Journal of Basic Research in Medical Sciences
Ilam University of Medical Sciences
Homepage: https://jbrms.medilam.ac.ir
Online ISSN: 2383-0972
Print ISSN: 2383-0506

Relationship Between Critical Thinking and Learning Styles in First-Year Medical Sciences Students (A cross-sectional study)

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Article Info

Article type:
Original Article

Article History:
Received: Sep. 13, 2024
Revised: Oct. 23, 2024
Accepted: Dec. 08, 2024
E- Publish: Apr. 01, 2025

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A B S T R A C T

Introduction: Critical thinking is one of the most key skills needed by an outstanding student, which can lead to beneficial results by influencing the learning process. Measuring the state of critical thinking among students and searching for the relationship of this variable with factors such as learning styles can be a guide for policymakers and educational managers in designing and revising educational strategies. Therefore, the present study was conducted with the aim of investigating the relationship between critical thinking and learning styles.

Materials and Methods: The current study was a cross sectional research which conducted in 2023. The participants were 110 first-year students who studying at Ilam University of Medical Sciences in the fields of health, nursing and midwifery, medical emergencies and allied health professions. The data were collected using VARK learning styles questionnaire and the California Critical Thinking Skills Test Questionnaire Form B. Statistical tests included independent t-test and analysis of variance (ANOVA) which imported to SPSS V.21 at the level of significance less than 0.05.

Results: The average critical thinking score of the participants was 8.55. More than half of the studied students had two or more learning styles. There is a statistically significant relationship between single-style and multi-style modes of VARK learning and evaluation skills (p=0.034) and inductive reasoning (p=0.009) of critical thinking.

Conclusion: It is necessary to strengthen the skills related to reasoning and critical thinking among students of medical sciences with a longitudinal theme approach, both in the form of official curriculum and in the form of short-term training courses.

Keywords: Thinking, Learning, Medicine, Students

➢ **How to cite this paper**
Tolideh M, Khorshidi A, Sadeghifar J, Shokri T, Shoara Z, Hosseini S. Relationship Between Critical Thinking and Learning Styles in First-Year Medical Sciences Students (A cross-sectional study). J Bas Res Med Sci 2025; 12(2):52-58.

Publisher: Ilam University of Medical Sciences

Introduction

Critical thinking has become one of the important skills that must be mastered in the 21st century (1). According to experts, critical thinking is an integral part of education at any level, because humans need it to face today's world, which includes thinking about analyzing, evaluating, choosing and providing solutions to problems (2). Critical thinking is the ability to consider facts from different sources, process them logically and creatively, and consider and analyze information to reach correct results (3). The importance of critical thinking skills as one of the most key skills of the 21st century for innovation and facing pervasive misinformation, developing self-regulated cognitive ability, cultivating responsible citizens, facing complex challenges in education, and finding logical solutions to complex problems has been widely accepted (4-6). Critical thinking, which has now become the main focus of education, is referred to as the art of thinking about thinking (7). Halpern defines critical thinking as problem solving and decision-making during thinking (1). Critical thinking is a combination of knowledge, attitude and performance of each person and is divided into five skills: deduction, identification of assumptions, inference, interpretation and evaluation of logical arguments (8). Shim and Walczak concluded that the university has an important role in promoting critical thinking (9). In fact, the issue of critical thinking is one of the intellectual and practical skills that should be strengthened by universities (7).

Various studies have investigated the relationship between critical thinking and other variables in the field of learning, such as cooperative learning (9), cooperative problem solving (10), learning motivation (11), critical study (12) and, thinking styles (13). One of the important areas affecting critical thinking is learning styles and the nature of receiving, processing and learning educational content by learners.

Students studying in a higher institution independently acquire the knowledge provided by professors, which is closely related to students' learning styles (14). Today, the main goal of education is not to teach reading and writing or arithmetic, but the goal of education is how to use learning styles and thinking skills (15). Learning styles are the method used by each person to process information, which is different from other people (16). These styles play an important role in determining students' understanding. Because by knowing the learning styles, one can find a proper strategy to achieve academic success. Learning styles include 6 main areas: A) Free and independent: the learner manages his learning alone and has high self-confidence. b) Avoidance: making excuses for not participating in classes and learning the content of the courses. c) Based on cooperation: the learner easily communicates with others and shares his ideas to learn. d) Relying: He relies on the professor and the instructor to learn the problems. e) Competitive: Learners learn content competitively with their friends. f) Participant: learners are diligent to attend class and actively participate in learning sessions (15). Introducing learning styles to students allows professors to advance them towards achieving critical thinking (16).

