Original Article

Investigation of learning style patterns: A case study of basic sciences medical students at Tabriz university of medical sciences

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Abstract

Background & Objective: A learning style refers to an individual's own approach to perceiving, processing, and retaining novel information. Modifying instructional approaches to align with students' individual learning preferences enhances their learning. The current study was carried out to investigate the learning style preferences of students studying basic medical sciences at Tabriz University of Medical Sciences.

Material & Methods: This cross-sectional study was conducted from September 23, 2022, to February 10, 2023, on 230 students who were selected by the available sampling method. The data collection tool was a two-part questionnaire including demographic factors and the Kolb Learning Styles Scale (version 3.1). Data were analyzed through descriptive statistics, chi-square test, and one-way analysis of variance using SPSS-24.

Results: The students had an average age of 20.35 ± 1.85 years, with 53.9% men and 46.1% females. Dominant learning styles comprised 37.4% assimilating and 33.9% converging, comprising 71.3% of participants. Diverging and accommodating accounted for 21.7% and 7%, respectively, of the remaining subjects. No statistically significant difference was identified between dominant learning styles and demographic characteristics ($p < 0.05$).

Conclusion: People with a preference for assimilating and converging learning styles show less interest in subjects that require communication with others. Therefore, it is necessary to improve students' interpersonal skills by using various educational strategies.

Keywords: learning style, medical students, medical education, medical sciences, case study, basic medical sciences course

Introduction

The quality of education in the medical sciences, especially in the field of medicine, is particularly significant due to direct interventions on humans and the impact these interventions have on sustaining people's health (1). Over the last few years, medical education has increasingly evolved from passive and teacher-centered learning to active and learner- centered learning (2). Teaching and learning have long been regarded as a two-way process, and understanding critical elements for effective learning is essential for successful education (3, 4). Various factors influence the learning process, and learning style is one of these elements (3). On one hand, learning style reflects people's preferences in how they gather, process, interpret, organize, and analyze information. On the other hand, a mix of cognitive, emotional, and physiological qualities is considered a reasonably continuous signal that reflects people's comprehension, behaviors, and responses to the learning environment (5-8). The fact that some learners, even those with the best teachers, do not learn well may be the strongest evidence supporting the argument that various learners have varying preferences in learning. In other words, based on their particular peculiarities, they acquire and process information in various ways such as observation and listening, reflection and action, thinking, analysis and imagination. Therefore, interpreting and processing information, and consequently acquiring new abilities, happens in a unique fashion for each learner (9-12).

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Researchers believe that teachers and planners paying attention to students' learning patterns may improve the teaching-learning process. When teachers understand how learners receive information, they can change from common lecturing to strategies that encourage a deeper grasp of educational material. This adaptation can lead to an improvement in students' learning results (13, 14).

Understanding learning styles can serve as a foundation for enhancing and establishing more efficient curricula and educational programs. It has the ability to encourage students to actively participate in these programs and motivate them to acquire professional knowledge (15). Moreover, evaluating the learning styles of learners supports teachers in deploying adaptable and effective instructional techniques and media, thereby increasing attitudes toward learning and supporting gains in thinking abilities, academic success, and creativity among students (12).

In the field of the concept of learning style, numerous theories have been offered. One of the known theories commonly applied for determining the learning styles of medical students is David Kolb's experiential learning theory, introduced as the most useful model to describe the learning process in adults in 1984 (16). According to this idea, learning is defined as the acquisition of information and experience and the combining and transfer of mental experience to achievement (17).

Kolb's approach is predicated on a synthesis of learning psychology theories, including those of John Dewey, Kurt Lewin, Jean Piaget, Lev Vygotsky, William James, Carl Jung, Paulo Freire, Carl Rogers, and Mary Parker Follett. This theory highlights two important features: interdisciplinary character and comprehensiveness, and it has been constructed as a result (18). According to this paradigm, Kolb introduces learning as a four-stage cycle. He believes that individuals learn through Concrete Experience (CE): encountering the learner with the topic, content, or learning situation; then Reflective Observation (RO): observing and contemplating the experience; followed by the stage of Abstract Conceptualization (AC): formulating a hypothesis or some kind of theory about it; and finally, Active Experimentation (AE): testing that hypothesis or theory in practical situations. Through this process, learning happens (19).

