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Predictive Association Between Critical Thinking and Problem-Solving Ability Among Medical Sciences Students: A Cross-Sectional Analysis

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Abstract

Background: Critical thinking and problem-solving are essential competencies for medical sciences students, who frequently encounter complex clinical situations requiring accurate judgment and effective decisions. With the shift toward competency-based education, examining their relationship is crucial. This study investigated whether critical thinking predicts problem-solving ability among these students.

Methods: In 2025, a cross-sectional study was conducted among 385 students of Sirjan School of Medical Sciences, southern Iran, selected via proportional stratified random sampling. Data were collected using the validated Persian versions of the California Critical Thinking Skills Test and the Problem-Solving Inventory. Analyses in SPSS v23 encompassed descriptive statistics, t-tests, ANOVA, Pearson's correlation, and multiple linear regression, with significance set at $P<0.05$.

Results: The mean scores for critical thinking and problem-solving were 18.74 (SD = 4.91) and 112.47 (SD = 18.36), respectively. Critical thinking showed a strong positive correlation with problem-solving ability ($r=0.65$, $P<0.001$). Regression analysis revealed that all five dimensions of critical thinking significantly predicted problem-solving, collectively explaining 35% of its variance ($R^2=0.35$, $F(6, 312)=28.67$, $P<0.001$). Field-of-study comparisons indicated that students in medicine discipline achieved higher scores in both domains ($P=0.013$ for critical thinking; $P=0.021$ for problem-solving).

Conclusion: This study highlights critical thinking as a key predictor of problem-solving skills in medical sciences students, with all dimensions contributing meaningfully. The results advocate for embedding targeted critical thinking training into medical curricula to strengthen students' capacity for effective clinical decision-making, especially given the superior performance observed among medical students. However, as this was a cross-sectional study, causal interpretations should be made with caution.

Keywords: Cross-sectional Studies, Students, Medical, Thinking, Curriculum, Iran

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Introduction

Critical thinking and problem-solving ability are widely recognized as fundamental cognitive skills for students in the medical sciences, a term which in this study refers not only to clinical disciplines such as medicine, nursing, and midwifery, but also to non-clinical fields like environmental health, health information technology, laboratory sciences, anesthesiology, occupational health, and public health (1,2). Whether in clinical or allied health sciences, students are frequently required to analyze complex situations, make informed decisions, and solve problems that impact individual and population health (3,4).

Critical thinking is generally defined as the process of purposeful, reasoned, and goal-directed thinking that involves interpretation, analysis, evaluation, and inference (5). Facione (1990) described it as self-regulatory judgment that guides beliefs and actions, enabling individuals to think in a clear, rational, open-minded, and informed manner (6). In the health sciences, this ability is crucial, not only for clinical decision-making but also for planning community interventions, interpreting health data, managing health systems, and adapting to rapidly changing healthcare environments (7).

Problem-solving ability, by contrast, refers to the process of identifying problems, developing and evaluating potential solutions, and implementing strategies effectively (8). Across all health-related disciplines, problem-solving is a daily requirement—whether diagnosing patients, improving hygiene in public health settings, organizing health information systems, or managing occupational risks (9). Thus, students must be equipped with the cognitive tools to tackle real-world challenges proactively and competently (9,10).

There is strong theoretical support for a close link between critical thinking and problem-solving. Critical thinking is thought to underpin effective problem-solving by facilitating deeper understanding, strategic planning, and rational decision-making (11,12). This connection has been supported by studies in various educational and professional contexts suggesting that students who demonstrate stronger critical thinking skills tend to be better at solving complex problems (12,13).

While numerous studies have explored these skills in clinical students or nurses, less attention has been given to the predictive relationship between critical thinking and problem-solving ability across a broader range of medical science disciplines, particularly in the context of Iranian universities. This lack of data presents a significant gap in the literature. Given the interdisciplinary nature of modern healthcare, where professionals from different domains must collaborate effectively, understanding this relationship across fields is both timely and essential.

