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# Study of medical students' learning approaches and their association with academic performance and problem-solving styles

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## Abstract:

**BACKGROUND:** Learners have various processing and understanding of the environment and issues and choose different strategies for problem-solving considering learning and studying approaches. The purpose of this study was to examine medical students' learning approaches and their association with academic performance and problem-solving styles.

**MATERIALS AND METHODS:** This study was conducted using the descriptive-correlational method. The statistical population comprised medical students of Iran University of Medical Sciences during the academic year of 2019–2020. Of them, 168 subjects were chosen based on simple random sampling and Morgan Table. Study tools include the Standard Approaches and Study Skills Inventory for Students (ASSIST) Questionnaire, which includes 18 items and a Likert five-choice spectrum, and includes a deep, superficial, and strategic approach. Its reliability was determined by Cronbach's alpha of 0.81. Problem-Solving Style Questionnaire developed by Cassidy and Long was used. This instrument included 24 items and 6 components, and its reliability equaled 0.83, which was their grade point average. Data were analyzed using normality tests, paired *t*-test, Pearson correlation coefficient, and regression through SPSS 16 software.

**RESULTS:** Results implied the positive and significant relationship between deep-strategic approaches, problem-solving styles, and academic performance of medical students ( $P < 0.001$ ); furthermore, there was no significant difference between learning approaches based on gender ( $P > 0.001$ ), while there was a significant difference between two groups in terms of problem-solving styles ( $P < 0.001$ ).

**CONCLUSION:** Because deep and strategic approaches predict academic performance and problem-solving styles, the diagnostic assessment must be done at the beginning of the educational process to determine the type of learners' approaches. Such an evaluation can be used to implement instructional strategies and educational designs to improve the academic performance of students.

## Keywords:

Academic performance, deep learning, learning approaches, medical students, problem-solving

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## Introduction

Academic performance (also known as an academic achievement) and factors affecting it is a fundamental and axial variable in educations that have received considerable attention from educational researchers and psychologists. It can be

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stated that learners' academic performance takes a big part in studies on educational psychology. There are various definitions of academic performance. Atkinson defines academic performance as the individual learned or acquired ability.<sup>[1]</sup> Academic performance is defined as achievement in different lessons by students and their appropriate performance in society and life

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based on the learned subjects.<sup>[2]</sup> Academic performance means the outcome of a person's attempts concerning the activities in formal education so that all of the efforts of the educational system focus on this phenomenon. As a dependent variable, academic performance is influenced by various factors.<sup>[3]</sup> In this case, Biggs believes that learning is affected by a sophisticated system, which includes components of the learning situation and individual abilities. According to this viewpoint, Biggs proposed the 3P (presage, process, and product) model to anticipate academic performance.<sup>[4]</sup> The component of presages includes two dimensions of factors related to the learner (prior knowledge, ability, and preferred approaches to learning), and factors related to teaching contexts (learning climate, teaching methods, and evaluation). Processes concentrate on learner's activities and current approaches to learning that are obtained from the interaction between learner's characteristics and educational situation. Learning outcomes point to what the learner presents as the results of participation in an educational course.<sup>[5]</sup> According to Biggs' model, learning outcomes are determined by the process used by the learners. It means learners' preferred approaches to learning are related to assessment performance due to behaviors existing in the learning process. In other words, what happens in the learning process can justify the relationship between presage and outcome. Accordingly, the current studies are done to refocus on learning processes instead of outcomes.<sup>[6]</sup> Various factors are affecting the academic performance of learners; studying approaches are one of the most important factors that have been highlighted in studies conducted by international researchers.<sup>[7]</sup> There are new approaches to educational objectives and teaching processes that have changed the traditional education objectives of reading and writing by focusing on substantial goals such as creative thinking, problem-solving, lifelong learning, information literacy, and familiarity with ICT. Learning approaches are concerned with how to target and select appropriate strategies for learning, and in fact, refer to deep and superficial tendencies in dealing with the curriculum. Therefore, universities and higher education centers should always review their students' learning approaches and, by considering the factors influencing students' tendencies to each of the learning approaches, direct their educational policies and methods in order to encourage students to take desirable approaches. In this case, processes and approaches to studying, and contexts of information receiving and processing, should be deepened considering how information process is received and processed. Such consideration finally is manifested in the form of learning and academic achievement.<sup>[8]</sup> One of the options that direct us toward appropriate learning is searching about methods and approaches to studying and its association with academic