In Kolb's approach, learners engage in an ongoing process of individual-environment interaction and are responsible for two learning tasks. Firstly, people acquire experience or grasp knowledge through two approaches: observation or experimentation (perception dimension). This incorporates the strategy of reflective observation learning in contrast to the active experimentation. Secondly, learners transform or process knowledge through two methods: concrete or abstract (processing dimension). This entails learning through concrete experience versus abstract conceptualization. Kolb, by combining these four learning methods, assigns each individual bipolar learning preferences and identifies four learning styles: Divergent (reflective observation and concrete experience); Convergent (abstract conceptualization and active experimentation); Accommodating (concrete experience and active experimentation); and Assimilator (abstract conceptualization and reflective observation) (17) (Figure 1).

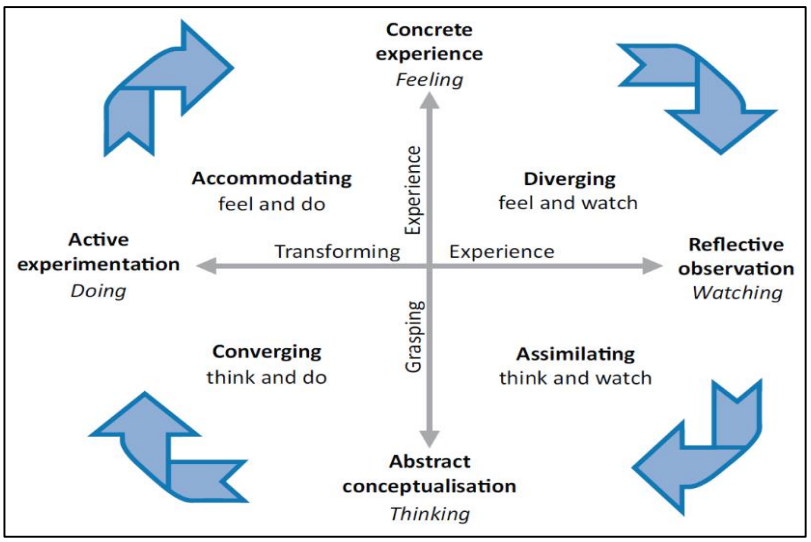

Figure 1. Learning cycle based on Kolb's Experiential Learning Theory (17).

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The essence of Kolb's theory is anchored in the assumption that learners develop through the learning cycle. In other words, individuals first alter their experiences through observation and reflection, followed by learning through the development of concepts and their application in new experiences and subsequent experiments. Generally, all learners cover all four stages, but they may display higher competence in one of the stages (20).

Medical students in Iran undergo a seven-year training cycle consisting of four stages: basic medical sciences, physiopathology, clerkship, and internship. The two-year basic sciences course provides a prelude to a detailed comprehension of the subject in the following general medical courses (21). This phase contains core disciplines such as microbiology, physiology, and anatomy, coupled with a series of general courses. In the one-year physiopathology course, students learn about the processes and circumstances that lead to diseases. The clerkship stage, spanning two and a half years, often marks students' initial exposure to the hospital environment and patients. It runs as the longest section in medical education, serving as a bridge between physiopathology and the internship course. During this stage, students are more involved in inpatient care. The internship stage, the final element of medical school in Iran, runs one and a half years. Learners learn the necessary abilities for managing patients, particularly in emergency departments and outpatient clinics (22).

