

The Association Between Critical Thinking Skills and Academic Performance Among Undergraduate Medical Students of Different Educational Levels at Iran University of Medical Sciences

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Abstract- Given the importance of Critical thinking (CT) skills in medical education and academic performance, along with the lack of recent studies on this topic after the medical education reform in Iran, we aimed to evaluate the association of CT skills with academic performance in undergraduate medical students of Iran University of Medical Sciences. In this cross-sectional study, using the convenience sampling method, 142 medical students entered the study. The Persian version of the California Critical Thinking Skills Test Form B (CCTST-B), previously validated for local populations, was used to measure CT skills, and the test's association with academic performance was measured using participants' cumulative grade point average (GPA). A significant correlation was observed between the total mean score of passed courses (0-20) and the CT skills score across all CT domains ($P<0.05$). The mean total CT skills scores were 17.53 ± 4.39 for basic science students, 17.17 ± 3.63 for physiopathology students, 16.54 ± 3.77 for clerkship students, and 17.60 ± 3.89 for internship students. Statistical analysis revealed that clerkship students had significantly lower scores compared to the other groups ($P=0.011$). There were no significant differences between males and females, nor between students living in dormitories and those living in personal accommodations. This study showed a significant positive correlation between CT skills and academic performance. On average, undergraduate medical students possess satisfactory CT skills. However, there is room for improvement in CT skills among undergraduate medical students and in enhancing their academic performance.

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Introduction

Critical thinking (CT) consists of analyzing issues, making inferences using inductive or deductive reasoning, evaluating, and making decisions for solving problems (1). Background knowledge is necessary but insufficient for enabling CT in a specific field (2). In the field of medicine, due to its uncertain nature and a wide range of problems, clinicians are prone to encountering challenges and faults in clinical decision-making (3).

Fortunately, previous studies have shown that developing CT could help clinicians make more accurate diagnoses, choose the best treatment plan with minimal harm to the patient, and improve clinical competence (4,5). Additionally, reducing the rate of medical errors while making quicker decisions in challenging cases has been linked to the enhancement of CT in previous studies (4,6). Moreover, higher education is an excellent stage for developing CT skills, which can correlate with greater academic success (7,8). Hence, based on the importance

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of CT in medical staff, the “World Federation for Medical Education” has announced CT as one of the basic standards for medical education (9). Additionally, the Institute for International Medical Education cites CT skills as one of the seven essential domains for medical education (10). Therefore, every medical institute should aim to improve CT skills (11). Over the past two decades, efforts have been made in Iran to improve CT skills; this has included integrating CT into the educational curriculum and introducing a CT course such as Tehran, Shahid Beheshti, Iran, Tabriz, and Shiraz universities of medical sciences (12,13).

Given CT's multidimensional nature, various factors influence it, including those related to educators, students, the environment, and the placement of accommodations (14). Based on the variability of these factors, previous research has established that CT skills differ among medical students (12,15,16). Most prior research results were unsatisfactory, with students' CT skills lower than expected, and surprisingly, students in this research also exhibited much lower academic success (16-18). Furthermore, earlier investigations have shown that higher CT skills may accompany academic success; however, the relationship between these two has been indeterminate in studies conducted in Iran (5,15,18).

Given the controversial findings of previous studies regarding CT skills among undergraduate medical students, the importance of CT for academic success, and recent significant changes in the medical curriculum (12,15,18), and the lack of research assessing CT skills among undergraduate medical students at Iran University of Medical Sciences (IUMS), we have designed a cross-sectional study to address these issues.

Materials and Methods

This cross-sectional study was conducted using a self-administered questionnaire. The study population comprised undergraduate medical students at IUMS who were enrolled in the 2023-2024 academic year and had completed a minimum of six months of their educational program. Participants were recruited via the convenience sampling method.

