EHR), has significantly enhanced healthcare delivery, empowering healthcare providers to focus more efficiently on patient care.

Across high-income countries worldwide, there is a noticeable trend of rapid advancement in computer literacy among medical and dental students. In Toronto, an evaluation called 'An Innovation Report' was conducted. It introduced a one-week course encompassing basic computer skills, including Python coding. Similarly, initiatives in the UK and Netherlands involving a two-day Python course and developing a medical teaching app for undergraduate medical students yielded positive outcomes.[6,7] In contrast, computer literacy in LMICs lags behind. Studies conducted in countries like Iran, Bangladesh and India reveal deficiencies in basic skills, frequency of computer use, and insufficient computer training among medical students.[8,9,10,13]

In Pakistan, studies conducted among university students of Southern Pakistan examined the correlation between computer literacy and academic performance[11] and a dental student survey assessing the computer literacy level and corresponding competencies emphasized deficiencies in these domains.[5] Given the divergent levels of computer literacy among medical and dental students in high-income countries (HICs) and LMICs, it is evident that this issue remains critical within the context of Pakistan. However, existing local research is insufficient and leaves a noticeable gap in exploring computer literacy among medical students. Therefore, it is important to evaluate the current level of computer literacy among medical students and implement appropriate interventions to facilitate their professional development in the future.

With the rapid advancement of healthcare technology, the necessity for computer literacy skills among medical and dental students is paramount, alongside their proficiency in this domain. Telemedicine and EHRs are integral to effective healthcare delivery, significantly impacting patient outcomes. Nevertheless, significant disparities persist in computer literacy between students in HICs versus LMICs, such as Pakistan. Therefore, this study aims to assess the current computer literacy level among medical and dental students in a private institution in Pakistan, identify existing gaps, and propose areas of improvement. By establishing a baseline understanding, the present research recommends appropriate interventions within the medical curriculum to equip future healthcare professionals with essential computer skills. This is crucial for academic achievement and their pivotal roles in the evolving global healthcare landscape, where technology assumes a central position. The research question addressed in this study is: What is the current level of computer literacy among medical and dental students in Pakistan, and how can their proficiency be improved in computer literacy skills for better academic performance and for future professional roles in the modern healthcare system?

Methods

The present observational cross-sectional study explored computer literacy among medical and dental students in a private medical and dental college in Pakistan. Our

study participant pool was 400 medical and dental students randomly selected. This study was conducted at Avicenna Medical and Dental College, Lahore, from July 2023 to September 2023. The ethical approval was obtained from the Institutional Review Board (IBR-04/5/23/AVC). All possible measures were implemented to safeguard participant privacy and confidentiality, including keeping the survey anonymous and conducting debriefing procedures when necessary. All the participants gave their informed consent before their involvement in the study.

The questionnaire was developed through a literature review of previous studies and modified where necessary, owing to the locale of our research. A pilot study was conducted on 20 students to check the construct validity of our questionnaire. Cronbach's alpha was employed for reliability, and relevant adjustments were made. The students who were a part of the pilot study were excluded from the main study. The questionnaire's content and face validity were assessed by experts in the field. A sample size 400 was determined using Cronbach's alpha value with a 95% confidence interval.

The students' participation in this study was voluntary and were approached during college. The contents of the questionnaire and the purpose of the study were explained to them. Informed consent was obtained from all participants who completed the survey forms via Google Forms, each taking approximately 15 minutes. All 400 students enrolled in the study voluntarily, while those unwilling to participate were excluded. To ensure anonymity and encourage candid responses, participant identities were kept confidential. The questionnaire consisted of two parts; the first part gathered demographic information such as age, gender, and computer accessibility during childhood, as well as details of computer education on a primary or secondary level. The second part utilized a pre-validated questionnaire known as the 'Linn Tung Cheng questionnaire,[12] designed to assess the level of computer literacy among medical and dental students. This questionnaire employed a 5-point Likert scale, with higher scores indicating a higher level of computer skills, while lower scores indicating a low level. It assessed six domains: hardware, software, multimedia, network, information ethics and information security.

Results

Before conducting our analysis, we appropriately transformed, scaled, or normalized the data as necessary. Statistical analysis was performed using the SPSS for Windows version 21 (SPSS Inc., Chicago, Illinois, USA) and GraphPad Prism version 8.4.2 (GraphPad Software, San Diego, CA, USA). To address our research question, we employed the Chi-square test. Additionally, the Kolmogorov Smirnov test was utilized for normality checks of variables. Descriptive statistics, including mean, standard deviation, number, and percentage, were used to summarize the data based on its type. Bivariate data analysis was conducted using the Chi-square test to assess the computer literacy of medical and dental students with a significance level set at $P < 0.05$.