Studies have been done in the field of learning styles and critical thinking. Durnali states that in order to improve the skills of professors in getting rid of critical thinking obstacles, attention should be paid to improving them to find their precise learning styles through self-directed practice (17). Critical thinking is one aspect of thinking recognized as a way to overcome problems and facilitate access to information (18). Also, this skill is considered a basic skill in medical sciences that should be noticed in all educational courses (13). Research conducted in Iran shows that the critical thinking score of Iranian students is lower than students of Western countries (19).

Considering that most of the studies conducted in Iran have merely investigated the critical thinking skill separately, the present study was conducted with the aim of investigating the relationship between critical thinking and learning styles in Ilam University of Medical Sciences in 2023.

Materials and Methods

Study design and setting

This study was Cross-sectional research conducted among First-year students in 2023, at the Ilam University of Medical Sciences, Iran.

Sample Size

First-year students studying at Ilam University of Medical Sciences in the fields of health, nursing and midwifery, medical emergencies and allied health professions, who had chosen the unit in the first semester of the academic year 2023, were included in the study using census. Guest students and students who were on academic leave were excluded from the study. Finally, a total of 110 student entered the study. In line with many studies, the reason for choosing first-year students is to be aware of the state of critical thinking and learning styles at the beginning of university education and subsequently to design appropriate interventions to improve students' critical thinking through paying attention to their learning styles.

Measurements & Validity and Reliability

1. Demographic form

Demographic variables included field of study and the gender of the students.

2. California Critical Thinking Skills Test Form B

This tool contained 34 multiple-choice questions with one correct answer in 5 areas of cognitive skills of critical thinking, including analysis, evaluation, inference, deductive reasoning, and inductive reasoning. Total of 6 scores are obtained with 5 subscales: analysis, evaluation, inference, inductive reasoning and deductive reasoning. The number of questions and the range of scores for the above subscales are, respectively, 9 questions (1-9), 14 questions (1-14), 11 questions (1-11), 16 questions (1-16) and 14 questions (1-14). The highest score in each subscale represents the respondent's skill: 1-Analysis skills includes: classification, decoding of sentences, clarification of meaning, examination and analysis of ideas;2-Evaluation skills includes: evaluating claims and discussions, expressing results, justifying procedures and presenting arguments; 3- Inferential skills includes: searching for evidence, speculating about alternatives and drawing conclusions;4-Inductive reasoning includes: drawing conclusions from discussion after confronting facts related to presuppositions and 5-Deductive reasoning includes: logical reasoning in mathematics. In the design of this questionnaire, a general field of knowledge that can be achieved simply as a result of natural maturity and at the school level is assumed; And therefore, no content knowledge at the university level that is for specific fields is needed to answer the questions of the questionnaire (14). The validity and reliability of this questionnaire was found to be favorable and the internal correlation coefficient for the subtests of analysis (r=0.71), evaluation (r=0.77), inference (r=0.71), inductive reasoning (r=0.70) and deductive reasoning (r=0.71) have been reported (20).

3. VARK Standard Questionnaire

The VARK questionnaire was used for learning style determination. Each participant was identified for learning style following the VARK model by using the VARK questionnaire (version 8.01). The VARK questionnaire consists of 16 multiple-choice items. Each item is associated with a specific style. The respondents could choose more than one choice according to their preferences, and they could leave any unrelated questions blank. The total score in each learning style (visual (V), aural (A), read/write (R), kinesthetic (K)) ranges from 0 to 16. A higher score in each learning style indicates a respondent's preference for that type of learning. If respondents obtain the same score in two or more learning styles, their learning styles are considered multimodal (two style preferences, three style preferences, and four style preferences). The students were divided into Twelve categories based on the following learning styles: V, A, R, K, VR, AR, AK, RK, VAR, VAK, RAK, and VARK (21).

The paper version of the questionnaires was given to the students anonymously and in person by the researcher in the educational environment and was collected within a maximum period of one week. In some cases, when the student was not available, the electronic version of the questionnaires was sent to him.

Ethical Consideration

Ethical concerns included acquiring the ethics code (IR.MEDILAM.REC.1398.041), ensuring integrity in library collection and data reporting, getting signed informed permission from all participants in accordance with the Declaration of Helsinki, and adhering to principles of human intervention.

Statistical and Data Analysis

Data analysis was done using SPSS V.21. In presenting the descriptive results, indicators such as frequency, frequency percentage, mean and standard deviation were used. To compare the means between different groups, independent t-test and analysis of variance were used (ANOVA). The significance level of the tests was considered less than 0.05.