Eligible participants were enrolled in one of the four educational levels of the national undergraduate medical curriculum

Basic sciences, pathophysiology, clerkship, or internship. Participants were excluded if they reported having previously completed the questionnaire, were non-native Persian speakers or international students, or

submitted responses with less than 30% of the questions answered.

The participants were invited to take part in the survey through a formal invitation from the project administrators, distributed in their classes and students' groups on social networks. All participants received the questionnaire and were informed about the study's objectives. They were allocated 45 minutes to complete it in a quiet environment and had the option to conclude the test whenever they chose.

The main objective of this study was to evaluate the relationship between CT skills, as measured by subscales, and academic performance, which was assessed based on the average grades of completed courses. Additionally, the study aimed to analyze the overall average scores for total CT skills and their subscales among undergraduate medical students at various educational levels, as well as to examine factors influencing these skills.

Assessment tool

The self-administered questionnaire comprised two sections. The first collected demographic data, including gender, age, level of medical education, and the mean mark of passed courses from 0 to 20, which is the standard grading scale in higher education in Iran. The second section contained the 34-item Persian version of the California Critical Thinking Skills Test, Form B (CCTST-B), whose validity and reliability have been previously established (19). The CCTST-B is a multiple-choice instrument with one correct answer per question, scored as 1 point, while incorrect answers receive no points. Originally designed by Facione to assess CT skills in college students, the test's precision in measuring five subscales: analysis (9 items), inference (11 items), evaluation (14 items), deductive reasoning (16 items), and inductive reasoning (14 items), and an overall total CT score, was validated using the Delphi method in prior research (20). Completing the 34 items does not require domain-specific clinical knowledge, but rather general reasoning skills at a post-secondary level within the 45-minute testing period.

Sample size

The sample size for this study was determined to identify a statistically significant association between the mean mark of passed courses and total CT skills points, based on CCTST-B, using a two-tailed correlation analysis with a significance level (α) of 0.05, a statistical power of 80%, and an anticipated correlation coefficient of $r=0.30$ (5), yielding a required sample size of estimated using the Fisher z-transformation formula. This

calculation indicated that at least 133 participants would be needed to detect this effect reliably. To account for potential missing data and incomplete responses, an additional 10-15% was added, resulting in a final target sample size of 150 participants.

Data analysis

Data analysis was performed using SPSS (Statistical Package for the Social Sciences), version 27. Continuous variables were expressed as means and standard deviations (SD), while categorical and ordinal variables were summarized as frequencies and percentages. To compare means between groups, independent samples *t*-tests and one-way ANOVA were employed where appropriate, based on the normality of variables. The Spearman correlation was used to find the association between the mean marks of passed courses and CT Skills. Finally, the relationships between the measured factors and overall CT skills, as well as their subscales, were evaluated using multiple linear regression. A *P* of less than 0.05 was considered statistically significant for all tests.

Ethics approval and consent to participate

This study was conducted per the Declaration of Helsinki 2013. The local ethics committee, the Iran University of Medical Sciences Ethics Committee, approved the research, granting it the approval number IR.IUMS.FMD.REC.1401.402. Informed verbal and written consent were obtained from all participants. The methods were carried out meticulously under the relevant guidelines.

Results

Of the 161 students who completed questionnaires, 19 (11.8%) were excluded from the study due to several unanswered questions and high missing values. Out of 142 participants, 73 (51.4%) were living in student dormitories. Clerkship students were the largest participant group ($n=46$, 32.4%). The mean and SD of age and the mark for passed courses in participants were 22.63 ± 2.02 and 17.05 ± 0.83 , respectively. The demographic data are summarized in Table 1.

Interns had the highest total CT skills score among medical students, with a mean and SD of 17.6 ± 3.89 . They were followed by basic sciences (17.53 ± 4.39), pathophysiology (17.17 ± 3.63), and clerkship students (16.54 ± 3.77); moreover, the highest response rate was in the inference subscale, followed by deductive reasoning (Table 2).