A total of 400 medical and dental students participated in this study, and their demographic characteristics were thoroughly analyzed. Most students fell within the age range of 21-23 years, accounting for 63.5% of the sample. Additionally, the study revealed a higher proportion of female participants than males, with 61.5% and 38.5%, respectively (Table 1).

The Data is presented as number (No.) and percentage (% age).

Their childhood computer usage was measured to assess the background computer literacy in students. Most students had access to computers in their childhood, with 41% (164) using computers regularly, 51.8% had limited access, and only 7.3% (29) had no computer

Table 1: *Demographic characteristics of medical and dental students, including variables related to computer usage.*

Parameters		No.	% age		No.	% age
Age (years)	18-20	119	29.8 %	**Gender**		
	21-23	260	65%	Male	154	38.5%
	24-26	21	5.3%	Female	246	61.5%
Study years	1st-year	54	13.5 %	**Monthly Income**		
	2nd -year	88	22%	<PKR 65,0000	45	11.3%
	3rd - year	117	29%	>PKR 266,000		35%
	4th-year	97	24%	PKR 65,000 – 266,000		53.8%
	Final year	44	11%			

access. Regarding the age when they got their first computer, 31.3% (125) had their first computer at 5-10 years, 44% (176) were 11-15 years old, and 22% (88) were 15-20 years of age. Only 1.3% (5) had a computer after age 21, and 1.5% (6) still don't. Exploring computer usage in childhood, 73.5% (294) were allowed to use the computer with limitations and expectations, 21.3% (85) had no limitations and expectations, and in 5.3% (21), there were no influences. Likewise, parents supported technology usage in 74% (299), but with reservations, on 8.5% (34), there were no restrictions from parents, and the rest, 16.8% (67), were permitted limited access to computers. Almost half, i.e. 52.3 % (209) students, undertook computer-related education in the past, whereas 47.8% (191) never received such education.

At present, 84.5% of students possess their own laptops, while 15.5% do not. 12.3% had access to a computer for academic purposes multiple times a day, while 39.3% of students occasionally and 17% never accessed a computer for academic purposes. Since most students had their own laptops, 79.5% of primary access was their personal laptops, while 6.3% used computers from institutes' labs, and 12% used friends' or family members' computers.

When students were asked questions about computer

Table 2: *Familiarity and skill with computers along with associations*

Computer Domains	Items for Computer Literacy Skills Responses	Very good (%)	Good (%)	Acceptable (%)	Poor (%)	Very poor (%)
Software	Understand the use of Microsoft and word processing software.	21	48.3	18.5	7.3	5
	Creating documents with Microsoft Word and word processing software.	18.8	43	25.3	8.5	4.5
	Creating PowerPoint presentations.	17.3	40.8	26.8	9.8	5.5
	Developing Microsoft Excel spreadsheet software.	12.8	32	34.5	12	8.8
Hardware	Understanding the basic computer system components, e.g. motherboard, memory, RAM and CD-ROM.	31.3	38.5	19.8	7.3	3.3
	Troubleshooting the problems with booting the computer.	15	26.8	31.3	20.5	6.5
	Installing the newly purchased peripheral device, e.g. a printer.	19.5	23.8	30	17.5	9.3
	Setting up connections for newly purchased network devices and utilizing accessory devices.	20	38.3	25	10.8	6
Multimedia	Using multimedia software, e.g. PhotoImpact, for image creation	23.5	43.5	20.8	9	3.3
	Editing pictures from a digital camera.	25.8	40.3	18.8	9.5	5.8
	Editing videos from a digital video camera.	23.8	35.8	23.5	10.5	6.5
	Playing multimedia files, e.g. AVI and MPEG files.	22.3	35	25.3	10	7.5
Network	Write and communicate through E-mail.	44.3	44.3	8	2.3	1.3
	Setting up and using communication software, e.g. Zoom.	47.5	39.8	8.5	3	1.3
	Attaching a file or documents to an E-mail	50.3	36.3	9.5	3.5	0.5
	Collecting information through search engines, e.g. Google, AI ChatGPT.	47	39.3	10	2.8	1
Information ethic	Refraining from disseminating illegal data, e.g. images, documents, music, and software.	42.8	37.5	14	3.5	2.3
	Purchasing paid online data legally.	28.3	45.5	17.8	5	3.5
	Refraining from downloading illegal data e.g. images, documents, music, and software.	45	32.5	12.3	4.8	5.5
	Refraining from installing unauthorized software.	43	33.8	14.3	ss	5
Information security	Installing antivirus software to prevent computer virus attacks.	27.5	34.5	22.5	10.5	5
	Safeguarding inappropriate access to computer information by setting up a password.	39.3	36.5	16	6	2.3
	Setting up secure passwords to prevent the risk of being deciphered.	43.5	39.3	11.8	3.8	1.8
	Avoid opening unknowns with the risk of computer virus infection.	44.5	38	10.5	5	2