While the learning styles of medical students vary across different countries and circumstances, in many cases, the convergent style has been described as the most common one among medical students (23). In a study by Shakeri et al. (24), which conducted a comprehensive analysis of 34 studies from 14 countries to evaluate the learning styles of medical students, the preferences for learning styles were described as accommodating (54.6%), convergent (52%), assimilating (47%), and divergent (19.7%). The study also showed discrepancies in learning styles between preclinical and clinical levels of medical students. For example, a study in Iran found that the main learning styles of basic sciences and basic clinical medicine students were reported to be divergent and convergent, respectively. Additional research by Meyari et al. (25) and Rezaei et al. (26) indicated that assimilating and converging styles account for approximately 80% of medical students' choices. Additionally, studies by Kalbasi et al. (23) and Nasirzadeh et al. (27) demonstrated that over 70% of medical students chose a learning approach that is convergent and assimilating.

Several Iranian studies consistently confirmed the convergent approach as the prevailing learning method among medical students (23, 25, 27, 28). In research involving dental students, the findings of Armandeh et al. (3) and Hosseini et al. (29) suggested that more than 75% of dental students prefer converging and assimilating methods. Furthermore, research connected to students in other departments of medical sciences (paramedicine) has reported assimilating style as the favored learning method (30–33). Research by Hooshmandan Moghddam Fard and Shams (34) on agricultural students found assimilating to be the prevalent learning technique.

Despite several studies on the learning styles of medical students, there is limited research, both in Iran and other countries, focusing on the learning styles of basic science students—those in the first two years of studying medicine. In a non-Iranian study, Burger and Scholz (35) reported that most students of basic medical sciences in Germany chose assimilating and converging learning styles as their first and second preferences. Similarly, the results of Rehan et al.'s study (36) at Sheikh Zayed Medical College in Pakistan suggested that the prevailing learning styles of third-year medical students are convergent and accommodating. In Iran, Allaa et al.'s (28) study at Tehran University of Medical Sciences found that the dominant learning styles of basic medical science students are in the order of frequent, accommodative, convergent, and assimilating.

Given the different results produced in studies analyzing the learning styles of medical students and the limited study on the learning styles of students in basic medical sciences, understanding the learning styles of medical students during the basic sciences course becomes vital. Planning for increased educational capacities based on their dominant learning styles can help to provide better and more successful education in the following stages of the medical sector, such as physiopathology, clerkship, and internship. Therefore, this present study was undertaken with the purpose of establishing the learning style preferences of students in basic medical sciences at Tabriz University of Medical Sciences.

Material & Methods

Design and setting(s)

This cross-sectional investigation was carried out on students in basic medical sciences from September 23, 2022, until February 10, 2023. In 2022, the research

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population for this study consisted of 611 medical students who were enrolled in the basic sciences program at Tabriz University of Medical Sciences.

Participants and sampling

Utilizing Morgan's table and accounting for a 10% dropout chance, the study comprised 255 individuals using a convenience sampling method. To be eligible for entry into the study, participants had to be students in basic sciences in the field of medicine at Tabriz University of Medical Sciences, enrolled in the first semester of the academic year 2022-2023, and willing to participate in the study. Exclusion criteria encompassed students with guest, transfer, or study leave statuses, as well as those who incompletely filled out the questionnaire. A total of 255 questionnaires were distributed among eligible students. Twenty-five individuals were removed from the research due to incomplete questionnaire replies, leaving a final cohort of 230 participants whose information became part of the study.

Tools/Instruments

The data gathering tool adopted in this research contained a two-part structured questionnaire. The introductory segment gave information on the research goals and benefits, informed students of the confidentiality of collected information, acquired their agreement, and provided instructions on answering the items. It concluded with questions to obtain demographic information, including gender, age, grade point average, total, marital status, and residential status. The second component of the questionnaire includes Kolb's Learning Styles Inventory-KLSI, Ver.3.1 (17).

Kolb's Learning Styles Inventory consists of 12 items, with each item having 4 possibilities for responders to choose from. These selections coincide with Kolb's four-stage experiential learning cycle and are ranked by respondents depending on their preference for the learning approach, ranging from 1 to 4. Respondents provide marks of 4 to 1 based on how closely each recommended option matches with their learning style: entirely, partially, slightly, and very little, respectively. It's vital to note that responders prioritize and rank the four possibilities for each question, and repeated scores for the options of a single question are not allowed.