When comparing CT skills among participants, neither gender nor place of residence was associated with differences ($P=0.802$ and 0.877 , respectively). However, only the total CT skills differed across the four educational levels ($P=0.006$). Table 3 presents these data in detail.

Table 1. Demographics of participants

Variable	N (%)
Male	82(57.77)
Residing in students' dormitories	73(51.4)
Internship	35(24.6)
Clerkship	46(32.4)
Pathophysiology	23(16.2)
Basic sciences	38(26.8)
Age (mean $\pm$ SD)	22.63 ± 2.02
Mark of passed courses (mean $\pm$ SD)	17.05 ± 0.83
Total participants	142(100)

To evaluate the link between academic performance and CT skills, a positive correlation was observed between the average grades in passed courses and overall CT skills scores among medical students ($r=0.324$, $P<0.001$). Moreover, in the multiple linear regression with dummy variables, we considered the total CT skills score as the dependent variable and gender, medical education level, and place of residence as independent variables. Assumptions related to multiple linear regression were checked. We removed the age variable due to collinearity with medical education level. 11.9 % of the variance of total CT skills score is explained by independent variables ($R^2=0.119$, $F=3.031$, $P=0.008$). The results revealed that the mean mark of passed courses was significantly positively associated with the total CT score ($\beta=0.349$, $P<0.001$), whereas being in the clerkship phase was significantly negatively associated with it ($\beta=-0.281$, $P=0.011$). Furthermore, analysis based on the phase of medical education revealed that, compared to Internship students, those in the Basic Sciences phase demonstrated significantly lower scores in deductive reasoning ($P=0.009$) and inference ($P=0.017$). Similarly, Clerkship students scored notably lower than Internship students in deductive reasoning ($P=0.04$) and evaluation ($P=0.006$). No other significant association in CT subscale scores was identified across the educational phases ($P>0.05$). Additionally, while female students exhibited a marginally higher mean total CT score (17.27 ± 4.16) than their male counterparts (17.10 ± 3.79), this difference, along with all subscale comparisons, was not statistically significant, indicating that gender had no association with CT skills.

Of note, students living in dormitories demonstrated a

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marginally higher total CT score compared to those residing in personal accommodations (Mean±SD: 17.22±3.26 vs. 17.12±4.58, respectively). However, this was not statistically significantly associated with the

overall CT score or for any individual CT domain ($P>0.05$ for all comparisons). These results are presented in Table 4.

Table 2. Critical thinking scores and correct responses by domain among participants at Iran University of Medical Sciences (n=142)

Domain	Range of the possible scores	Score Mean±SD*	Correct response (%)
Total CCTST-B **	0-34	17.17±3.94	50.5
Deductive reasoning	0-16	8.86±2.32	55.3
Inductive reasoning	0-14	6.44±2.18	%46.0
Evaluation	0-14	6.04±2.02	43.1
Inference	0-11	6.23±1.78	56.6
Analysis	0-9	4.94±1.43	54.8

* Standard Deviation ** California Critical Thinking Skills Test Form B

Table 3. Critical thinking scores by participant characteristics among medical students at Iran University of Medical Sciences (n=142)

Critical thinking skills	Total score (Mean±SD)	Deductive reasoning (Mean±SD)	Inductive reasoning (Mean±SD)	Analysis (Mean±SD)	Evaluation (Mean±SD)	Inference (Mean±SD)
Male	17.1±3.80	8.65±2.38	6.50±2.38	5.00±1.35	6.05±1.86	6.10±1.83
Female	17.27±4.16	9.15±2.23	6.37±2.37	4.87±1.54	6.03±2.24	6.40±1.73
P	0.802	0.203	0.721	0.586	0.964	0.321
Residing in dormitories	17.22±3.26	8.84±2.29	6.59±1.86	5.07±1.31	6.18±1.80	6.04±1.79
Non-residing in dormitories	17.12±4.58	8.88±2.37	6.29±2.49	4.81±1.54	5.90±2.23	6.42±1.77
P	0.877	0.902	0.417	0.287	0.412	0.208
Basic sciences	17.53±4.39	8.26±2.51	7.21±2.51	4.87±1.52	6.92±2.34	5.74±1.88
Pathophysiology	17.17±3.63	8.78±1.88	6.61±2.53	4.96±1.29	5.96±2.16	6.30±1.71
Clerkship	16.54±3.77	8.89±2.32	5.98±1.79	4.96±1.44	5.41±1.62	6.28±1.68
Internship	17.6±3.89	9.51±2.29	6.11±1.86	5.00±1.45	5.97±1.74	6.63±1.81
P	0.006	0.150	0.051	0.984	0.007	0.195