literacy skills, 51.1% said that they were really very confident, and 13.5% were not confident. While 66.1% of students showed motivation towards improving their computer skills for academic purposes, 73.6% were confident about acquiring computer-related skills.

Computer literacy results on the Likert scale showed that students were most familiar with Microsoft Word (48.3%, good) while familiarity and understanding with spreadsheet Microsoft Excel was least among software with 30% as good. Regarding hardware, 31.3% (very Good) students were highly familiar with the basic components of the computers, for example, the motherboards. The majority of students were very good at handling the network, such as communicating and attaching a file via Email, Zoom and searching on Google / AI (50.3%, 47.5%, and 47%). Students desired to install only legal and authorized software on their PCs (43% very good). In the field of information security, they knew how to install antivirus software to protect their computer from viruses and how to open an unknown file that contained a risk of viruses (27, 44.5% very good). These results are shown in Table 2.

The associations between computer access in childhood and computer literacy were analyzed. A statistically significant association existed between lack of computer access in childhood and present unfamiliarity with software ($p<0.0001$). Similarly, a strong association was noted between no computer access in childhood and unfamiliarity with computer hardware, multimedia, internet networks, information technology (IT) ethics, data, and information security ($p<0.0001$ for all). The association between computer education in childhood and computer literacy has been analyzed. A statistically significant association of no computer-related education in childhood had greater chances of unfamiliarity with software ($p<0.0001$). Likewise, associations with no computer-related education had higher risks of unfamiliarity with hardware, multimedia, network, information ethics, and information security ($p<0.0001$ for all).

Discussion

In LMIC, like Pakistan, computer literacy is a cornerstone for empowering health professional students with essential skills to meet modern healthcare education and practice challenges. In the current study, we evaluated the knowledge and familiarity of medical and dental students with various computer technologies, including software, hardware, multimedia, network, and information ethics. Our findings revealed that students displayed the highest familiarity with Microsoft Word (50.3%), while they were the least familiar with Microsoft Excel 30%. They demonstrated considerable proficiency in using the internet for email (50.3%), Zoom (47.5%), and the widely used Google search engine (47%). These results aligned with previous studies conducted by Robabi et al., where 43.8% were familiar with word processing programs, 41.1% with search engines, and 30.5% with email[14]. Similarly, a study by Jadoon et al. indicates proficiency levels of 41% in Word processing, 52.4% in email, 63.1% in Google search engine, and only 7% in Microsoft Excel.[15] Notably, another study in Pakistan found that 23% of the students regularly utilized the internet.[16]

These findings suggest a growing awareness among medical and dental students regarding the importance of computer literacy, leading to increased utilization of computers and the Internet for personal and academic purposes. However, these proficiency levels still fall short compared to those observed in developed countries.[4,5,6] Furthermore, it is noteworthy that students continue to lack familiarity with the Excel programs.

Table 3: *Associations of computer access and education in childhood and present familiarity with computer use.*

Parameters	Full computer access	Limited computer access	No computer access	p-value	Computer Education Yes	Computer Education No	p-value
Software	115	207	29	<0.0001	160	117	<0.0001
Hardware	97	219	28	<0.0001	167	112	<0.0001
Multimedia	100	208	29	<0.0001	148	116	<0.0001
Network	159	195	29	<0.0001	196	159	<0.0001
Information ethic	119	212	20	<0.0001	202	142	<0.0001
Information security	155	191	29	<0.0001	183	149	<0.0001

The students demonstrated limited familiarity with understanding hardware, with only 31.3% reporting proficiency in it. These findings are consistent with previous studies, which reported rates of 18% and 22.7%.[16,12] This reflects a significant proportion of medical students who may not perceive familiarity with computer components or troubleshooting minor issues as essential skills. However, it is important to recognize that by understanding computer hardware, health professionals can facilitate collaboration with IT departments, leading to improved technology integration in hospital settings and ultimately enhancing patient care.

