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Original Article

Comparison of Learning Styles and E-Health Literacy among Undergraduate Medical Students

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ABSTRACT

Objective: To assess the learning styles and eHealth literacy among undergraduate medical students and to compare eHealth literacy scores across gender and different learning style domains (Visual, Auditory, kinesthetic and Read/write).
Study Design: Analytical cross-sectional study.
Place and Duration of study: Department of Medical Education, Fazaia Medical College Islamabad, Pakistan from Jan to Feb 2025.
Methodology: Data was collected using pre-validated Visual, Aural (auditory), Read/Write, and Kinesthetic (VARK) and e-Health Literacy Scale (eHEALS) from 152 students of first and second-year MBBS using convenience sampling. After excluding two participants with multiple missing values, data was analyzed. Descriptive statistics, reliability, independent t-test, ANOVA and Pearson's correlation were used for data exploration and analysis.
Results: With response-rate of 76.0% and male: female ratio of 1:1.27, this study shows that in unimodal category Kinesthetic 70 (46.7%) is most predominantly prevalent style while Visual 06(4.0%) and Read/Write 04(2.7%) are least preferred learning styles. Multimodal style was observed in 22(14.7%) individuals. This pattern was replicated across genders as well. eHEALS shows mean score of 27.44+5.83 with 86(57.3%) students in developing, 42(28.0%) in high and (n=20;13.3%) in low e-health category. No significant relationship was found between e-Health literacy and learning styles or gender. There was significant strong negative relationship between different learning styles (p<0.05).
Conclusion: Medical students' digital health literacy is not related to learning styles or gender. Students may have single or multimodal learning styles but this does not impact their e-Health literacy.

Keywords: Digital Health Competence, eHealth literacy, Medical Education, Undergraduate Medical Education, VARK model.

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INTRODUCTION

Medical education in the twenty-first century requires not only an understanding of the subject but also the flexibility to adapt to digital tools and learning preferences.[1]

Understanding each student's unique learning style enables teachers to modify their teaching strategies, which could improve academic performance.[2] The four learning modalities identified by the VARK model are kinesthetic, visual, auditory, and read/write.[3] This widely used scale assesses how well students assimilate and process information presented to them through various types of teaching and learning platforms.[4] The students may have predominantly unimodal learning preference or they may possess multimodal style. However, it is plausible that learning style-related cognitive and behavioral processes may influence how students search, analyze, and utilize online health information.

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eHealth literacy, which involves understanding and applying electronic health information to make informed health decisions, thereby reducing health inequality and promoting overall health, making it as a crucial component of public health initiatives, as stated in the report of the World Health Organization.[5,6]

Medical students, in the early preclinical years, are at a crucial stage in developing their digital skills and learning preferences.[7] Recent studies have indicated that medical students' eHealth literacy needs to be taken into consideration, even though students in the health and medical fields are presumed to be well-versed due to their knowledge of the relevant health field. This information helps with readiness for technologically advanced healthcare settings.[8]

Although medical students' learning preferences and eHealth literacy is the subject of worldwide research in Western and East Asian countries, limited data from Pakistan and South Asia is available. In Pakistan many studies discussed VARK learning styles and correlate them with academic performance,

but none studied their relationship with eHealth literacy.[9,10]

We conducted this study to assess the learning styles and eHealth literacy among undergraduate medical students and to compare eHealth literacy scores across gender and different learning style domains.

METHODOLOGY

This analytical cross-sectional quantitative study was conducted at the Department of Medical Education, Fazaia Medical College Islamabad, Pakistan from Jan to Feb 2025. Approval was sought from the Institutional Ethical Review Board (IBD/FMC/1341/IRB/14 dates 30/7/25) prior to data collection.

Inclusion Criteria: First and second year students of either gender, of any age group, currently enrolled in the MBBS program were included.

Exclusion Criteria: Students were from allied health sciences disciplines were excluded.