To identify students' learning styles, the scores of the first options for all questions are summed up, followed by the same method for the second, third, and fourth options. This gives in four total scores, each corresponding to a separate approach to learning (perception and information processing). The initial total score, determined from the sum of the first alternatives, indicates the way of concrete experience. The remaining three total scores imply reflective observation, abstract conceptualization, and active experimentation, respectively.

Two scores are derived by subtracting abstract conceptualization from concrete experience and active experimentation from reflective observation. These two scores, expressing negativity and positivity, are represented on a coordinate system as shown in Figure 1. The horizontal axis contains reflective observation on the right side and active experimentation on the left side, while the vertical axis includes concrete experience above and abstract conceptualization below. These axes divide the coordinate plane into four quadrants, with each quadrant corresponding to a learning style—divergent, convergent, assimilator, and accommodating. Therefore, the intersection of the two scores, coming from the two-by-two subtraction of the ways of perceiving and processing information on the coordinate axis, indicates the learning style (17).

Individuals with a divergent personality type tend to approach circumstances with more observation than action. Divergents, frequently referred to as 'innovators,' demonstrate a depth of imagination and emotion. Those with a convergent personality type are extroverted and analytical. This group, known as 'decision-makers,' excels in practical applications of ideas and theories, exhibiting efficiency in problem-solving. Assimilators, introverted and analytical people, are less focused on interpersonal relationships and more oriented toward abstract thoughts and ideas. Termed 'planners,' they emphasize logical and theoretical features over practical implementations. Accommodators, with an extroverted and emotional personality type, love practical work, implementing ideas, and engaging in new and challenging situations. Referred to as 'pragmatists,' they approach learning with excitement (23, 37).

The validity and reliability of Kolb's Learning Styles Questionnaire have been established by Kolb and other worldwide academics (17, 38, 39). Similar studies in Iran have likewise verified the tool's norms for use (23, 29, 30, 40, 41). In this study, Cronbach's alpha was applied to examine the reliability of the instrument, obtaining results in the areas of concrete experience (0.898), reflective observation (0.891), abstract conceptualization (0.869), and active experimentation (0.910). The questionnaire's reliability was confirmed in this order.

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Data collection methods

In this study, data collection was undertaken online. After getting ethical approval from the university's ethics committee, the questionnaire was electronically generated using avalform.com. Subsequently, the link to the questionnaire was distributed to all students enrolled in basic medical sciences at the university. The introductory section of the questionnaire stated the study's aims, gave participants the required guidance on completing the questionnaire, and stressed the voluntary nature of participation. Participants were guaranteed that their information would be protected. Additionally, a two-week limit was given for completing the questionnaire.

Data analysis

After students completed the surveys, the data were imported into SPSS version 24 and underwent statistical analysis at both descriptive and inferential levels. Initially, descriptive statistics such as frequency, percentage, and mean values were computed to assess the variables' state and provide a descriptive overview of the participants. Subsequently, inferential statistics tests, including Chi-squared ($\chi 2$) and one-way Analysis of Variance (ANOVA), were utilized to explore the correlations between learning styles and demographic characteristics. The significance level for all tests was set at $p < 0.05$.

Results

The findings revealed that 124 individuals (53.9%) were male, while 106 (46.1%) were female. The average age was 20.35 ± 1.85 years, ranging from 18 to 39 years. The participants' average GPA was 16.57 ± 1.79. The great majority, 224 people (97.4%), were single, while only 6 people (2.6%) were married. In terms of living arrangements, 113 participants (49.1%) resided in their father's house, 97 (42.2%) lived in the university dormitory, 14 (6.1%) in their own residences, and 6 (2.6%) in a private dormitory (Table 1).

The primary learning styles among the participating students in this study were as follows: assimilator (37.4%), convergent (33.9%), divergent (21.7%), and accommodating (7%) (Figure 2).

