Research Article

Exploring the Preferred Learning Style for Gross Anatomy among Undergraduate Medical Students in Pakistan: An Analysis Using the Index of Learning Styles Questionnaire

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Abstract

Background: Learning styles encompass a student's mindset, influences, and actions that aid their learning within a specific context. Students frequently employ a blend of learning styles, with no inherent correctness or incorrectness associated with any particular style

Objective: Exploring the preferred learning styles for gross anatomy among undergraduate medical students in Pakistan is essential for academic trainers to tailor educational approaches effectively, enhancing student learning and outcomes.

Methods: A cross-sectional survey was conducted on 522 undergraduate medical students enrolled in a gross anatomy course, utilizing The Index of Learning Styles questionnaire (ILS). Participants were chosen through non-probability consecutive sampling. The collected data was analyzed employing SPSS 21.0.

Results: The analysis revealed that the predominant learning styles among these students were active (54.9%), sensing (85.1%), visual (81.2%), and sequential (74.4%). While we attempted to identify preferred learning styles for specific anatomical regions, no particular domain emerged as dominant. However, the active/reflective dimension was favored by learners specifically during the study of the head and neck region.

Conclusion: To optimize learning outcomes in gross anatomy courses for undergraduate medical students in Pakistan, integrating knowledge of preferred learning styles with teaching methodologies like the flipped classroom method is crucial. By incorporating active, sensing, visual, and sequential learning elements into course activities, designers can create a more engaging and effective learning experience.

Introduction

In the realm of educating health professionals about anatomy, educators are perpetually exploring the pros and cons of different learning styles to determine their effectiveness.[1] Learning styles encompass a student's mindset, influences, and actions that aid their learning within a specific context.[2] Students frequently employ a blend of learning styles, with no inherent correctness or incorrectness associated with any particular style.

Knowing one's learning style can assist in developing efficient learning strategies to capitalize on strengths

and address weaknesses, which will ultimately result in enhanced academic achievement. Gaining insights into the profiles of learning style and methods preferred by the learners, particularly at the beginning of a course, empowers the course directors to customize their teaching for enhanced effectiveness and improved results.[3]

Among over 71 diverse learning style assessment tools, commonly employed ones include Kolb's Experiential Learning, Entwistle model, Fleming's VARK and Index of Learning Styles questionnaire (ILS).[4] Index of Learning Styles questionnaire (ILS) which was developed by Dr. Richard, M. Felder and Dr. Linda Silverman, evaluates preferences in four domains: processing (active or reflective), perception (intuitive or sensing), input (verbal or visual) and understanding (global or sequential).[5] Felder and Silverman found that active learners preferred collaborative activities, hands-on learning, and applying knowledge, while reflective learners tend to work independently and engage in in-depth conceptual thinking before immersing themselves in information. Visual learners gravitate towards images and visual materials, verbal learners on the other hand like spoken explanations and written text. Sequential learners favor a systematic, step-by-step approach, while global learners think holistically and make significant learning leaps by connecting information.[6]

All the ILS domains align with the anatomy curriculum and can be implemented through diverse course design approaches.[7,8,9] Active learners thrive with hands-on activities (e.g., dissection), while reflective learners benefit from lecture notes and written materials. When it comes to grasping complex concepts, sensing learners appreciate the practical and real-world applications, while intuitive learners gravitate toward more abstract and conceptual interpretations. Visual learner prefers learning through cadaveric dissection, prosected specimens, atlases, diagrams, and charts, while verbal learners opt for text explanations over physical demonstrations. All these domains can be incorporated into the anatomy curriculum through a variety of course design approaches. Extensive studies in undergraduate medical programs have explored gross anatomy instruction and its correlation with learning style preferences and student achievements.[10,11,12,13]. Only few studies are conducted on the preferred learning styles for gross anatomy among undergraduate medical students in Pakistan Hence,

understanding these learning styles of Pakistani undergraduate medical students is important for effective curriculum design and implementation.