A sample size of 132 was calculated using Open-Epi based on 95% confidence interval and 5% margin of error and 50% population proportion. To account for missing data in returned questionnaires, a sample of 152 first and second-year medical students was selected using non probability convenience sampling.

After informed consent of participants, data was collected using pre-validated E-Health Literacy Scale (eHEALS) (10-item),[11] and VARK Questionnaire (Version 8.01),[12] ensuring anonymity.

VARK is a 4-option scale consisting of 16 items to identify perceived learning preferences, with responses recordable in four categories of Visual (V), Aural (A), Read/Write (R), and Kinesthetic (K). Students could exhibit unimodal or multimodal learning style. E-HEALS is a 5-point Likert scale with 10 item to assess student's perceived ability to locate, evaluate, and apply electronic health information for solving health-related problems. The eHEALS score were then computed across the 4 domains of VARK learning styles.

Data were collected during inhouse academic workshops, using printed questionnaires. For data triangulation, students also filled the forms online individually on VARK official website and submitted their results from website on a piece of paper attached to the printed questionnaire. The responses were manually recorded and analyzed in Statistical Package for Social Sciences (SPSS) Version 25. To minimize bias, double data entry was performed by two independent researchers, followed by cross-checking for discrepancies. The entered data was also cross matched to the submitted results from the website during data entry. Any mismatches were resolved through verification against original forms. Mean and SD were calculated for eHEALS and VARK domain scores, while frequencies and percentages were used for gender, year of study, and dominant learning styles. Data normality was checked by Kolmogorov Smirnov test which showed that eHEALS and all VARK domains were normally distributed (p>0.05); Skewness ranged from –0.43 to 1.00 and kurtosis from –0.55 to 0.69 and Levene's test showed equal variances for eHEALS (F=0.046, p=0.831). Independent t-test compared eHEALS across gender, One Way ANOVA was used measure whether Eheals scores varied significantly across learning styles and Pearson's correlation assessed relationships between eHEALS and VARK domain scores. Significance was set at ≤ 0.05.

RESULTS

Out of 200 participants, 152 returned the questionnaires, 2 questionnaires were incomplete and excluded from the study (Response rate=76%). There were 66(44%) males and 84(56%) females. The distribution of dominant learning styles (Figure) shows that in Unimodal category Kinesthetic (46.7%) is the most predominantly prevalent style while Visual (4.0%) and Read/Write (2.7%) were the least common styles. The prevalence of Multimodal learning style was 22(14.7%) This pattern was replicated across gender as well.

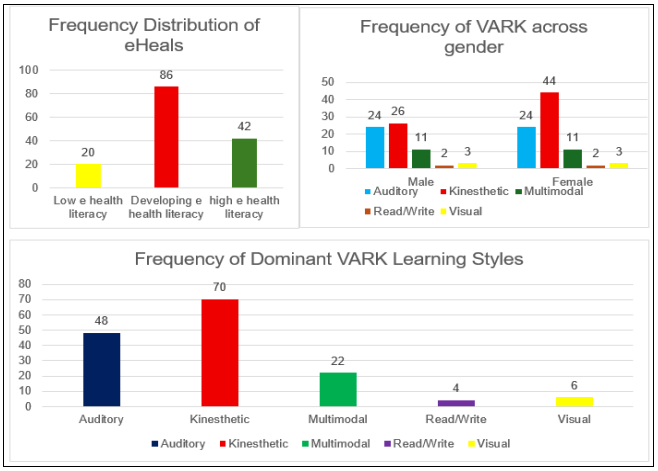

Figure: Frequency Distribution for e-Health Literacy and Learning styles among medical students

On the eHealth Literacy Scale (eHEALS), descriptive statistics revealed an average total score of 27.44+5.83. The item mean ranged from 2.69 to 3.63. Eighty-six (57.3%) participants were in the developing stage, 42(28.0%) had high eHealth literacy, and 20(13.3%) had low eHealth literacy.