Table 4. Multiple linear regression model predicting total and subscale critical thinking scores by academic and demographic variables (n=142)

Critical thinking subscales		Total critical thinking skills	Deductive reasoning	Inductive reasoning	Analysis	Evaluation	Inference
Mean mark of passed courses	Standardized Coefficients of β	0.349	0.250	0.400	0.173	0.371	0.216
	Std. Error	0.405	0.241	.215	0.154	0.197	0.187
	P	.000	0.005	0.000	0.049	0.000	0.016
Basic sciences*	Standardized Coefficients of β	-0.074	-0.275	0.141	-0.088	0.138	-0.251
	Std. Error	0.909	0.542	0.483	0.345	0.443	0.420
	P-value	0.472	0.009	0.153	0.411	0.159	0.017
Pathophysiology*	Standardized Coefficients of β	-0.092	-0.151	0.020	-0.045	-0.060	-0.093
	Std. Error	1.027	0.612	0.546	0.390	0.501	0.475
	P	0.340	0.124	0.828	0.655	0.516	0.344
Clerkship*	Standardized Coefficients of β	-0.281	-0.230	0.202	-0.080	-0.289	-0.199
	Std. Error	0.918	0.547	0.487	0.349	0.447	0.424
	P	0.011	0.040	0.055	0.486	0.006	0.076
Not residing in the students' dormitories **	Standardized Coefficients of β	-0.062	-0.032	0.032	0.064	-0.036	-0.129
	Std. Error	0.662	0.395	0.351	0.251	0.323	0.306
	P	0.460	0.711	0.691	0.469	0.656	0.136
Female gender ***	Standardized Coefficients of β	-0.007	-0.071	0.016	0.051	-0.012	-0.039
	Std. Error	0.654	0.390	0.347	0.248	0.319	0.302
	P	0.932	0.394	0.837	0.557	0.877	0.641

* The reference group is Internship. ** The reference group is residing in the students' dormitories *** The reference group is male.

Discussion

Our results indicated that higher CT skills were associated with better academic performance within the specific context of undergraduate medical education. However, the educational level did not significantly correlate with CT skills overall. Notably, clerkship students exhibited lower total CT skills, deductive reasoning, and evaluation, while basic sciences students showed lower inference skills and deductive reasoning. Furthermore, neither gender nor residency in student dormitories was correlated with CT skills.

The current study found that academic performance, defined as the mean mark in passed courses, is a significant indicator of CT skills across almost all domains. This finding diverges from earlier Iranian studies, which reported no considerable correlation between CT skills and the mean mark in passed courses (15,21). In contrast to our results, Rezaeaiian *et al.*, documented a negative correlation between academic performance and CT skills. However, their research employed Ricketts's Critical Thinking Disposition Questionnaire, which assesses attitudinal disposition, not the measurable skills evaluated by the CCTST-B ability test used in our study (18). The stronger correlation found in our study aligns with meta-analytic evidence indicating that the relationship with academic achievement is more pronounced when CT is operationalized as a measurable skill through tests like the CCTST-B (22,23).