The current study evaluated the learning style preferred by Pakistani undergraduate medical using the Index of Learning Styles questionnaire (ILS). The ILS, validated and reliable, categorizes preferences on a gradient scale rather than as either/or. It assesses various domains and how students utilize them in class. The hypothesis is that undergraduate medical students share common learning style preferences, predominantly in processing, perception, input and understanding domains. Understanding these preferences can inform curriculum design and implementation for more effective medical education in Pakistan.

Methods

The current study evaluated the learning style preferred by Pakistani undergraduate medical using the Index of Learning Styles questionnaire (ILS). The ILS, a well-established and trustworthy tool, categorizes preferences on a continuum rather than as binary choices.

The Gross Anatomy Course spanned the initial two years of medical education, covering topics such as General Anatomy, upper limbs, lower limbs and thorax during the first year. The anatomy of head and neck, brain, abdomen and pelvis were taught in the second year. After completing each anatomical region, students faced a comprehensive 150-marks examination comprising of MCQs, SEQs, OSPE and viva. Regardless of their chosen lecture format, all students were subject to the same end-of-region as well as sendup examination.

The research included 555 18 volunteer undergraduate medical students from two medical institutions, University Medical and Dental College, Faisalabad and Faisalabad Medical University, Faisalabad, spanning the period from January 2021 to September 2023 after obtaining ethical approval (letter# UMDC/Dean/ 2021/ 103). Only those volunteer students were included who understood the questionnaire how to respond it while students who were confused and did not want to participate were excluded from the study.

In the context of this study, the Undergraduate Gross Anatomy Course encompassed both instructional and practical aspects. The instructional part followed a

traditional approach, with two hour of classes held four days a week, involving demonstrations on prosected specimens, models, torsos, bones, and radiographs. Additionally, dissection sessions took place weekly for approximately two hours, enabling hands-on cadaveric dissection experiences.

To supplement their learning, students were granted access to downloadable links for prerecorded online lectures, available as podcasts or streaming videos. Both traditional and online lectures employed identical PowerPoint presentations to ensure consistent content delivery. Course assessments, including examinations, were collaboratively developed by the teaching instructors. Students had the flexibility to choose their preferred lecture delivery method, but classroom attendance requirements mandated a minimum of 75%. Recorded lectures provided flexible learning options, allowing students to review material at their own pace and convenience, reinforcing understanding and retention of complex subjects like gross anatomy. Additionally, they supported diverse learning preferences and served as a valuable resource for examination preparation.

At the conclusion of the course, the students were required to complete a brief demographic survey and index of Learning Styles questionnaire (ILS) [Appendix I]. This questionnaire consisted of 44 questions, 11 questions for each of the four domains: processing (active/reflective), perception (visual/verbal), input (sensing/intuitive) and understanding (sequential/global. The Index of Learning Styles questionnaire (ILS) provided a preference score within each domain, ranging from "balanced" (1-3) to "strong" (9-11), allowing for the evaluation of each student's learning style on the scale from -11 to +11.

An Excel database was created to store and analyze data, including student names, class, demographic information, ILS scores for each learning style dimension, and region-wise exam scores. The data was analyzed with SPSS 21.0 (Statistical Package for Social Sciences 21.0). The descriptive statistics were used to identify the demographic composition and preferred learning styles of the undergraduate medical students learning anatomy while regression analysis was used to find out if any learning style could predict their examination outcome.

Results

The demographics and ILS survey forms were received from 555 learners, but only 522 were completely filled, yielding a response rate of 91%.

The Table 1 presents the demographic summary of learning style preferences among the 522 participants. Table 2 shows descriptive statistics of preferred learning styles of Gross Anatomy among medical students at undergraduate level.