Results

In this study, out of 183 first-year students, a total of 110 people entered the study by completing both questionnaires (response rate: 60.10%). Of this number, about 84% (92 people) were women and 16% (18 people) were men. And the highest frequency in terms of field is assigned to students of health fields with 42% (Table 1).

Table 1. Frequency distribution of the studied subjects according to gender and field of study

Variable	Type	Number	Percentage
Gender	Woman	92	83.6
	Man	18	16.4
	Midwifery and nursing	27	24.5
	Emergency	11	10

Field of Study	Health (Public, Environmental and Occupational)	46	41.8
	Laboratory and Operating Room	26	23.6

The average score of critical thinking of the participants in the present study was 8.55 ± 2.70 out of a total score of 34Based on the standardized score of critical thinking areas, the studied students had the best situation in evaluation skills (2.10) and the lowest score in Deductive reasoning (0.5). The raw and standard mean and standard deviation obtained in different areas of critical thinking skills are shown in Table 2.

Table 2. Mean and standard deviation of critical thinking scores and its different areas in the studied subjects

Area	Raw Score		Standard Score	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**
Analysis	2.31	1.2	1.97	1.0
Evaluation	3.60	1.7	2.10	1.0
Deduction	2.72	1.5	1.82	1.0
Deductive reasoning	5.71	2.0	0.00	0.5
Inductive reasoning	3.41	1.6	0.00	0.6
Total (critical thinking)	8.55	2.70	3.17	1.0

Based on the students' responses to the VARK standard 16-question questionnaire, data analysis shows that more than one-third of the research subjects do not have a dominant learning style and use all four learning styles (VARK) (38.2%). Also, more than 21% preferred reading and writing style and more than 15% listening style as the dominant learning style. Visual and kinesthetic learning styles were preferred only in 3.9% and 2% of students, respectively. Also, more than 18 percent of students used two or three learning styles together (VA, AK, VAK, VAR, etc) as the dominant learning style (Figure 1).

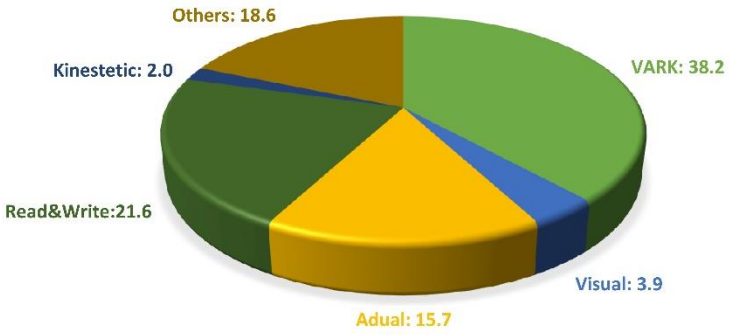

Figure 1. Status of learning styles of the research sample

The average critical thinking scores of the participants in multi-dimensional and one-dimensional learning styles were 8.3 ± 2.4 and 8.9 ± 2.7, respectively. The score obtained in different areas of critical thinking skill according to learning styles is shown in Table 3. A significant difference was observed between the score of evaluation skills (P = 0.034) and Inductive reasoning (P = 0.009) and the preferences of multidimensional and unidimensional learning styles (Table 3).

Table 3. Mean and standard deviation of critical thinking scores and its different areas according to learning styles

Critical Thinking Area	Learning Style	Mean	Standard Deviation	P-value
Analysis	Multi-dimensional	2.25	1.3	0.064
	One dimensional	2.4	1.1	
Evaluation	Multi-dimensional	3.3	1.6	0.034
	One dimensional	4	1.7	
Deduction	Multi-dimensional	2.7	1.6	0.498
	One dimensional	2.5	1.3	
Deductive reasoning	Multi-dimensional	5.6	2.00	0.900
	One dimensional	5.7	1.9	
Inductive reasoning	Multi-dimensional	3.0	1.3	0.009
	One dimensional	3.9	1.8	
Total (critical thinking)	Multi-dimensional	8.3	2.4	0.233
	One dimensional	8.9	2.7	

Independent t-test and analysis of variance were used (ANOVA).

Discussion

The present study was conducted to determine the relationship between critical thinking and learning styles of students of Ilam University of Medical Sciences. The results showed that the average total score obtained by the studied students was about a quarter of the obtainable score. In Hamedan University of Medical Sciences, the total score of students' critical thinking was 12.5 out of 34 (14) In medical students of Shahid Beheshti University of Medical Sciences and Tehran University of Medical Sciences, the critical thinking score was 13.3 and 12.63, respectively (15). Also, in Sabzevar and Mazandaran nursing students, the average of critical thinking skills in students is reported to be less than half (16, 17). The results of the present study are consistent with the mentioned studies and are even lower than all of them.