The mean total CT skills score among medical students was 17.17 ± 3.94 . Regarding studies conducted among Iranian medical students using the same questionnaire, we estimated that CT skills are higher than in most previous research (11,24,25). However, a more recent study exploring CT skills among medical students at Tehran University of Medical Sciences reported a total CT score of 17.41 ± 3.87 on the CCTST-B after integrating the CT course into the medical education curriculum (12). Another study assessed higher total CT skills, with a total CCTST-B score of 18.25 ± 6.05 , in a sample of 102 medical students (26). These results indicate that recent curriculum reforms, particularly the addition of CT training, have likely improved CT skills among Iranian medical students (12).

Iranian medical students outperform global averages in analysis, evaluation, and deductive reasoning but show weaker inductive reasoning and inference skills (17,27). The study's findings align with Soltani *et al.*, showing the lowest scores in the analysis subscale (12). The highest correct response rate in this study was in the inference

subscale, while other Iranian studies showed different strongest CT domains (21). However, a common finding across studies was that students generally exhibited stronger deductive reasoning skills (12,21). These differences may stem from varying educational methods, which play a key role in developing CT (28). Regarding the essential role of CT in clinical decision-making, some studies suggested novel pedagogical approaches to enhance CT skills in higher education. Such as team-based learning and concept mapping education, are essential to reinforce these weaker domains (25,29,30).

Internship students scored highest in total CT skills, with a significant difference only compared to clerkship students, likely due to the cognitive overload and practical demands encountered during clerkship, which hinder critical thinking (31).

Our results demonstrated lower deductive reasoning and inference skills among basic science students, as well as reduced deductive reasoning and evaluation skills among clerkship students, consistent with recent evidence that medical students' CT abilities remain relatively stable over seven years of training. These results suggest a persistent gap in the current curriculum. Our analysis of deductive reasoning highlights specific areas requiring pedagogical improvement, providing a foundation for developing targeted educational strategies to strengthen CT skills in medical education (11,21,25,32). Moreover, studies from medical universities in southern Iran found a decline in CT skills as students progressed through more semesters (16,18). This discrepancy between the results could be due to the quality of education in these universities and the medical education reform, which improved CT skills (33,34).

The development of CT skills in medical education may be hindered by a common lack of structured extracurricular courses (35). This study's findings align with previous research in that no statistically significant difference in CT was observed between students residing in university dormitories and those in private accommodations (21,36). Also, there was no notable difference between the CT skills of male and female students. Furthermore, gender was not found to be a significant factor influencing CT skills, a result consistent with existing literature conducted within medical student populations (12,21,36). On the other hand, some studies have found a significant relationship between gender and CT performance. For example, a study by Mehrpoor *et al.*, which focused on postgraduate specialty residents, found that female participants achieved significantly higher overall CT scores (14.3 ± 2.98) than their male

counterparts (13.48 ± 3.82 ; $P=0.008$) (17). This finding is supported by research within nursing education, where female students have also been shown to exhibit superior CT skills (37,38). The discrepancy between these results and the present study's null finding may be attributable to differences in the study populations and variations in educational curricula.

Our study has several limitations. First, the relatively small sample size and the use of convenience sampling from a single medical university may limit the representativeness of the study population and restrict the generalizability of the findings to other medical schools or educational settings. This sampling approach also introduces the potential for selection bias, as participation may have been influenced by students' availability or interest in the topic. Second, although the CCTST-B is a validated instrument, its use as a self-administered assessment may not fully capture the applied and context-dependent nature of CT in clinical practice, thereby introducing potential measurement bias.

In short, academic performance shows a positive correlation with CT skills across all subscales, and the CT skills among medical students at IUMS are favorable compared to those at other Iranian medical universities, although they could still improve through the implementation of new approaches. CT skills were not completely associated with the phase of medical education. Additionally, gender and students' dormitory residency did not have a significant relationship with CT skills among undergraduate medical students.