Moreover, educational institutions in Iran, including faculties of medical sciences, are increasingly adopting competency-based curricula. In these programs, students' progression is measured not only by passing exams but also by achieving specific competencies, such as clinical reasoning, teamwork, communication, and critical thinking. For example, Iranian medical schools have integrated problem-based learning, early clinical exposure, and structured skill-labs to ensure competency-based outcomes. Therefore, examining whether critical thinking can predict problem-solving ability among a diverse group of students is crucial for aligning training objectives with practical healthcare demands.

This study aims to fill this gap by investigating the predictive role of critical thinking in determining problem-solving ability among students from various disciplines at Sirjan School of Medical Sciences. By encompassing students from medicine, nursing, midwifery, laboratory sciences, anesthesiology, public health environmental health, occupational health, emergency medicine, and health information technology the research provides a comprehensive view of how critical thinking contributes to problem-solving across the medical sciences. The findings may inform curriculum design and teaching strategies that aim to enhance these essential skills for future healthcare professionals in multiple fields.

The theoretical foundation of this study is rooted in cognitive psychology and educational theory, emphasizing the interdependence of critical thinking and problem-solving abilities. According to Ennis (1987), critical thinking encompasses skills such as analysis, evaluation, inference, and explanation, which are prerequisites for effective problem-solving (14). Problem-solving models, such as those by Polya (1945), describe a stepwise approach that begins with understanding the problem, devising a plan, executing solutions, and reviewing outcomes (15). Critical thinking processes guide each of these steps by enabling reflective judgment and flexible thinking (14).

In medical education, clinical reasoning theories emphasize how critical thinking supports diagnostic accuracy and therapeutic decisions. Benner's novice-to-expert model also highlights how the development of critical thinking enhances problem-solving efficiency as students gain experience (16). Thus, this framework posits that stronger critical thinking skills should predict higher problem-solving ability.

Critical thinking and problem-solving are two interrelated cognitive skills essential for effective performance. The ability to think critically allows individuals to analyze information systematically, evaluate evidence, and draw logical conclusions, which form the foundation for effective problem-solving (17,18). Several studies have demonstrated a significant positive relationship between critical thinking and problem-solving in various educational and clinical contexts (19). In medical education, the development of critical thinking is crucial because students must continuously assess complex patient data, recognize patterns, and make informed decisions under uncertainty (20). These processes inherently require problem-solving skills to identify solutions and implement appropriate interventions (20). The ability to solve problems efficiently can improve reasoning, emphasizing the importance of fostering critical thinking as a predictor of problem-solving ability (21). Moreover, the educational frameworks in medical sciences, such as competency-based education and evidence-based practice, stress the cultivation of critical thinking to enhance diagnostic accuracy and therapeutic decision-making (22). Therefore, understanding whether and how critical thinking predicts problem-solving ability can provide insights for curriculum development and targeted training programs. Despite the established theoretical connection, empirical evidence specifically examining the predictive power of critical thinking on problem-solving ability among medical sciences students, especially in the Iranian context, remains limited. Identifying this predictive relationship will contribute to filling this gap and guide educators in designing interventions that enhance both skills simultaneously.

Accordingly, the present study hypothesizes:

H1: Critical thinking positively predicts problem-solving ability among students of medical sciences.

This hypothesis reflects the expectation that higher critical thinking skills will be associated with greater problem-solving ability, underscoring the importance of integrating critical thinking development into medical education.

Methods

Study Design and Setting

This cross-sectional, descriptive-analytical study was conducted in 2025 among students of Sirjan School of Medical Sciences, located in the south of Iran.

Participants and Sampling

The study population consisted of all students enrolled in various disciplines at Sirjan School of Medical Sciences, including medicine, nursing, midwifery, public health, environmental health, occupational health, anesthesiology, laboratory sciences, emergency medicine, and medical technology. Based on the total population of 723 students, the required sample size was calculated to be 385 using the following formula:

$$n = \frac{Z^2_{\alpha/2} \times S^2}{d^2}$$

where:
n is the sample size,
Z is the Z-value for 95% confidence level (1.96),
S is the estimated standard deviation (0.5),
d is the margin of error (0.05).