The association between learning styles and students' demographic factors, including gender, married status, and residential status, was evaluated using the chi-square test (χ^2). Additionally, the association between learning styles and the variables of age and GPA was explored using a one-way ANOVA. The outcomes of both tests demonstrated no significant difference between learning styles and students' demographic factors ($p < 0.05$). In essence, the unique features of basic medical sciences students revealed no discernible impact on their learning methods (Table 2).

Table 1. Demographic characteristics of basic sciences medical students

Qualitative variables		**Frequency**	**Percentage**
Gender	Female	106	46.1
	Male	124	53.9
Marital status	Single	224	97.4
	Married	6	2.6
Residential status	University's dormitory	97	42.2
	Private dormitory	6	2.6
	Family housing	113	49.1
	Individual housing	14	6.1
Quantitative variables		Mean	SD
Age		20.35	1.86
GPA		16.57	1.79

Abbreviations: SD, standard deviation; GPA, grade point average

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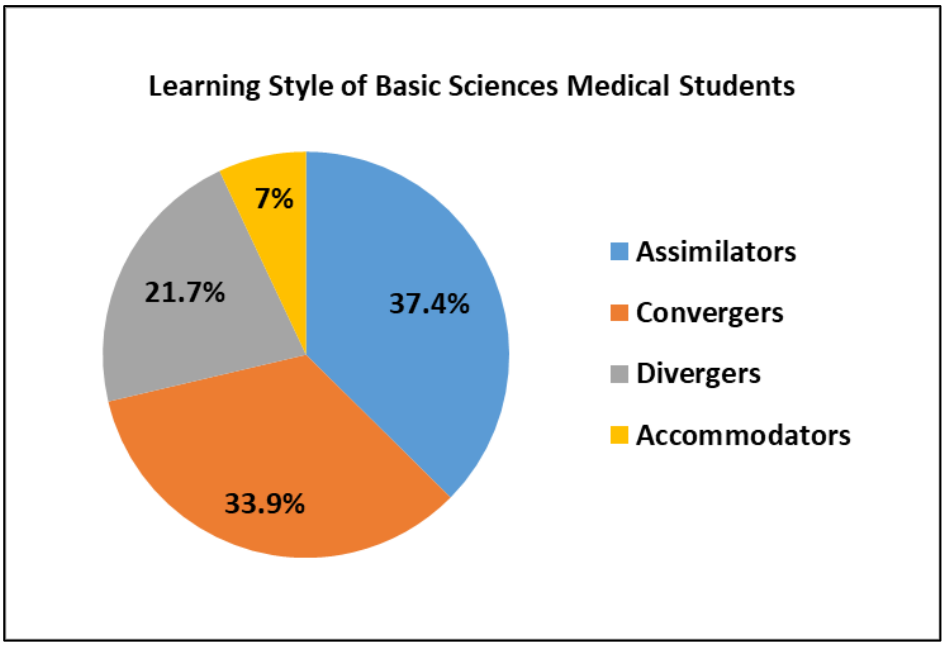

Figure 2. Learning style preferences of basic sciences medical students

Table 2. Relationship between learning style and demographics of basic sciences medical students

Variables	Learning style				Sig.
	Diverger	Accommodator	Assimilator	Converger	
Gender n (%)					
Female	23 (21.7)	6 (5.7)	39 (36.8)	38 (35.8)	$X^2 = 0.711$
Male	27 (21.8)	10 (8.1)	47 (37.9)	40 (32.3)	p = 0.871
Marital status n (%)					
Single	48 (21.4)	15 (6.7)	85 (37.9)	76 (33.9)	$X^2 = 1.924$
Married	2 (33.3)	1 (16.7)	1 (16.7)	2 (33.3)	p = 0.588
Residential status n (%)					
University's dormitory	26 (26.8)	9 (9.3)	32 (33)	30 (30.9)	
Private dormitory	2 (33.3)	1 (16.7)	1 (16.7)	2 (33.3)	$X^2 = 9.558$
Family housing	21 (18.6)	6 (5.3)	47 (41.6)	39 (34.5)	p = 0.387
Individual housing	1 (7.1)	0 (0)	6 (42.9)	7 (50)	
Age Mean ± SD	20.90 ± 2.97	20.38 ± 1.36	20.16 ± 1.43	20.19 ± 1.30	$F_{(3, 226)} = 1.968$ p = 0.120
GPA Mean ± SD	16.32 ± 2.28	16.06 ± 1.85	16.75 ± 1.81	16.66 ± 1.30	$F_{(3, 226)} = 1.035$ p = 0.378