achievement. Approaches to studying are habitual and distinctive behaviors done to acquire knowledge, skill, and attitude through the studying process preferred by learners as a method to learn lessons. Learners improve these approaches by facilitating the learning process and academic performance.<sup>[9]</sup> The purpose of the deep approach is to comprehend. Corresponding strategies to this approach include making a relation between ideas and using evidence. The dominant motivation in this approach is interest in innovative ideas.<sup>[10]</sup> The learners, who choose a deep approach, are interested in the lesson content, have an inner motivation, and try to enhance their understanding of subjects. They are interested in doing tasks and emphasize the implicit meanings of words instead of verbal meanings by using proper strategies. Such learners look for coherence between details of tasks and the connection between tasks. In the deep approach, the tendency for meaning extraction leads to an active learning process that includes relating ideas and seeking principles and patterns (holistic viewpoint). On the other hand, a deep approach comprises using evidence and logic test on the discussion. This approach also includes monitoring the development of individual perception.<sup>[11]</sup> In the surface approach, learner tends to memorize and recreate the existing realities without concentrating on facts cohesions and creating or discovering new relations between learned concepts. Compared to the deep approach, the surface approach does not have a dynamic and reproductive aspect. This approach is full of surface and trivial strategies such as memorizing and reviewing with external motivation. This approach considers the syllabus as separate units of information that should be memorized to answer the possible questions. Therefore, the surface approach leads to invaluable learning processes and bounded processing.<sup>[12]</sup> The strategic approach is determined by the tendency to obtain the highest score through time organizing, attempt distribution to have the highest effect, providing materials and conditions for appropriate studying, using previous tests to predict questions, and being alert to find some signs of scoring program.<sup>[13]</sup> This approach also includes monitoring the effectiveness of personal study and alertness to the assessment process, and some aspects such as metacognitive alertness and self-regulation. It is stated that strategic learners have two attention centers, including academic content and assessment system requirements. Interest in the content is a kind of deep approach, while alertness to the assessment system is a strategy.<sup>[14]</sup> The concept of learning approaches has appeared in all three levels of learning models. At the presage level, this concept points to how every learner looks toward the teaching context differently. At the process level, the learning approach includes behaviors of learners shown during learning. At the outcome level, learning approaches point to the

effects of assessment on learning strategies.<sup>[15]</sup> On the other hand, problem-solving is a student-focused educational strategy in which students analyze educational issues and reflect on their experiences in partnership. The professor and students are responsible partners in the teaching-learning process, and learning approaches of learners are ways to achieve and accelerate problem-solving by medical students. Like reasoning, problem-solving is a crucial part of daily life. Therefore, it is essential in teaching to identify learning methods used by learners.<sup>[16]</sup> Problem-solving is a critical skill for living in the current era. Most communities believe that problem-solving skills should be improved. Like other people, medical students are not exceptions to this rule. Caregiving requires knowledge, skill, and expertise and problem-solving ability is the core of effective performance. Patients are continuously facing problems in the clinical environment, while many medical students enter this environment without being able to identify the problem or plan to solve it.<sup>[17]</sup> Problem-solving skills are specific purposeful activities enabling a person to define and solve a problem successfully. This component includes four steps: defining and formulating the problem, creating alternative solutions, decision-making, and adjusting solution (ability to evaluate solutions and coping responses effectively) that have been named as problem-solving steps by some authors. All of these purposeful and skillful activities play a vital role in discovering and creating an adaptive coping response to problematic situations.<sup>[18]</sup> When a learner faces a situation, in which he/she cannot deal with it immediately by using his/her available information or skills, or if he/she has not found a solution to achieve a goal, the learner faces a problem. According to the definition of the problem, problem-solving can be defined as identifying and applying the knowledge and skills leading to the correct solution found by the learner to achieve his/her goal. As an excellent mental activity, problem-solving is a kind of learning. Therefore, learning how to solve a problem leads to the acquisition of new knowledge and skills. Similarly, other kinds of learning bring new knowledge and skills.<sup>[19]</sup> Problem-solving is a complicated cognitive skill that requires a higher level of information processing compared to other cognitive procedures and indicates a smart human activity.<sup>[20]</sup> According to Gagne, problem-solving is higher-order learning. The learner creates higher-order rules by synthesizing simple rules, which leads to problem-solving. Therefore, previous learnings, particularly the previous rules or principles learned by the individual, should be combined in problem-solving.<sup>[21]</sup> Therefore, it can be stated that a person's type of approach to learning can improve his/her problem-solving skill. Cassidy and Long considered six problem-solving styles including helplessness, problem-solving control, problem-solving confidence, avoidance style, approach style, and creative