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References

- Andreucci-Annunziata P, Riedemann A, Cortés S, Mellado A, del Río MT, Vega-Muñoz A, et al. Conceptualizations and instructional strategies on critical thinking in higher education: a systematic review of systematic reviews. *Front Educ* 2023;8:1182450.
- Lai ER. Critical thinking: a literature review. *Pearson Res Rep* 2011;6:40-1.
- Croskerry P. Achieving quality in clinical decision making: cognitive strategies and detection of bias. *Acad Emerg Med* 2002;9:1184-204.
- Chan ZC. A systematic review on critical thinking in medical education. *Int J Adolesc Med Health* 2018;30:20160120.
- Ross D, Loeffler K, Schipper S, Vandermeer B, Allan GM. Do scores on three commonly used measures of critical thinking correlate with academic success of health professions trainees? A systematic review and meta-analysis. *Acad Med* 2013;88:724-34.
- Ali-Abadi T, Babamohamadi H, Nobahar M. Critical thinking skills in intensive care and medical-surgical nurses and their explaining factors. *Nurse Educ Pract* 2020;45:102783.
- Bezanilla MJ, Fernández-Nogueira D, Poblete M, Galindo-Domínguez H. Methodologies for teaching-learning critical thinking in higher education: the teacher's view. *Think Skills Creat* 2019;33:100584.
- Behar-Horenstein LS, Niu L. Teaching critical thinking skills in higher education: a review of the literature. *J Coll Teach Learn* 2011;8:25-42.
- Tackett S, Grant J, Mmari K. Designing an evaluation framework for WFME basic standards for medical education. *Med Teach* 2016;38:291-6.
- Schwarz MR, Wojtczak A. Global minimum essential requirements: a road towards competence-oriented medical education. *Med Teach* 2002;24:125-9.
- Athari ZS, Sharif SM, Nasr AR, Nematbakhsh M. Assessing critical thinking in medical sciences students in two sequential semesters: does it improve? *J Educ Health Promot* 2013;2:5.
- Soltani A, Mafinejad MK, Tajik M, Moosapour H, Bayat T, Mohseni F, et al. Effects of a curriculum integrating critical thinking on medical students' critical thinking ability in Iran: a quasi-experimental study. *J Educ Eval Health Prof* 2021;18:14.
- Soltani A, Allaa M, Moosapour H, Aletaha A, Shahrtash F, Monajemi A, et al. Integration of cognitive skills as a cross-cutting theme into the undergraduate medical curriculum at Tehran University of Medical Sciences. *Acta Med Iran* 2017;55:68-73.
- Mahapoonyanont N. The causal model of some factors affecting critical thinking abilities. *Procedia Soc Behav Sci* 2012;46:146-50.
- Moslemi Z, Ghomi M, Mohammadi D. The relationship between critical thinking skills with mental health and academic achievement of Qom University of Medical Sciences students. *J Med Educ Dev* 2016;9:90-101.
- Shakurnia A, Aslami M. Critical thinking skills of medical students at Ahvaz Jundishapur University of Medical Sciences. *Iran J Med Educ* 2017;17:420-7.
- Mehrpour SR, Hoseini Shavoun A, Kheiltash A, Masoomi R, Nasle Seraji R. Evaluating and comparing critical thinking skills of residents of Tehran University of Medical Sciences. *BMC Med Educ* 2023;23:133.