Since the actual population variance of critical thinking and problem-solving scores was not available prior to data collection, we used S = 0.5 as a conservative estimate, which is a widely accepted approach in behavioral and educational studies when variance is unknown. This method ensures the maximum required sample size.

A proportional stratified random sampling method was employed to ensure adequate representation across academic disciplines and entry years. First, the total required sample size (n = 385) was proportionally allocated to each field of study based on the number of students enrolled in that discipline out of the total population of 723. Then, within each field, further stratification was applied according to the students' year of entry (e.g., first-year, second-year, etc.). After stratification, a random sampling technique was used to select participants by assigning a unique number to each eligible student and using a random number table to identify the final sample in each stratum.

Inclusion and exclusion criteria were carefully defined to ensure the appropriateness and reliability of the sample. Students were eligible to participate if they were officially enrolled at Sirjan School of Medical Sciences during the first semester of the 2024–2025 academic year, had completed at least one full semester of coursework prior to data collection, and expressed a willingness to participate voluntarily. Students were excluded from the study if they were in their first semester of academic enrollment (due to limited academic exposure), if their questionnaires were incomplete or contained inconsistent responses, defined as failing at least two embedded attention-check items (e.g., "select option 3 for this item") or providing contradictory answers to reverse-coded items, or if they were simultaneously involved in another research project that could interfere with their engagement or introduce bias in their responses.

Instruments

The data collection tool used in this study was a structured three-part questionnaire. The first part included demographic information such as age, gender, marital status, field of study, academic level, place of residence, and employment status. The second part consisted of the Problem-Solving Inventory (PSI) developed by Heppner and Petersen, which assessed students' problem-solving ability across three dimensions: problem-solving confidence (11 items), approach-avoidance style (16 items), and personal control (5 items). Responses were rated on a six-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree), resulting in a total score ranging from 32 to 192. The reliability of this inventory had been previously confirmed by Rastgo et al reporting a Cronbach's alpha coefficient of 0.89 (23). In the present study, the content validity of the PSI was confirmed by a panel of five faculty members specialized in Health Services Management and three faculty members from Medical Education in Iran. Also, the PSI was pretested on 30 students, and demonstrated good internal consistency with a Cronbach's alpha coefficient of 0.91.

The third part of the questionnaire included the California Critical Thinking Skills Test (CCTST), developed by Facione, which comprised 34 items assessing five core components of critical thinking: evaluation (14 items), inference (11 items), analysis (3 items), deductive reasoning (3 items), and inductive reasoning (3 items). Each item had four or five response options, of which only one was correct, and participants received a score of 0 or 1 per item. The total score ranged from 0 to 34. The validity and reliability of the Persian version of this test were confirmed by Mehrinejad et al with a reported Cronbach's alpha of 0.83 (24). The content validity of the Persian version of this test was similarly confirmed by the same panel of experts. Moreover, the CCTST was pretested on 30 students and exhibited satisfactory reliability with a Cronbach's alpha coefficient of 0.87.

Procedures

After obtaining the required approvals from the university and the ethics committee (ID number IR.SIRUMS.REC.1404.016), the researchers informed students about the objectives of the study, emphasized the confidentiality of their responses, and obtained written informed consent. To ensure voluntary participation, students were clearly told that completing the questionnaire was optional and would not affect their academic status. The research team coordinated with the academic affairs office to determine the class schedules of selected students and arranged appropriate times for data collection. Two trained research assistants (SB, AB) attended the university in person, distributed the questionnaires during class sessions, and collected them immediately upon completion to minimize data loss and ensure full participation.

Statistical Analysis:

Data were analyzed using SPSS software version 23. Initially, data cleaning and screening were performed to detect any missing or outlier values. The normality of the distribution of the main quantitative variables, including critical thinking and problem-solving scores, was assessed using the Kolmogorov–Smirnov test. Based on the results of the normality test and visual inspection of histograms, parametric tests were used for subsequent analyses.