The results suggest a link between personal computer access and computer proficiency. Of the students surveyed, 79% owned personal computers, with 39.9% utilizing them for academic purposes. Limited classroom encouragement and exposure to computers and the internet may contribute to this trend, consistent with findings in Pakistan (97%),[16] Sri Lanka (80%),[4] and India (93.2%).[10] A strong correlation exists between current computer usage and proficiency ($p < 0.0001$), potentially linked to early exposure and formal childhood computer education. However, 51.8% of students had limited early computer access and expectancy, while parental support showed reservations (74%). Similar patterns were observed in Sri Lanka (60% formal training)[4] and India (22.4%).[17]

The COVID-19 pandemic highlighted the disadvantage of deficient computer literacy for medical and dental students in Pakistan.[19] The staff's lack of training hindered the rapid transition to online education, impacting student learning and satisfaction.[18] Proficient computer skills are crucial for navigating virtual learning platforms, accessing resources, and maintaining educational continuity.

A positive attitude and motivation toward learning computer skills are crucial. In this study, 51.1% of students expressed confidence in their computer skills, while 66.1% were motivated to learn. Proficient computer skills foster virtual learning platforms, engagement in online lectures, and participation in collaborative projects. The online learning resources and communication tools ensure that students can remotely access course materials, participate in discussions, and stay connected with faculty and peers. However, the overall computer literacy of medical students remains subpar, highlighting the need for computer literacy programs in medical education to prepare future health professionals for the evolving digital landscape, improving patient care and research efficiency.

Furthermore, adopting computer technology among medical students has led to negative psychological effects, impacting their learning and satisfaction, including feelings of anxiety, frustration, and overwhelm.[20] Therefore, a positive attitude and motivation towards learning computer skills are needed. In this study, 51.1% of the students were confident about their computer skills, while 66.1% of them were motivated to learn computer skills, correlating with studies done in India.[21]

Considering our study's findings revealing suboptimal computer literacy among medical and dental students, we suggest incorporating computer literacy initiatives in medical curricula with targeted training programs and workshops. Accessibility to computer and internet resources with properly trained staff will help eliminate disparities in computer literacy among medical and dental students. This will ultimately make them better prepared for future health professionals to navigate the evolving digital landscape of healthcare, scientific research, and evidence-based practice, enhancing patient care delivery in the long run.

Although our study sheds light on the current state of computer literacy, areas of improvement, and strategies to enhance the digital skills of medical and dental students, it has some limitations. Firstly, it is a cross-sectional study conducted at only one institution; therefore, it has limited generalization and measures the responses at one point in time and not longitudinally over a period of time. Secondly, the data collection involved students' responses to the items on the questionnaire on the Likert scale, limiting the depth of responses; including qualitative responses will improve understanding. Thirdly, there is an element of subjectivity and potential bias in responses due to the personal desirability of respondent students. We hope that by taking this study as a starting point to identify the shortcomings in computer literacy among medical and dental students, future researchers will conduct studies addressing these limitations.

Conclusion

Significant gaps exist in computer literacy among medical and dental students. This digital divide is influenced by limited access to computer technology, inadequate computer skills training, and difficulties with uninterrupted internet and electricity availability in LMICs such as Pakistan. The present dire situation is due to the complex interplay of socioeconomic factors, inadequate educational opportunities, and limited resource development. With the rapid incorporation of technology in healthcare and health professional education, preparing medical and dental students as future physicians and dentists in the modern era is crucial. It is imperative that medical educationists and policymakers make a concerted effort to recognize the barriers and work towards solutions to improve computer literacy across the health professional education and healthcare system.

Ethical Approval: The Research Ethics Review Committee, Avicenna Medical College & Hospital, Lahore approval this study vide Letter No. IRB-40/5/23/AVC).