problem-solving style. The creative problem-solving style indicates planning and considering various solutions based on the problematic situation. Problem-solving confidence style implies belief in an individual's ability to solve problems. The approach style shows a positive attitude toward problems and a tendency to cope with them. The helplessness style expresses an individual's helplessness in a problematic situation. The problem-solving control style points to the impact of internal and external controllers in problematic situations. Finally, the avoidance style shows a tendency to ignoring problems instead of coping with them. The three first styles (creative, confidence, and approach) are called constructive problem-solving methods and the second three styles (helplessness, control, and avoidance) are named nonconstructive problem-solving methods. Constructive methods are associated with some constructs such as life satisfaction, positive affection, achievement motivation, and social support, while nonconstructive methods are related to variables of anxiety, depression, disappointment, hostility, and job stress.<sup>[22]</sup> Considering the importance of the academic performance level of medical students and the research gap in Iran's University, this study was conducted to examine medical students' approaches to learning and its association with academic performance and problem-solving styles among medical students of Iran University of Medical Sciences.

## Materials and Methods

### Study design and setting

This study was a quantitative study in terms of nature and applied research in terms of objective, and a descriptive-correlational study in terms of methodology. In terms of time, this is a cross-sectional study and correlational research in terms of the relationship between variables.

### Study participants and sampling

The statistical population comprised all medical students of Iran University of Medical Sciences during the academic year of 2019–2020. According to the Cochrane formula, 168 subjects were selected using simple random sampling.

### Data collection tool and technique

#### *Approaches and Study Skills Inventory for Students*

This questionnaire was developed by the Center for Research on Learning and Instruction at the University of Edinburgh in 1997. This inventory measures three deep, surface, and strategic approaches. This questionnaire uses the Likert scale to assess attitude asking respondents to record their agreement on a five-point scale (strongly agree: 5, agree: 4, no idea: 3, disagree: 2, and strongly disagree: 1). The sum of

responses provides a scale score for each construct. Factor analysis was used in the original version to determine the validity of the questionnaire. Results confirmed the existence of the mentioned approaches.<sup>[23]</sup> Baniasadi and Pourshafei (2012) calculated Cronbach’s alpha coefficients of 0.67, 0.57, and 0.67 for deep, surface, and strategic approaches, respectively. The reliability coefficient of the retest equaled 0.67, 0.73, and 0.67, respectively. In the present study, the reliability of this scale equaled 0.81 using Cronbach’s alpha.

### Problem-Solving Style Questionnaire

This questionnaire was developed by Cassidy and Long. This questionnaire consists of 24 items that assess 6 factors. Respondents answer the items with yes and no. The factors included helplessness, problem-solving control, creative style, problem-solving confidence style, avoidance style, and approach style. The styles of creative, problem-solving confidence, and approach are called constructive methods, and styles including helplessness, problem-solving control, and avoidance are named nonconstructive problem-solving methods. These two measures consist of 12 items with minimum and maximum scores of 0–12 in two constructive and nonconstructive problem-solving styles. Taheri and Karami obtained a reliability value of 0.85 for this questionnaire. Cassidy, who is the designer of this tool, calculated a new validity value of 0.80 for it. The reliability value of this questionnaire equaled 0.84 using Cronbach’s alpha.