Descriptive statistics, including means, standard deviations, frequencies, and percentages, were used to summarize the demographic characteristics of the participants and the main study variables. Independent t-tests were used to compare the mean scores of critical thinking and problem-solving abilities between two groups (gender, marital status, place of residence, and employment status). One-way analysis of variance (ANOVA) was used to examine differences in these scores across more than two groups (field of study, academic level). Where significant differences were observed, post-hoc tests (e.g., Tukey's test) were conducted to determine pairwise group differences. Pearson's correlation coefficient was employed to assess the bivariate relationships between critical thinking and problem-solving ability. Additionally, Pearson's correlation was also used to evaluate the association between these two main variables and participants' age.

To investigate the predictive role of critical thinking in students' problem-solving ability, multiple linear regression analysis was performed using a backward elimination procedure (a specific type of stepwise method). In this approach, all demographic variables (age, gender, marital status, place of residence, employment status, academic level, and field of study) and the five dimensions of critical thinking were initially entered into the model. Variables were sequentially removed if their P-values exceeded 0.05, resulting in a final model that retained only significant predictors.

Before conducting the regression, the assumptions of linearity, independence of errors, homoscedasticity, absence of multicollinearity, and normality of residuals were tested. Linearity was assessed through scatterplots; independence of errors was examined using the Durbin–Watson statistic; homoscedasticity was evaluated by plotting standardized residuals against predicted values; multicollinearity was checked using variance inflation factor (VIF) and tolerance values; and the normality of residuals was confirmed through the histogram and normal probability plot (P-P plot) of standardized residuals.

The categorical variable "field of study" was dummy-coded for regression analysis, with "Medicine" serving as the reference category. A significance level of $P < 0.05$ was considered statistically significant in all analyses.

Results:

A total of 12 questionnaires were excluded from the analysis due to incompleteness or inconsistent responses, as identified by embedded attention-check items and contradictions in reverse-coded questions. These 12 participants were subsequently replaced with 12 additional students to achieve the target sample size of 385 participants.

The majority of students were in the age group of 21–23 years (54.81%), and 62.08% were female. Most participants were single (87.28%) and pursuing a bachelor's degree (83.64%). Regarding their field of study, the largest group belonged to nursing (21.56%), followed by environmental health (16.10%). The majority of students lived in dormitories (80.78%), and 86.75% were not employed at the time of the study. Table 1 presents the demographic characteristics of the participants (Table 1).

Table 1. Demographic Characteristics of the Participants ($n = 385$)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	≤ 20	102	26.49
	21–23	211	54.81
	≥ 24	72	18.70
Gender	Male	146	37.92
	Female	239	62.08
Marital Status	Single	336	87.28
	Married	49	12.72
Field of Study	Medicine	37	9.61
	Nursing	83	21.56
	Midwifery	19	4.94
	Public Health	29	7.53
	Environmental Health	62	16.10
	Occupational Health	27	7.01
	Anesthesiology	38	9.87
	Laboratory Sciences	44	11.43
	Emergency Medicine	42	10.91
	Medical Technology	4	1.04
Academic Level	Associate Degree	26	6.75
	Bachelor's Degree	322	83.64
	Medical Doctorate	37	9.61
Place of Residence	Dormitory	311	80.78
	Non-Dormitory	74	19.22
Employment Status	Employed	51	13.25
	Unemployed	334	86.75

The results showed that the mean total score of students on the Problem-Solving Inventory (PSI) was 112.47 (out of 192) with a standard deviation of 18.36. Additionally, the mean total score on the California Critical Thinking Skills Test (CCTST) was 18.74 (out of 34) with a standard deviation of 4.91 (Table 2).

A significant positive correlation was found between critical thinking and problem-solving ability ($r=0.65$, $P<0.001$), indicating that higher levels of critical thinking were associated with stronger problem-solving skills (Table 3). Age showed no significant correlation with either problem-solving ability ($r=0.15$, $P=0.201$) or critical thinking ($r=0.12$, $P=0.214$).

Group comparison analyses revealed no significant differences in problem-solving or critical thinking scores based on gender, marital status, residence, employment status, or academic level. However, significant differences were found based on field of study, with medical students achieving higher mean scores than other groups ($P=0.013$, $F=3.78$ for critical thinking; $P=0.021$, $F=3.42$ for problem-solving ability) (Table 4).