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Authors' Contribution:

NAA: Conception & design, acquisition of data, analysis & interpretation

FF: Analysis & interpretation of data, drafting of article,

MZ: Conception & design, analysis & interpretation of data, drafting of article

VA: Acquisition of data, data analysis & interpretation

GW: Conception & design, analysis & interpretation of data, drafting of article, critical revision for important intellectual content, final approval

References

1. Hindi NM, Miller D, Wenger J. Computer literacy: Implications for teaching a college-level course. J Inf Syst Educ. 2002;13(2):143.
2. Topol E. The Topol review: Preparing the healthcare workforce to deliver the digital future. 2019;1-48.
3. Park JC, Kwon HJ, Chung CW. Innovative digital tools for new trends in teaching and assessment methods in medical and dental education. J Educ Eval Health Prof 2021;18(1):13
4. Ranasinghe P, Wickramasinghe SA, Pieris WA, Karunathilake I, Constantine GR. Computer literacy among first year medical students in a developing country: A cross-sectional study. BMC Res Notes. 2012;5(1):1-8.
5. Ali S, Alam BF, Farooqi F, Almas K, Noreen S. Dental and medical students' knowledge and attitude toward COVID-19: a cross-sectional study from Pakistan. Eur J Dent. 2020;14(S 01):S97-S104.
6. Morton CE, Smith SF, Lwin T, George M, Williams M. Computer programming: should medical students be learning it. JMIR Med Educ. 2019;5(1):e11940.
7. Kubben PL, Looije P, Scherpbier A, van Merode F. Teaching computer programming to medical doctors, nurses and hospital staff: a pilot study. OAJNN. 2017; 4(2):555632.
8. Mahdizadeh F, Mahdizadeh F, Tatari M, Sheykhtayefeh M. The relationship between health literacy and computer literacy among Torbat Heydarieh Students of Medical Sciences. Payavard Salamat. 2021; 15(2): 118-126.
9. Ferdoush J, Biswas RS, Khan IU, Momtaz T, Alam J, Morshed MM, et al. Information and communication technology in medical education: A survey among medical students of Bangladesh. J Sci Soc. 2021;48(3):165-70.
10. Prabhavathi K, Ramraj B, Kumar GT, Saravanan A. Knowledge and perspective on the application of computer and Internet in medical curriculum among first-year medical students. Natl J Physiol Pharm Pharmacol. 2020;10(08):609-613.
11. Khan RU, Khan A, Anwar M. Computer literacy and academic performance in universities of southern Khyber Pakhtunkhwa Pakistan. Gomal Univ J Res. 2023; 39(2):147-55.
12. Lin TC. A computer literacy scale for newly enrolled nursing college students: development and validation. J Nurs Res. 2011;19(4):305.
13. Foruzandeh N, Delaram M, Deris F, Foruzandeh M, Darakhshandeh S. Information literacy and use of information technology by students in Shahrekord University of Medical Sciences. Interdiscip J Virtual Learn Med Sci. 2017;7(1).
14. Robabi H, Arbabisarjou A. Computer literacy among students of Zahedan University of Medical Sciences. Glob J Health Sci. 2015;7(4):136.
15. Jadoon NA, Zahid MF, Mansoorulhaq H, Ullah S, Jadoon BA, Raza A, et al. Evaluation of internet access and utilization by medical students in Lahore, Pakistan. BMC Med Inform Decis Mak. 2011;11(1):1-7.

16. Masood SA, Khan RA, Waheed GU. Computer literacy among the medical staff at Avicenna Medical College and Hospital. J Nurs Econ. 2010;16(2):33.
17. Jain R, Dupare R, Bhanushali N, Kumar V. Knowledge and utilization of computer among health-care professionals in Mumbai. J Indian Assoc Public Health Dent. 2020;18(1):97-102.
18. Azim SR, Nisar M, Baig M, Azfar SM, Azim SN, Anwar A. Experiences of virtual teaching during COVID-19 in medical institutes of Karachi, Pakistan: teachers' perspective. J Pak Med Assoc. 2022;72(2223).
19. Mushtaque I, Awais-E-Yazdan M, Waqas H. Technostress and medical students' intention to use online learning during the COVID-19 pandemic in Pakistan: The moderating effect of computer self-efficacy. Cogent Educ. 2022;9(1):2102118.
20. Almarzooq ZI, Lopes M, Kochar A. Virtual learning during the COVID-19 pandemic: a disruptive technology in graduate medical education. Journal of the American College of Cardiology. 2020;75(20):2635-8.
21. Naik Bijaya N, Knungo S, Rangasamy S. Level of motivation for learning among undergraduate medical students: An explorative study from Pondicherry, South India. Indian J. Prev. Soc. Med. 2020;51(4):212.