Note: One way ANOVA test was used to compare participants based on quantitative demographic variables of four groups. Chi-square test was employed to compare participants based on qualitative variables.
Abbreviations: n, number of participants; SD, standard deviation; GPA, grade point average; X^2, Chi-square test; F, analysis of variance test; Sig, statistical significance; p, probability-value.

Discussion

The primary purpose of this study was to identify the learning style preferences among students in the basic medical sciences program at Tabriz University of Medical Sciences. The research findings demonstrated that the majority of students exhibited preferences for the assimilator and convergent learning styles, collectively representing the choices of 71.3% of the participants in the survey. Divergent and accommodating styles placed third and fourth among the students' preferences.

Consistent with the outcomes of our study, research by Meyari et al. (25) and Rezaei et al. (26) found that over

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80% of first-year medical students chose assimilator and convergent learning methods, respectively. Similarly, research conducted by Kalbasi et al. (23) and Nasirzadeh et al. (27) indicated that more than 75% of medical students favored convergent and assimilator learning methods, respectively. Darvishzade et al. (42) also found assimilation as the major learning method among medical students. Other research by Armandeh et al. (3) and Hosseini et al. (29) found that over 75% of dental students chose convergent and assimilator techniques, respectively.

Research in comparable domains, such as paramedicine, has repeatedly revealed assimilator style as the preferred learning style among students (30–33), agreeing with the conclusions of our present study. Additionally, a non-native study by Burger and Scholz (35) showed assimilator and convergent learning styles as the top two choices among basic medical science students. Chung's study (43) similarly concluded that the assimilator learning style was more common among medical students, further validating the results of our current research.

The findings from this study, in addition to other national and international research, consistently indicate that the predominant learning styles among most medical students are assimilation and convergence. A shared trait of both assimilator and convergent learning styles is a predilection for learning through abstract thinking. Individuals with an assimilator learning style tend to be interested in theories without necessarily investigating their practical application. In contrast, convergents prioritize the practical application of ideas and demonstrate superior success in examinations that measure the application of theories in practical conditions (27). Individuals who choose assimilation as their learning method frequently show an introverted and thoughtful temperament. They excel at absorbing enormous amounts of information and delivering it with a short, accurate, and logical approach. These individuals usually focus less on interpersonal relationships, demonstrating a deeper interest in abstract thoughts and notions. Consequently, logical and theoretical features have more relevance for them than practical application. Assimilators favor educational modalities such as lectures and self-learning materials (37). Students with a convergent learning style succeed at developing practical uses for ideas and theories. They are good at problem-solving and base their decisions on the solutions they discover. Group discussions and collaborative projects may not appeal to these people, as they find them uninteresting. Their choice is to engage in individual learning activities, preferably with an instructor as an assistant. Consequently, in the education of medical students with a convergent learning style, a problem-solving-based learning method may be seen as more limiting compared to the lecture method (23).

According to the results of this research, divergent and accommodating learning styles are less favored by students in the basic medical sciences curriculum. When analyzing students' preferred learning methods, it is crucial to not only focus on the positive components of their learning style but also consider the weaker aspects of their learning cycle. Plans should be made to upgrade and strengthen these weaker regions. Strengthening the divergent style requires attention to learning approaches involving concrete experience (experience) and reflective observation (reflection). Similarly, reinforcing the accommodating style involves an emphasis on procedures that combine concrete experience and active experimentation (practice) (23, 37). This underlines the requirement for medical students to apply all four learning methods—assimilator, convergent, divergent, and accommodating—simultaneously to attain success and efficiency in their field. This entails engaging in events with an open mind and without bias (concrete experience), observing and reflecting on experiences from multiple angles (reflective observation), generating concepts, creating hypotheses based on observations, or devising fitting plans (abstract conceptualization). Ultimately, these hypotheses and plans are put to the test through implementation, allowing students to make decisions regarding problem-solving (active experimentation).