Multiple linear regression analyses was used to find out if any of the learning style domains of the learners could predict their academic achievement in the end-of-region examinations. In the upper limb, lower limb and thorax analysis, only 246, 235 and 240 participants

Table 1: *Demographic data of medical students studying "Gross Anatomy" at undergraduate level*

Demographic Data	Frequency (%)
Gender	
Male	120 (22.8)
Female	402 (77.2)
Academic year	
First Year	246 (47.2)
Second year	276 (52.8)
Age range (Years)	18-25
Mean age (±SD)	21.5 (±1.7) years

**Table 2:** *Preferred learning styles of Gross Anatomy among medical students at undergraduate level*

Learning Style Domains	Frequency (%)
Active: Reflective	293 (55.9):229 (44.1)
Sensing: Intuitive	435 (83.3):87 (16.7)
Visual: Verbal	415 (79.5):107 (20.5)
Sequential: Global	401(76.8):121 (23.2)

were included respectively. The mean end of region exam scores for these learners were 81.34 ± 29.22, 85.9 ± 22.7 and 97 ± 12.5). While in the Head and Neck, Brain and Abdomen Pelvis region, 275, 269, 272 participants were included respectively, with a Mean ± SD scores for the end-of-region examination scores of 79.84 ± 45.42, 78.8 ± 21.5 and 89.6 ± 23.9.

Figure. 1 shows the percentages of variance for four predicting domains predicted by regression analysis for all the six regions of the gross anatomy (Upper limb, Lower limb, Thorax, Head and Neck, Brain and Abdomen Pelvis).

For Head and neck region the active/reflective domain significantly predicted the examination scores (β = -3.32, p = 0.02). But none of the learning style domains exhibited a significant ability to predict the examination scores in other regions of gross anatomy

However, it's crucial to emphasize that none of the learning style domains had a substantial effect in predicting the other examination scores.
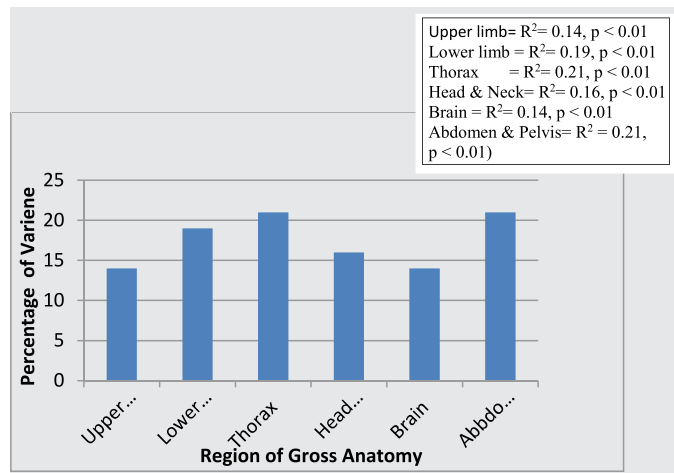
Figure 1: *The percentages of variance for four predicting domains predicted by regression analysis for all the six regions of the gross anatomy.*

Discussion

The study's analysis of learning style preferences among 522 undergraduate gross anatomy students revealed a diverse landscape of learning approaches. This study also delved into the relationship between learning style preferences and academic achievement among undergraduate gross anatomy students, encompassing a diverse cohort of 522 participants. A high response rate of 91% underscored the robustness of the dataset, and demographics offered a comprehensive view of the participant demographics. The predominant learning style preferences pointed towards active, sensing, visual, and sequential domains, reflecting the practical and visually oriented nature of anatomy education. These results are in line with past studies reflecting that students learning anatomy at undergraduate level also possess the similar learning styles that are predominating in undergraduate students in other academic fields, like business[14], biology[15], mechanical engineering[16] and health sciences.[17]

The study revealed diverse learning styles among anatomy students, with a majority leaning towards active learning and a preference for sensing over intuition. Additionally, most participants identified as visual learners and favored a sequential learning approach. However, a notable percentage preferred a holistic, global approach. These findings align with those of a previous study,[18] emphasizing the need for flexible teaching strategies to accommodate diverse preferences, ultimately supporting improved academic outcomes in anatomy education in Pakistan.