In general, due to lack of attention to teaching critical thinking skills in schools and universities, students of most universities do not get good scores (22); And if there is a difference between the scores related to critical thinking skills among different universities, it can be mainly due to the difference in the field and years of study of the students and adding the subject of critical thinking to students' curriculum. It is worth mentioning that the present study was conducted among first-year students of medical sciences, and perhaps the low score of critical thinking compared to other studies is also due to this issue.

In recent years, various studies have investigated students' learning styles using the VARK tool. The results of the present study showed that more than half of the studied students do not have a dominant learning style. 38.2% of students use all four learning styles (VARK) and 18.6% of students use two or three learning styles together (VA, AK, VAK, VAR, etc.). Similar results were obtained in Mozafari et al.'s study on 184 dental students of Kermanshah University of Medical Sciences (23). Among students who have a dominant learning style, the most common learning style is reading and writing (21.6%) and the least one is kinesthetic learning style (2%), which is consistent with the results of Mozafari's study (23). In Taheri's study, more than 80% of second-year dental students and above had a dominant learning style. The most common learning style was reading and writing and the least dominant learning style was visual, which is not consistent with the present study (24). Also, in a study conducted in Pakistan among dental students, most of the subjects (71%) preferred a single style. The results of this study are

inconsistent with the present study (25). The difference in the field and the years of study of the students and even in some cases the tools for measuring learning styles in the present study with the mentioned studies can be the reason for the difference in the results.

According to the results of the present study, there is a significant relationship between learning styles and critical thinking evaluation and inductive reasoning skills, while no significant statistical relationship was observed in other skills such as analysis, inference and comparative reasoning. Based on the results of a review study conducted by Christos Andreou, critical thinking is significantly different among different learning styles (26). The results of another study on the relationship between critical thinking skills, biology learning outcomes and students' visual learning style show that critical thinking ability has a limited relationship with the learning outcomes of students with a dominant visual learning style (27). In Alborz University of Medical Sciences, the average score of deductive reasoning and evaluation skills was higher than other skills, and analytical skills had the lowest average. Critical thinking was reported to be significantly different among different learning styles and a significant relationship has been observed between critical thinking, learning styles and students' performance (28). In the current research, the status of evaluation and analysis skills was better than other skills, and there was a statistically significant relationship only between the two skills of evaluation and comparative reasoning and learning styles. The difference between the results of the present study and the mentioned study is the difference in the use of Kolb's learning styles model and the study between medical students in different academic years in contrast to the use of the VARK tool to measure learning styles and examine first-year students. Among the limitations of this research, we can mention the small sample size, which was constrained by implementation limitations. Additionally, initial resistance from students and the challenge of poor cooperation in completing questionnaires posed further constraints. Also, the strength of our research is the use of internationally standard tools to measure critical thinking and learning styles variables, and the study of first-year health science students to plan for improving students' thinking throughout their studies.

Conclusion

It is necessary to strengthen the skills related to reasoning and critical thinking among students of medical sciences with a longitudinal theme approach, both in the form of official curriculum and in the form of short-term training courses. Teaching based on students' learning styles will also lead to the improvement of critical thinking among them.

In addition, the awareness of students' dominant learning styles by university professors at the beginning of classes can lead to the strengthening of students' non-cognitive skills in addition to cognitive skills by creating suitable learning environments and also providing a context for strengthening critical

thinking. It is suggested that future studies use other research designs, including qualitative studies and operations research, to identify and prioritize barriers and facilitators of critical thinking among students. It would also be useful to use a longitudinal theme approach to examine changes in students' learning styles and critical thinking and simultaneously implement appropriate educational interventions.

Acknowledgement

The researchers consider it necessary to thank and appreciate the sincere cooperation of the students in completing the questionnaires.

Financial support

This research was supported by a research project (986003/58) approved by Ilam University of Medical Sciences

Conflict of interest

All authors declare that they have no conflict of interest.

Authors' contributions

Conceptualization: JS, TS, Investigation: JS. ZS, Data Curation: SH, MT, Methodology, Validation, Resources, Writing– Review & Editing: JS, AK, Formal Analysis, Visualization: AK, Writing– Original Draft Preparation: JS, AK, MT, ZS, Supervision: JS, AK, MT, Project Administration: JS

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