Comparison of eHEALS scores by gender revealed no statistically significant difference (p=0.696), as seen in Table-I. No significant difference in eHEALS scores was observed among students in the 4 learning groups of visual, auditory, read/write, and kinesthetic learning styles (p=0.535, Table-II). Intergroup comparisons revealed no statistically significant pairwise differences in mean eHEALS scores among the five VARK groups (Table-III).

Table-I: Comparison of E-Health Literacy Scores (eHEALS) by Gender (n=150)

Category	Male (n = 66)	Female (n = 84)	*p*-value
	Mean + SD	Mean + SD	
e-HEALS score	27.23+5.70	27.61+5.95	0.696

Table-III: Comparison of E-Health Literacy Scores (e-HEALS) and VARK learning domains (n=150)

Parameters	Learning Styles Domain					*p*-value
	Visual (n=6)	Auditory (n=48)	Kinesthetic (n=70)	Read/Write (n=4)	Multi-modal (n=22)	
eHEALS Score	30.33±4.93	28.05±5.20	27.10±5.89	25.00±3.46	26.86+7.36	0.534

Table-III: Pairwise comparison of mean e-HEALS scores across dominant VARK learning styles (n=150)

Group Comparison	*p*-value
Visual vs Auditory	(0.895)
Visual vs Read/Write	(0.620)
Visual vs Kinesthetic	(0.691)
Visual vs Multimodal	(0.697)
Auditory vs Read/Write	(0.854)
Auditory vs Kinesthetic	(0.908)
Auditory vs Multimodal	(0.933)
Read/Write vs Kinesthetic	(0.956)
Read/Write vs Multimodal	(0.977)
Kinesthetic vs Multimodal	(1.00)

No significant relationship was found between eHEALS and Visual (r=0.088, p=0.286), Auditory (r=–0.034, p=0.681), Read/Write (r=–0.006, p=0.940), or Kinesthetic (r=0.029, p=0.727) learning style scores. Significant strong negative relationships were observed between Kinesthetic and Auditory (r=–0.542, p=0.000), and Kinesthetic and Read/Write (r =–0.514, p=0.000). A moderately negative relationship was observed between Visual and Auditory (r=–0.409, p < *0.001)* The results indicate that students who prefer one learning style, like Kinesthetic, tend to perform poorly in other styles, indicating a mutual exclusivity in learning style dominance.

While the eHEALS tool demonstrated strong internal consistency and meaningful variability among students, neither learning style nor gender significantly influenced literacy outcomes. Notably, several VARK domains exhibited inverse relationship, reinforcing the distinctive nature of learning preferences.

DISCUSSION

This study shows that the most common learning style among participants was kinesthetic, followed by auditory, with visual and read/write being among the least prevalent. This is consistent with past findings that show medical students favor experiential, hands-on learning methods like kinesthetic due to the clinical and practical nature of medical education.[13, 14] These preferences highlight the necessity for preclinical curricula to include interactive and experiential learning strategies for medical educators.

In terms of eHealth literacy, the average eHEALS score of this study indicating that students understand the fundamentals of digital health, a significant proportion are classified as developing. This aligns with research by Kim *et al*. that highlights the growing but still insufficient preparedness of students pursuing health careers to evaluate and utilize online health information critically.[15] As the use of digital tools in healthcare grows, it is critical to improve eHealth literacy to ensure that future physicians can use online resources for patient care, continuing education, and evidence-based decision-making.[16,17]

Interestingly, our study found no significant association between dominant learning styles and eHealth literacy levels. This implies that learning preferences do not always predict digital competencies, although they may have an impact on classroom engagement and retention. Similar findings were reported by researchers such as Dashti *et al*. and Karimian *et al*. who found that access to technology, prior exposure, and personal motivation are more strongly associated with digital literacy than cognitive learning preferences.[18,19] The lack of association in our study may be attributed to confounding and contextual factors such as prior digital experience, socioeconomic background, and technical resources, rather than cognitive learning preferences.