Given the interdisciplinary character of the medical profession and the necessity of gaining information from other subjects such as sociology, behavioral sciences, and ethics in medical education, the ability to apply diverse learning methods is thought vital. It's worth noting that the findings of this study addressing the learning style preferences of medical students may not totally correspond with the results of previous Iranian and non-Iranian studies (28, 40, 44–47). The variance in results across various research projects could be related to the demographic characteristics of the investigated society, including educational records before university enrollment, individuals' adaptations to their field of study, and preferences for teaching and learning methods (48).

In agreement with the further findings of this study, no significant link was observed between students' learning

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style preferences and demographic characteristics such as gender, age, GPA, marital status, and residential status. These findings line up with Akhlaghi et al.'s study (49), which similarly revealed that students' preferred learning styles are unchanged by demographic characteristics, including gender, age, and marital status. Similar results have been recorded in different research studies, where no significant link between learning style and cognitive characteristics was detected (23, 40, 42, 48, 50, 51). However, it is necessary to highlight various limitations observed in this study, including reliance on self-reporting by students for learning style features and the absence of predictive capacities. Additionally, data collection did not capture some demographic variables such as educational records before university enrollment, socio-economic status, and access to specific equipment and tools.

Conclusion

The primary learning styles among most students in the basic medical sciences curriculum at Tabriz University of Medical Sciences were characterized as assimilator and convergent, collectively representing over 70% of students' learning preferences. These findings, in conjunction with earlier studies, indicate the predominance of assimilator and convergent learning styles among medical students as prevailing patterns. In Kolb's theory, people with an assimilator learning style have the capability for deep thought. They tend to prioritize duties and technical issues over social and interpersonal considerations, exhibiting a reduced interest in communication-related concepts. Given the nature of the medical sector, which is professional, scientific, people-oriented, and highly communicative, persons with assimilator and convergent learning style preferences may demonstrate less interest in elements requiring interpersonal communication. Thus, it becomes necessary for university planners and educators in the medical sciences to address these problems. Implementing varied instructional methodologies will help strengthen the necessary capacities of these students to thrive in educational environments and perform their duties in real-world settings. It is crucial to acknowledge that each learning model and style includes its own strengths and shortcomings, requiring a balanced approach when constructing educational programs. Neglecting the weaker elements of a learner's learning cycle could hinder their overall success. Therefore, a focus on many aspects of preferred learning styles, appropriate to individual student characteristics, and changing instructional techniques accordingly can enrich the learning process for medical students. This technique facilitates assimilating the huge and continually developing knowledge and information linked with this vital profession, ultimately contributing to the advancement of medical education quality.

Finally, it seems the design of experimental studies is to know the factors influencing the students' learning styles, besides examining the relationship between their learning styles and variables such as educational records before university, cultural, social, and economic status, education, and the amount of parents' income, etc. To create a more comprehensive view in the field of understanding the learning style of medical students and factors related to it.

Ethical considerations

This paper is the outcome of a research project assigned tracking code 69952, undertaken by the Medical Sciences Education Research Center of Tabriz University of Medical Sciences. The study has received ethical approval with ID IR.TBZMED.REC.1401.479 from the Ethics Committee of Tabriz University of Medical Sciences. The dedication to ethical standards supports the legitimacy and integrity of the research findings.

Artificial intelligence utilization for article writing

The authors declare that they did not use generative Artificial Intelligence (AI) and AI-assisted technologies in the writing process of this paper.

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Conflict of interest statement

The authors affirm that they have no conflict of interest at any point in the research, authorship, or publication of this paper.

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Author contributions

Both authors actively contributed to the conceptualization, design, data collection, analysis, interpretation, and paper writing. They have reviewed and approved the final version of this article.

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Data availability statement

Data and materials could be made available upon reasonable request.

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