The approved proposal was implemented after getting permission from the Ethics Committee of the university. After obtaining the required permissions, sampling steps were done and data were collected. The quantitative data were analyzed using normality tests, mean, Pearson correlation coefficient, paired *t*-test, and regression through SPSS 16.0 software. (IBM Corp, Newyork, USA) and  $P < 0.05$  was considered as statistically significant, were used for data analysis.

### Ethical consideration and inclusion criteria

Obtaining the permission from the Ethics Committee of the university, medical student studying at medical faculty of Iran’s University of Medical Sciences, informed consent and willingness for participation in the study, and being higher than the 2<sup>nd</sup> semester. The code of ethics was obtained from the Ethics Committee Vice Chancellor for Research & Technology at Iran University of Medical Sciences (IR.IUMS.REC.1398.1152).

### Exclusion criteria

Noncooperation, no tendency to participate in the study, incomplete questionnaire, and guest students.

## Results

The data collected from the questionnaire and frequencies of respondents were examined based on the personality traits reported in Table 1. Table 1 indicates the demographic variables of research subjects. The age average of students was equal to  $23 \pm 4.16$ . Table 2 reports the mean and standard deviation of research variables; accordingly, the deep approach had a higher mean value compared to other approaches to learning. On the other hand, constructive factors had higher mean values among problem-solving styles. According to the normality test on the obtained data and the *P* value of these tests [Table 2], relevant research variables had a normal distribution. Hence, parametric tests were used for variables. As shown in Table 3, there is no significant difference between girls and boys regarding learning approaches ( $P > 0.001$  and  $P = 0.141$ ). However, there is a significant difference between these groups regarding problem-solving styles ( $P < 0.001$ ). According to Table 4, among approaches to learning, the deep approach had the highest correlation with academic performance (students’ grade point average [GPA]), and the strategic approach was ranked as the second approach with a minor difference. Moreover, finally, the surface approach showed the lowest correlation with academic performance. Data of Table 4 show that among learning approaches, deep approaches had

**Table 1: Demographic variables of respondents**

Variable	Frequency (%)
Gender	
Male	73 (0.43)
Female	95 (0.57)
Age	
>20	12 (0.7)
20-24	101 (0.60)
24-28	39 (0.23)
<28	16 (0.10)
Grade	
Basic sciences	30 (0.18)
Internship	59 (0.35)
Interne	79 (0.47)

**Table 2: Mean and standard deviations of variables normality test for the main research variables**

Variable	Mean±SD	Kolmogorov–Smirnov Z	P
Deep approach	3.89±2.36	2.408	0.133
Surface approach	2.74±2.83	2.319	0.117
Strategic approach	3.86±2.21	2.529	0.216
Constructive factors	3.29±2.14	2.148	0.202
Nonconstructive factors	3.17±2.09	2.761	0.136
Term average	17.04±1.91	-	-
Total average	16.22±2.08	-	-

SD=Standard deviation

the highest correlation with constructive measures of problem-solving styles (creativity, problem-solving confidence, and approach), then strategic approach was ranked as the second one with a minor difference, and ultimately, the surface approach had the lowest correlation with constructive agents of problem-solving styles. Besides, the abovementioned correlation was also observed regarding nonconstructive factors including helplessness, problem-solving control, and avoidance. To examine learning approaches dimensions' prediction of academic performance, simultaneous regression was employed. First, statistical presumptions of this test were tested by using statistical data. Results showed that the regression test assumptions were observed. Table 5 presents regression coefficients to predict the academic performance of medical students based on the dimensions of approaches to learning. Coefficient of determination ( $R^2$ ) indicates that 39% of the variance of academic performance is predictable based on the dimensions of learning approaches. Furthermore, beta coefficients show that a deep approach (0.49), a strategic approach (0.42), and a surface approach (0.11) affected academic performance. Regression coefficients were presented to predict problem-solving styles based on the dimensions of learning approaches. Coefficient of determination ( $R^2$ ) indicates that 28% of the variance of problem-solving styles is predictable based on the dimensions of learning approaches. Furthermore, beta coefficients show [Table 5] that surface approach (0.19), deep approach (0.38), and strategic approach (0.31) affected problem-solving styles (constructive factors). Regression coefficients were presented to predict problem-solving styles (nonconstructive factors) based on the dimensions of learning approaches. Coefficient of determination ( $R^2$ ) indicates that 12% of the variance of problem-solving styles (nonconstructive factors) is predictable based on the dimensions of learning approaches. Furthermore, beta coefficients in Table 5 show that surface approach (0.12), deep approach (0.19),