Multiple linear regression analysis showed that all five critical thinking dimensions and field of study (dummy-coded, reference = Medicine) were significant predictors of problem-solving ability. All regression assumptions were met, as the residuals were normally distributed ($P>0.05$), the scatterplots confirmed linearity and homoscedasticity, the variance inflation factors (VIFs) were below 2 indicating no multicollinearity, and the Durbin–Watson statistic of 1.95 confirmed the absence of autocorrelation. The final model was statistically significant ($F(6, 312)=28.67$, $P<0.001$), explaining 35% of the variance in problem-solving ability ($R^2=0.35$, Adjusted $R^2=0.34$). While all dimensions of critical thinking were significant predictors, the effects of inductive reasoning ($P=0.03$) and field of study ($P=0.04$) were marginally significant and should be interpreted with caution (Table 5).

Table 2. Descriptive Statistics of Critical Thinking and Problem-Solving Scores (n = 385)

Variable	Score Range	Mean	Standard Deviation (SD)
Problem-Solving Inventory (Total)	**32-192**	**112.47**	**18.36**
Problem-Solving Confidence	11-66	38.21	7.05
Approach-Avoidance Style	16-96	54.89	10.13
Personal Control	5-30	19.37	3.42
Critical Thinking (CCTST Total)	**0-34**	**18.74**	**4.91**
Evaluation	0-14	7.42	2.11
Inference	0-11	6.13	1.76
Analysis	0-3	1.82	0.72
Deductive Reasoning	0-3	1.63	0.69
Inductive Reasoning	0-3	1.74	0.67

Discussion

The primary objective of this study was to investigate the relationship between critical thinking and problem-solving ability among medical sciences students, with a particular focus on the predictive role of critical thinking and its subcomponents. Understanding this relationship is crucial in the context of medical education, where

Table 3. Pearson Correlation between Critical Thinking and Problem-Solving Ability

Variable	Critical Thinking	Problem-Solving Ability
Critical Thinking	1	0.65*
Problem-Solving Ability	0.65*	1

* Note: $P<0.001$

Table 4. Comparison of Critical Thinking and Problem-Solving Ability Across Demographic Characteristics

The main research variable	Demographic specifications	Type of test	*P*-Value*	Cohen's d
		t-test (t)		
Problem-Solving Ability	Gender	1.24	0.215	0.13
Critical Thinking		0.99	0.321	0.11
Problem-Solving Ability	Marital Status	0.77	0.442	0.09
Critical Thinking		0.48	0.634	0.06
Problem-Solving Ability	Place of Residence	0.11	0.912	0.01
Critical Thinking		0.14	0.887	0.01
Problem-Solving Ability	Employment Status	0.43	0.668	0.05
Critical Thinking		0.77	0.441	0.08
---	---	**ANOVA (F)**	***P*-Value***	**η² (Effect Size)**
Problem-Solving Ability	Field of Study	3.42	**0.021**	0.04
Critical Thinking		3.78	**0.013**	0.05
Problem-Solving Ability	Academic Level	1.27	0.261	0.01
Critical Thinking		1.73	0.183	0.02

* Cohen's d values are interpreted as small (0.2), medium (0.5), and large (0.8) effects.
* η^2 values indicate the proportion of total variance in the outcome variable that is explained by each factor, providing a measure of the practical significance of group differences.

Table 5. Multiple Linear Regression Predicting Problem-Solving Ability from Critical Thinking and Its Dimensions

Predictor	B*	SE B*	β *	t*	*P**	VIF*
Constant	10.24	2.01	---	4.86	<0.001	---
Evaluation	0.45	0.10	0.31	5.89	<0.001	1.45
Inference	0.39	0.09	0.25	4.43	<0.001	1.52
Analysis	0.18	0.06	0.13	2.52	0.01	1.38
Deductive Reasoning	0.16	0.05	0.09	2.24	0.03	1.41
Inductive Reasoning	0.12	0.02	0.07	2.01	0.03	1.33
Field of Study (dummy-coded; ref=Medicine)	0.09	0.01	0.05	1.78	0.04	1.27