In our study, gender differences in VARK preferences and eHealth literacy were not statistically significant. Females made up 84% of the sample, but their eHEALS scores did not differ significantly from those of males. These findings concur with those of Purcel et al., who also observed that the eHealth literacy of medical students did not significantly differ by gender.[20] The lack of significant gender gaps may be due to similar training and access to digital resources provided to both genders. Because of the female-majority sample, subtle discrepancies might have remained undetectable. However, other research carried out in larger or more diverse groups show that structural or cultural variables have an impact on the differences.

The negative relationship among VARK domains in our study, especially auditory and kinesthetic, and between read/write and kinesthetic, emphasize the distinguishing and mutually exclusive nature of some learning preferences. Noor *et al*. also highlighted that some students have multimodal tendencies while many prefer a single dominant style making blending in classroom a challenge for educators.[21] Inverse relationship demonstrated in this study also indicates a similar concept.

Additionally, no meaningful relationship between VARK domains and eHEALS scores suggest that both are related to students' information processing and learning but operate separately. This demonstrates the idea that enhancing digital health literacy necessitates specific instruction that goes beyond accommodating various learning styles.[22]

Modern medical education demands personalized learning approaches and digital proficiency coherently and this is grounded in the recognition of relationship between learning styles and eHealth literacy.[2,23] VARK learning preferences focus on how students best absorb information while eHealth literacy assesses student's ability to use digital health content.[15]

LIMITATIONS OF STUDY

The results of the study should be interpreted considering the various limitations. Firstly, it is a unicentric study, which limits generalizability of results. Second, there is a chance of response bias when self-reported questionnaires like the VARK and eHEALS scales because participants might have overestimated or underestimated their digital literacy or learning preferences. The sample, comprising of predominantly female students, may have distorted the results, preventing useful gender-based comparisons. More balanced and diverse samples from different institutions would be used in future studies to fully understand these educational dynamics.

CONCLUSION

Medical students' digital health literacy is not related to learning styles or gender. Students may have single or multimodal learning styles but this does not impact their e-Health literacy.

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Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

MS & NA: Conception, study design, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Adera N. Innovative learning spaces and blended learning: Quest for 21st century competency teaching and learning approaches. Creating Dynamic Space in Higher Education: Modern Shifts in Policy, Competencies, and Governance 2025: 139-174 https://doi.org/10.4018/979-8-3693-6930-2.ch006
2. El-Sabagh HA. Adaptive e-learning environment based on learning styles and its impact on development students' engagement. Int J Educ Technol High Educ 2021; 18(1): 53. https://doi.org/10.1186/s41239-021-00289-4
3. Beltran K, Abonita A, Brazal A, Relente J, Relente JM. Visual, Auditory, Read/Write and Kinesthetic (VARK) Model-Based Peer Teaching Approach. Educative: J Ilmiah Didik 2025; 3(1): 17-24. https://doi.org/10.70437/educative.v3i1.937
4. Baumgartner M, Sauer C, Blagec K, Dorffner G. Digital health understanding and preparedness of medical students: a cross-sectional study. Med Educat Online 2022; 27(1): 2114851. https://doi.org/10.1080/10872981.2022.2114851
5. Hasannejadasl H, Roumen C, Smit Y, Dekker A, Fijten R. Health literacy and eHealth: challenges and strategies. JCO Clin Cancer Inform 2022; 6: e2200005. https://doi.org/10.1200/CCI.22.00005
6. Campanozzi LL, Gibelli F, Bailo P, Nittari G, Sirignano A, Ricci G et al. The role of digital literacy in achieving health equity in the third millennium society: A literature review. Front Public Health 2023; 11(1): 1109323. https://doi.org/10.3389/fpubh.2023.1109323
7. McGee RG, Wark S, Mwangi F, Drovandi A, Alele F, Malau-Aduli BS, et al. Digital learning of clinical skills and its impact on medical students' academic performance: a systematic review. BMC Med Educ 2024; 24(1): 1477. https://doi.org/10.1186/s12909-024-06471-2
8. Mengestie ND, Yilma TM, Beshir MA, Paulos GK. eHealth literacy of medical and health science students and factors affecting eHealth literacy in an Ethiopian university: a cross-sectional study. Appl Clin Inform 2021; 12(02): 301-309. https://doi.org/10.1055/s-0041-1727154
9. Fahim A, Rehman S, Fayyaz F, Javed M, Alam MA, Rana S, et al. Identification of preferred learning style of medical and dental students using VARK questionnaire. BioMed Res Int 2021; 2021(1): 4355158. https://doi.org/10.1155/2021/4355158