18. Rezaeian M, Zare-Bidaki M, Bakhtar M, Afsharmanesh K. Comparison of the critical thinking skills among medical students in different educational levels in Rafsanjan University of Medical Sciences in 2013. *J Rafsanjan Univ Med Sci* 2015;13:715-24.
19. Khalili H, Hosseini ZM. Investigation of reliability, validity and normality Persian version of the California Critical Thinking Skills Test; Form B (CCTST). *J Med Edu* 2009;3:e105016.
20. Facione PA. The California Critical Thinking Skills Test—College Level: Technical Report No. 1. Millbrae, CA: California Academic Press; 1990.
21. Khazaei MR, Niromand E, Shahsavari A, Sepahi V. Evaluation of critical thinking skills in medical students of Kermanshah University of Medical Sciences. *Educ Res Med Sci* 2023;12:e131655.
22. Orhan A. The relationship between critical thinking and academic achievement: a meta-analysis study. *Psycho-Educ Res Rev* 2022;11:283-99.
23. Fong CJ, Kim Y, Davis CW, Hoang T, Kim YW. A meta-analysis on critical thinking and community college student achievement. *Think Skills Creat* 2017;26:71-83.
24. Rezaee R, Mazareie E, Momeni Danaei S, Mirzaei S. Critical thinking skills in Shiraz dental students. *Interdiscip J Virtual Learn Med Sci* 2014;5:35-43.
25. Darban L, Ashtari S, Forghani Z, Yazdani S. Evaluation of critical thinking skills among medical sciences students in Shahid Beheshti and Tehran University of Medical Sciences. *Med Sci J Islam Azad Univ Tehran Med Branch* 2016;26:229-37.
26. Mafinejad MK, Arabshahi SKS, Monajemi A, Jalili M, Soltani A, Rasouli J. Use of multi-response format test in the assessment of medical students' critical thinking ability. *J Clin Diagn Res* 2017;11:LC10-3.
27. Leach BT. Critical thinking skills as related to university students' gender and academic discipline [dissertation]. Johnson City (TN): East Tennessee State University; 2011.
28. Sefein M, Zaigham MT, Idrees Z, Shahzil M. Pedagogical practices that enhance medical students' capacity for creative thought: a qualitative study. *J Med Educ Dev* 2024;17:1-8.
29. Silberman D, Carpenter R, Takemoto JK, Coyne L. The impact of team-based learning on the critical thinking skills of pharmacy students. *Curr Pharm Teach Learn* 2021;13:116-21.
30. Mohamed AA, Garas AF, Elsayl KA. Effect of concept mapping on critical thinking skills of baccalaureate nursing students. *Int J Res Appl Nat Soc Sci* 2017;5:59-76.
31. Stuart E, O'Leary D, Rowntree R, Carey C, O'Rourke L, O'Brien E, et al. Challenges in experiential learning during transition to clinical practice: a comparative analysis of reflective writing assignments during general practice, paediatrics and psychiatry clerkships. *Med Teach* 2020;42:1275-82.
32. Amini M, Fazlinejad N. Critical thinking skill in Shiraz University of Medical Sciences students. *Hormozgan Med J* 2010;14:213-8.
33. Rezaei H, Mosavi A, Yousefi A, Larijani B, Rezaei N, Dehnavieh R, et al. Strengths of Iran for internationalization of medical sciences education. *J Educ Health Promot* 2020;9:92.
34. Mortaz Hejri S, Mirzazadeh A, Khabaz Mafinejad M, Alizadeh M, Saleh N, Gandomkar R, et al. A decade of reform in medical education: experiences and challenges at Tehran University of Medical Sciences. *Med Teach* 2018;40:472-80.
35. Izadabadi F, Amini M, Kiani M. Implementation and evaluation of extracurricular theme for undergraduate basic sciences medical courses at Shiraz Medical School. *J Educ Health Promot* 2021;10:98.
36. Mahmoodabad SSM, Nadrian H, Nahangi H. Critical thinking ability and its associated factors among preclinical students in Yazd Shaheed Sadoughi University of Medical Sciences (Iran). *Med J Islam Repub Iran* 2012;26:50.
37. Liu NY, Hsu WY, Hung CA, Wu PL, Pai HC. The effect of gender role orientation on student nurses' caring behaviour and critical thinking. *Int J Nurs Stud* 2019;89:18-23.
38. Azizi-Fini I, Hajibagheri A, Adib-Hajbaghery M. Critical thinking skills in nursing students: a comparison between freshmen and senior students. *Nurs Midwifery Stud* 2015;4:e25721.