and strategic approach (0.17) affected problem-solving styles (nonconstructive factors). Data reported in Table 6 indicated no significant difference between the two studied groups regarding learning strategies, and these groups had almost equal mean values. Data reported in Table 6 showed a significant difference between the two studied groups regarding problem-solving styles. Therefore, it can be argued that gender is one substantial variable affecting problem-solving styles. Hence, the research hypothesis was confirmed. According to this table, boys had higher mean values of problem-solving styles compared to girls. Hence, there was a significant difference between the two variables of gender and problem-solving styles.

### Discussion

Academic performance means the outcome of individuals' efforts regarding formal education activities so that all attempts of the educational system are subject to this phenomenon. As an independent variable, academic performance is affected by various factors. Studies on university students' approaches to learning are beneficial references to improve the teaching and learning process in the university. While students receive a wide range of educational services during several years at the university, such a continuous need for higher educations should be met by examining factors affecting the improvement of educational service quality. The definition of a university mission to train life-lasting and self-motivation learners has changed the focus of higher education programs from the teacher to the student. Therefore, it is essential to scrutinize effective and driving agents of self-study in students. Because of the interpretative nature of learning approaches to learning status that include incentive and self-regulation structures and because learning approaches lead to different outcomes, they are procedural variables affecting self-motivated learning. Hence, these factors must be studied. As an excellent mental activity, problem-solving is a kind of learning. Therefore, learning how to solve a problem requires the acquisition of new knowledge and skills as other kinds of learning lead to the acquisition of new knowledge and skills.<sup>[24]</sup> Some skills such as observation, comparison, information organizing, determining and controlling variables, designing and testing hypotheses, analysis, inference, evaluation, and judgment are improved in the problem-solving method.<sup>[25]</sup> Mahmoodzadeh *et al.*

**Table 3: Comparison of learning approaches and problem-solving approaches based on gender**

Variable	Gender, frequency (%)		P
	Male	Female	
Surface approach	16 (0.22)	20 (0.21)	0.141
Deep approach	28 (0.38)	34 (0.36)	
Strategic approach	29 (0.40)	41 (0.43)	
Constructive factors	49 (0.67)	45 (0.47)	0.001
Nonconstructive factors	24 (0.33)	50 (0.53)	

**Table 4: Pearson correlation matrix between learning approaches and academic performance and problem-solving styles**

Variables	Academic performance	P	Constructive factors	Nonconstructive factors	P
Deep approach	0.538	0.001	0.574	0.469	0.001
Surface approach	0.212		0.263	0.168	
Strategic approach		0.522	0.548	0.483	

**Table 5: Predicting student’s academic performance, type of problem-solving styles (constructive factors and nonconstructive factors) based on learning approaches (linear regression)**

Model	B	SE	$\beta$	T	P	R	R <sup>2</sup>	F	P
Fixed coefficient	15.81	2.37	-	4.64		0.53	0.28	12.34	0.001
Surface approach	0.32	0.18	0.19	5.16	0.001				
Deep approach	0.21	0.25	0.38	4.55	0.001				
Strategic approach	0.27	0.19	0.31	5.39	0.001				
Fixed coefficient	9.53	1.88	-	7.23		0.48	0.39	19.61	0.001
Surface approach	0.18	0.16	0.11	6.31	0.001				
Deep approach	0.55	0.40	0.49	5.97	0.001				
Strategic approach	0.48	0.37	0.42	5.28	0.001				
Fixed coefficient	12.61	2.01	-	4.42		0.24	0.12	10.21	0.001
Surface approach	0.21	0.14	0.12	3.27	0.001				
Deep approach	0.26	0.16	0.19	3.31	0.001				
Strategic approach	0.25	0.10	0.17	4.88	0.001				