When exploring the association between learning styles and academic achievement across different anatomical regions, intriguing insights emerged. While the upper limb and abdomen, pelvis, and thorax regions did not reveal significant correlations, the head and neck region exhibited a noteworthy relationship. Specifically, the active/reflective domain emerged as a significant predictor of exam scores in this region. These findings are also consistent with previous study,[18] affirming that the context-specific nature of learning style effects on academic performance in anatomy.

This study revealed there is significant need for academic trainers to consider and accommodate diverse learning styles in anatomy education. This is supported by another study that described the multifaceted nature of learning preferences emphasizes that one size does not fit all when it comes to teaching methods.[18] Extensive evidences is there to indicate that tailoring teaching methods to align with students' specific learning styles can substantially improve academic performance, student attitudes and student conduct not only at the primary and secondary school levels[19] but at college[20] level too.

The findings of this study offer benefits to both the academic trainers and the learners who are enrolled in undergraduate anatomy courses. The questionnaire of ILS enables the learners to know their distinct learning preferences that can help them understanding how to approach the subject to maximize their output.[18] For example, if student is facing hard time in learning or not performing to his expectations in a course, awareness of his learning style and knowledge how to approach the material in alignment with his own learning style could assist learner to modify his study habits in order to maximize their study efficiency.[18] The use of ILS enables the learners to understand the learning style they can adopt in not only in their anatomy but also in other and in their professional endeavors. Educators

in academia could also gain valuable insights into the learning styles of students entering medical education and can customize not only the curriculum but their teaching strategies to enhance the course's efficacy.

Our Study reported improvements in academic scores, when learners adopted their preferred learning styles. This finding is consistent with previous research, where potential enhancements were observed not only in academic performance but also in attitudes and behaviors among primary and secondary school students when teaching methods align with their learning styles.[9,21] Unfortunately, the alignment of teaching styles with individual student preferences is infrequent in today's academic settings. Addressing the needs of students who experience such mismatches is undeniably important. However, it's essential to heed the guidelines provided by Felder and Spurlin regarding discussions on learning styles.[22] According to these guidelines, learning styles should not be taken as fixed domains but rather continuous dimensions. These could only indicate inclinations rather than predicting specific outcomes. These should only be regarded as preferences, neither as determinants of a person's strengths and shortcomings nor to stigmatize students or drive wholesale curriculum changes in the classroom.[22]

The notion of learning styles as a "myth" or an "urban legend", is at the forefront right now, but it is not reasonable to brush this useful educational tool under the rug.[23] When considering the distinct traits of learners and the different ways they relate to the circumstances, abundant confounding factors (like cognitive abilities, motivation and attitudes toward learning), often complicate the data collecting process. Researchers do agree that learning styles cannot be classified as a "theory" due to the dearth of supporting evidence and cannot be employed to categorize individuals rigidly.[18] However, they can be utilized to broaden and enhance the educational experience for learners by facilitating students in further honing their predominant learning styles while also improving their capacity to employ less dominant learning styles. In this way, it can provide potential benefits to both learners and academic trainers to growth both inside and outside of the classrooms.

Since this is the first study to identify the predominant learning styles and provided context-specific insights into their impact on academic achievement of undergraduate medical students from Pakistan. Its strengths include a high response rate (91%) yielding a robust dataset and detailed demographics offering comprehensive insights. The study has limitations such as not exploring potential confounding factors, which may impact reliability. Additionally, the lack of longitudinal analysis may restrict generalizability beyond the surveyed population. Sampling from only two institutions in Pakistan further limits generalization. Future research should consider larger sample sizes and longitudinal analyses to better understand the dynamic nature of learning styles.

Conclusion

This study illuminates the prevalence of various learning styles among the undergraduate students studying gross anatomy. Active, visual, sensing and sequential learners remained dominated. The acknowledgment of these diversities is crucial for students to maximize their efficacies by adopting the best one and for the academic trainers to adapt teaching methods effectively thus enhancing academic outcomes in this complex discipline.

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