* **B**; Unstandardized regression coefficient, **SE B**; Standard Error of B, **β**; Standardized regression coefficient, **t**; t-statistic, ***P***; *P*-value, **VIF;** variance inflation factor
** **Model Fit**: **R^2**=35, **Adjusted R^2**=0.34, **F (6, 312)**=28.67, ***P***<0.001, **Durbin-Watson**=1.95

students are regularly required to make informed, timely, and ethically sound decisions in complex environments. The findings revealed a significant and positive correlation between students' critical thinking skills and their ability to solve problems. This association suggests that students who possess stronger critical thinking abilities tend to be more proficient in identifying, analyzing, and resolving complex academic and clinical problems. Furthermore, results from regression analysis demonstrated that critical thinking is a meaningful predictor of problem-solving ability. In other words, the more developed a student's critical thinking is, the more capable they are of navigating the cognitive and emotional demands of effective problem-solving. However, with $R^2=0.35$, approximately 65% of the variance remains unexplained, suggesting that other factors such as motivation, clinical experience, or academic self-efficacy may also contribute to problem-solving performance.

Among the dimensions of critical thinking assessed in this study, evaluation, inference, and deductive reasoning emerged as the strongest predictors of students' problem-solving ability. These components appear to be particularly influential in enabling students to weigh evidence, draw logical conclusions, and systematically assess different aspects of a problem before deciding on a course of action. This highlights the multidimensional nature of critical thinking and its differential impact on problem-solving processes. These results are consistent with and extend prior findings in the literature. For instance, Yang et al reported a significant positive relationship between critical thinking disposition and problem-solving ability among nursing students, suggesting that students with higher levels of reflective thinking were better at generating and implementing solutions in clinical scenarios (25). Similarly, Dolmans et al found that students exposed to problem-based learning methods developed stronger reasoning and decision-making skills, both of which are components of problem-solving closely linked to critical thinking (26). In another study, Simmons highlighted that inference and evaluation, two of the same subdimensions identified in our research, were particularly important in enhancing students' ability to diagnose patient problems and choose appropriate interventions (27). Royce et al also emphasized that students who scored higher on critical thinking assessments demonstrated more efficient information processing and fewer cognitive errors when faced with ambiguous clinical data (28). Further support comes from Kuiper and Pesut, who showed that critical thinking training significantly improved students' diagnostic accuracy, mainly through improvements in deductive and inductive reasoning (29).

These comparisons reinforce the notion that critical thinking is not only an abstract cognitive skill but also a practical asset that translates into real-world academic and clinical decision-making. The consistency between this study and the existing body of evidence strengthens the validity of the findings and provides educators with confidence in the utility of enhancing critical thinking in curricula.

The prominence of the evaluation and inference subdimensions in predicting problem-solving may be particularly relevant to the health sciences context. Evaluation allows students to judge the relevance, credibility, and applicability of information, a critical requirement in evidence-based practice. Inference, on the other hand, equips students with the capacity to draw justified conclusions from observed data, which is essential for forming diagnostic hypotheses and treatment plans. Deductive reasoning, which involves logically connecting premises to reach a valid conclusion, further contributes to systematic decision-making, reducing the risk of errors under pressure.

A deeper interpretation of these findings suggests that fostering critical thinking may not only improve cognitive performance but also build resilience and confidence in dealing with uncertainty, which are indispensable traits in health professions. Problem-solving in such settings is rarely linear or straightforward; it involves ethical dilemmas, time-sensitive decisions, and balancing competing priorities. Thus, a strong foundation in critical thinking enables students to approach problems methodically, remain open to alternative perspectives, and make rational decisions even under stressful circumstances.

Moreover, the enduring association between critical thinking and problem-solving observed across different studies and cultural contexts, including both Western and Middle Eastern settings, indicates a universal cognitive mechanism that transcends educational systems and pedagogical styles. This supports the call for integrating structured critical thinking training into health sciences education, not as an optional enrichment, but as a core competency aligned with clinical reasoning and patient care.

Our results showed that field of study was the only demographic factor significantly associated with critical thinking and problem-solving, with medical students scoring higher than peers in other disciplines. One possible explanation is the competitive selection process and prior academic achievement of medical students, which may create a form of selection bias. Additionally, medical curricula often emphasize case-based and problem-based learning, fostering stronger reasoning and decision-making skills compared to other programs.