SE=Standard error

**Table 6: Results of t-test study strategies and problem-solving styles by gender**

Gender	Statistical indicators			
	Frequency	Mean±SD	SE	P
Male	73	79.15±10.36	1.46	0.325
Female	95	78.84±11.54	1.13	
Male	73	16.95±6.24	1.58	0.91
Female	95	12.56±7.51	1.28	

SD=Standard deviation, SE=Standard error

conducted a study entitled the relationship between dimensions of studying approaches and academic performance of students of Birjand University of Medical Sciences. Results showed a significant relationship between surface approach and academic performance so that surface approach could explain 6% of academic performance variable.<sup>[7]</sup> Kamari and Fouladchang found a positive and significant correlation between deep approach and academic performance. They also found a negative and significant correlation between surface approach and academic performance.<sup>[26]</sup> Rezaee (2016) carried out a study and concluded that there is a positive association between the strategic approach to learning and academic performance of students while there is a negative and significant association between surface approach and academic performance.<sup>[6]</sup> Roshanaee found a positive and significant relationship between deep approach and preference for comprehension and a significant association between surface approach and preference for information representation.<sup>[27]</sup> Shokri *et al.* found an association between learning approaches and academic performance that was significant regarding the surface learning approach.<sup>[28]</sup> Shahrabadi *et al.* carried out a study entitled “the relationship between learning and studying approaches and academic performance of students of Rafsanjan University of Medical Sciences,” in which mean value and standard deviation of deep approach were significantly greater than the surface approach to learning. On the other hand, there was a positive and

direct relationship between deep approach and GPA as well as a negative and reverse relationship between surface approach and GPA. The deep approach was the most substantial predictor of GPA. It means one-unit increase in deep approach led to a 0.28 increase in GPA rate. In all fields, the mean value of students’ deep approaches was greater than their surface approach. This study introduced a deep approach as the predictor of learning outcomes of students of Rafsanjan University of Medical Sciences.<sup>[29]</sup> Rastjoo *et al.* found a positive and significant correlation between deep and strategic approaches and academic performance; they also obtained a negative and significant correlation between surface approach and academic performance.<sup>[30]</sup> Bhat concluded that learning styles of learners influence their problem-solving ability so that learners who use engaging learning styles are more capable of problem-solving compared to the application of other styles.<sup>[31]</sup> According to behaviorists, learners collect their previous lessons related to the new problem to solve it based on the shared elements between the new problem and previous problems. If such experiences are not applicable for problem-solving, then learners will deal with trial and error and examine solutions one after another to solve the problem based on one of the solutions. According to this viewpoint, problem-solving is a kind of learning with a gradual process.<sup>[32]</sup> Proponents of the metacognitive theory argue that metacognitive procedures are involved in the central executive of the cognitive system, designing performance, reviewing, and regulating behaviors pertained to problem-solving.<sup>[33]</sup> The core assumption of constructivism is based on the activities done by the learner in the learning process. In other words, proponents of constructivism believe that learners can generate knowledge by acting and interacting with the external environment. In this case, Dewey’s thoughts have played a vital role in the problem-oriented approach to the teaching–learning process. According to Dewey, problem-solving is a