10. Khan AM. A Study of the Relationship of Learning Styles of Undergraduate Medical Students to Academic Achievements. Pak Armed Forces Med J 2023; 73(1): 260. https://doi.org/10.51253/pafmj.v73i1.6188
11. Carella G, Colombo F. Teaching design and actively applying it through project-based learning format: A practical case study of a collaboration between a university course and a company. Inted Proc 2024; 1(1): 2391-2398. https://doi.org/10.21125/inted.2024.0664
12. Fleming N. The VARK Questionnaire Version 8.01. VARK Learn Ltd (Internet) 2022. Accessed on 24th June 2025. Available from https://vark-learn.com/the-vark-questionnaire/
13. Özdemir H, Zaybak A. Investigation of relationship between learning styles and psychomotor skills of nursing students. Int Anatol Acad Online J Health Sci 2020; 6(3): 234-245. https://doi.org/10.63053/iaaojhs.26
14. Hernandez JE, Vasan N, Huff S, Melovitz-Vasan C. Learning Styles/Preferences Among Medical Students: Kinesthetic Learner's Multimodal Approach to Learning Anatomy. Med Sci Educ 2020; 30(4): 1633-1638. https://doi.org/10.1007/s40670-020-01049-1
15. Kim K, Shin S, Kim S, Lee E. The relation between eHealth literacy and health-related behaviors: systematic review and meta-analysis. J Med Internet Res 2023; 25(2): e40778. https://doi.org/10.2196/40778
16. Champlin S, Hoover DS, Mackert M. Health literacy in adult education centers: Exploring educator and staff needs. Health Promot Pract 2020; 21(2): 198-208. https://doi.org/10.1177/1524839918789690
17. Conard S. Best practices in digital health literacy. Int J Cardiol 2019; 292: 277-279. https://doi.org/10.1016/j.ijcard.2019.05.070
18. Dashti S, Peyman N, Tajfard M, Esmaeeli H. E-Health literacy of medical and health sciences university students in Mashhad, Iran in 2016: a pilot study. Electron Physician 2017; 9(3): 3966. https://doi.org/10.19082/3966
19. Karimian Z, Zolfaghari Z. Learning styles vs. virtual education preferences: a cross-sectional study on medical sciences e-students. Front Educ 2024; 9(1): https://doi.org/10.3389/feduc.2024.1499501
20. Purcell D. The relationship between electronic health literacy, locus of control, trust in physicians, attitudes towards providers, and medication adherence: Nova Southeastern University. Health Lit Res Pract 2023; 7(2): e80-e88. 2021. https://doi.org/10.3928/24748307-20230417-01
21. Noor S, Ramly MKA. Bridging learning styles and student preferences in construction technology education: VARK model analysis. Int J Acad Res Prog Educ Dev 2023; 12(3): 2075-2085. https://doi.org/10.6007/IJARPED/v12-i3/19313
22. Fitzpatrick PJ. Improving health literacy using the power of digital communications to achieve better health outcomes for patients and practitioners. Front Dig Health 2023; 5(1): 1264780. https://doi.org/10.3389/fdgth.2023.1264780
23. Anurogo D, Hardin R, Nabila P, Ulfah P. Digital Literacy 5.0 to Enhance Multicultural Education. Multicult Islamic Educ Rev 2023; 1(2): 109-179. https://doi.org/10.23917/mier.v1i2.3414