These findings are consistent with earlier studies. For instance, Midilli and Altas (2020) reported higher critical thinking scores among medical students compared to paramedical groups, attributing this to differences in training methods and academic background (18). Similarly, Azizi-Fini et al found that medical and nursing students engaged in more active learning strategies demonstrated better problem-solving abilities (30).

Interestingly, our study did not find significant associations between age, gender, or other demographic factors and critical thinking or problem-solving ability. While some previous studies have suggested possible links between these characteristics and cognitive outcomes, the inconsistency may reflect contextual differences, relatively homogeneous student samples, or the dominant influence of educational design over individual demographics. This suggests that structured pedagogical strategies may play a stronger role than demographic factors in shaping these skills. Taken together, these results suggest that while medical students may benefit from both selection effects and structured curricula, the lack of significant differences across other demographic variables underscores the stronger role of educational design rather than inherent characteristics. This highlights the need to expand active and problem-based approaches to non-medical disciplines to narrow the gap.

In summary, this study adds to a growing body of evidence supporting the significant role of critical thinking in enhancing students' problem-solving abilities. By identifying the most influential dimensions of critical thinking, such as evaluation, inference, and deductive reasoning, it provides educators and curriculum developers with practical insights into which areas to target in order to develop more effective and reflective healthcare professionals.

Conclusion

In conclusion, the results of this study highlight the potential predictive role of critical thinking in students' problem-solving ability. With critical thinking accounting for 35% of the variance in problem-solving skills, it is evident that students who possess stronger critical thinking abilities, particularly in areas such as evaluation, inference, and deductive reasoning, are better equipped to analyze situations, generate effective solutions, and respond adaptively to challenges. These findings suggest that integrating structured critical thinking development into medical education curricula could meaningfully improve problem-solving performance among future healthcare professionals, with potential benefits for similar institutions, although caution is warranted due to the single-university sample.

Given the essential role of problem-solving in clinical reasoning and patient care, academic institutions and policymakers should prioritize the development of critical thinking skills within health sciences education. Specific recommendations include:

- Incorporating critical thinking modules into core curricula across all medical and allied health programs.
- Utilizing active learning strategies such as problem-based learning (PBL), case analysis, and reflective writing to cultivate analytical skills.
- Providing faculty training on how to foster critical thinking in classroom and clinical settings.
- Integrating standardized assessments of critical thinking into academic evaluations and professional readiness assessments.

These practices, highlighted by the study findings, have implications for change management in curriculum design and educational policy, ensuring that interventions target the most impactful aspects of critical thinking.

This study has several limitations. First, the cross-sectional design limits causal inference between critical thinking and problem-solving abilities. Future interventions should consider longitudinal follow-up. Second, the study relied on self-report questionnaires, which may be subject to social desirability bias or misinterpretation. Third, although the sample size was adequate, it was drawn from a single medical sciences university, which may limit the generalizability of findings to broader student populations or other cultural contexts. Lastly, other potentially influential variables such as cognitive load, emotional intelligence, or academic self-efficacy were not measured.

Future studies should consider longitudinal designs to explore how critical thinking and problem-solving abilities evolve over time, especially through educational interventions. Additionally, incorporating qualitative approaches, such as interviews or think-aloud protocols, could yield deeper insights into students' cognitive strategies. Expanding the scope to include other psychological and contextual variables (e.g., motivation, stress, learning styles) could also help in developing a more comprehensive model of academic problem-solving. Finally, replicating this study in diverse academic institutions and cultural settings would enhance the external validity of the findings.

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Data Availability Statement

All data is presented as part of the tables or figures. Additional data can be requested from the corresponding author.

Competing Interests

The authors declare that they have no competing interests.

Ethical Approval

This study is approved by the Sirjan School of Medical Sciences Ethics Committee under ID number IR.SIRUMS.REC.1404.016. All methods were carried out in accordance with relevant guidelines and regulations. Written informed consent was obtained from all subjects and/or their legal guardians.

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