substantial method for education.<sup>[34]</sup> Constructivists emphasize the knowledge construction instead of generating, fostering thoughtful actions, participatory teaching and learning, paying attention to metacognition and self-regulation of learners, and problem-solving process. Deseth carried out a study entitled “personality and approaches to learning as factors affecting academic performance” and found a positive and significant relationship between deep approach and academic performance. However, there was no significant correlation between the surface approach to learning and academic performance.<sup>[23]</sup> Kim *et al.* also explained that the learning strategies used by medical students are related to their goal achievement.<sup>[35]</sup> Chen and Hu proved that a deep approach to learning is correlated to academic performance in designing the problem-oriented learning environment.<sup>[36]</sup> Hejazi *et al.* assume that the surface approach is projected based on task-transition learning; hence such an approach does not provide high academic performance.<sup>[37]</sup> Moreover, it can be argued based on the students’ use of a strategic approach that when the learning environment uses score as an incentive and learners compete with each other to achieve academic performance, then students adopt an approach, which is matched with the evaluation system leading to highest scores. In other words, GPA-based academic achievement is more motivational than meaningful studying and deep understanding for learners. Therefore, some processes such as study organizing, alertness to the evaluation system, and use of strategy – that is one of the features of strategic approach – are more considered because they show higher academic achievement and success. Problem-solving skills are one of the excellent actions of the mind, in which the person connects the previous experiences to the problem to discover their relationship and to adopt the best solution. Moreover, problem-solving skill is a systematic approach that enables a person to solve his/her living problems effectively. Educational environments should be organized for some goals of making students involved in problems instead of storing scientific truths in their minds. Such problems that are pertained to their lives because real-life-matched heuristic methods will make academic achievement more attractive and students will be more interested in learning. Furthermore, some studies indicate that certain forms of education and assessment motivate students to adopt more surface or deep approaches. For instance, Rose and Craik<sup>[38]</sup> and Clinton<sup>[39]</sup> introduced problem-oriented education and measurement of questions (open-ended comprehension) as incentive methods for a deep approach to learning.

### Limitation and recommendation

The innovation of the present study is due to the type the variables under consideration as well as the University of Iran as one of the prestigious universities

with international students. Learning approaches are a habitual and distinctive behavior in order to acquire knowledge, skills, and attitudes through study that learners prefer as a way to learn their curriculum to other methods, and these approaches facilitate the learning process, academic performance under affects.

The limitation of this study was that only one university was evaluated as a sample. It is recommended that all universities of the Ministry of Health and Medical Education be evaluated and that the questionnaire itself has an inherent limitation.

### Conclusion

Academic performance is a critical issue at the university that receives great attention from leaders, principals, and researchers. They tend to find factors affecting the academic performance or academic achievement of students and to what extent these factors are effective. It is generally believed that the improved quality of universities is directly related to the academic performance of students. Besides, academic performance is on top of educational development programs based on the examined utilities acquired by students during a specific period. Results implied a positive and significant association between deep and strategic approaches, problem-solving styles, and academic performance of medical students. Furthermore, there was no statistically significant difference between learning approaches regarding gender, but problem-solving styles were different based on the gender of students. Students’ approaches to learning form information processing, intention, and key elements of learning approaches theory. Now, each approach includes specific studying behaviors that are specified based on the studying objectives and processes for the learning task. Research results indicate that those students who use deep and strategic studying approaches show better academic performance compared to those who employ the surface approach because they study because of failure fear and memorize learning details without any coherence. Hence, professors should pave the way for students’ desire for such approaches by changing the learning environment and evaluation procedures. According to the results of the present paper, it is recommended to introduce learning styles and methods to university students and professors within educational courses. In this case, learning methods are determined, and proper strategy is employed for problem-solving. On the other hand, professors can use diagnostic examinations at the beginning of the semester to identify the learning styles of students and design the most appropriate and efficient education method. According to findings, it is suggested to emphasize learning and studying

approaches as well as problem-solving styles when designing educational contexts and contents for medical students.

### Ethics approval and consent to participate

The present paper was adopted from the research plan of the Research Center for Iran's University of Medical Sciences under the project code of 16618. This study was approved by the Ethical Review Board of Iran University of Medical Sciences (approval number: IR.IUMS.REC.1398.1152). All methods were carried out in accordance with relevant guidelines and regulations under the supervision of this committee. Informed consent was obtained from all participants. Participation in this study was voluntary. Furthermore, at any stage of the study, if they did not want to cooperate, they could leave the study.

### Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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### Conflicts of interest

There are no conflicts of interest.

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