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The Relationship Between Egypt's Post-Reform Educational Climate and Medical Students' Learning Approaches: A National Cross-Sectional Study

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Introduction The educational climate profoundly shapes student learning. Following Egypt's 2017 medical education reform, little is known about the current learning environment or its influence on student approaches. This study examined the relationship between the educational climate and learning approaches among Egyptian medical students.

Methods A cross-sectional study was conducted from December 2024 to March 2025 using convenience sampling across universities in Egypt's seven regions. Students' deep and surface learning approaches were measured with the Revised Two-Factor Study Process Questionnaire (R-SPQ-2F), and perceptions of the educational climate were assessed using the Educational Climate Inventory (ECI). Multiple linear regression identified factors associated with students' learning approaches.

Results A total of 1,752 students participated (mean age 20.9 years; 55.7% female). Only 31.3% received study guidance, while 80.4% felt exams prioritize recall over critical thinking, and 85.5% saw education as entirely memorization-based. Higher deep learning scores were associated with receiving formal study guidance ($B = 1.29, p < .001$), a perceived climate valuing the Centrality of Learning and Mutual Respect ($B = 0.19, p < .001$), and greater perceived Competitiveness and Stress ($B = 0.12, p = .046$). In contrast, a perceived climate of Passive Memorization was associated with lower deep learning ($B = -0.21, p = .013$). Higher surface learning scores were associated with a perceived climate of Passive Learning and Memorization ($B = 0.26, p < .001$), while a climate valuing Centrality of Learning and Mutual Respect was linked to lower surface learning ($B = -0.16, p < .001$).

Conclusion A supportive educational climate that values meaningful learning is associated with deeper learning approaches, whereas recall-driven environments promote surface learning. Reducing memorization-focused assessments and

implementing guided learning may foster more effective learning approaches among medical students.

Keywords Medical education · Learning approaches · Educational climate · Medical students · Egypt

Introduction

Medical education is often characterized by the extensive study hours students must dedicate to meet both the rigorous demands of medical school and the rapidly expanding body of medical knowledge. In response to evolving educational needs, medical curricula worldwide have shifted in recent years from traditional lecture-based instruction toward integrated curricula and competency-based medical education (CBME) [1]. This shift, recently implemented in Egypt as well [2], seeks to develop not only what students know but, more importantly, their capacity to translate that knowledge into practice. However, achieving the intended outcomes of integrated curricula and competencies outlined in CBME depends largely on the quality and depth of students' learning processes, as different approaches to learning are shown to yield markedly different outcomes [3].

In 1976, Marton and Säljö distinguished between two contrasting approaches to learning: the deep and the surface approaches [4]. A deep approach reflects a learner's intention to understand new knowledge meaningfully by connecting ideas and building coherent understanding. In contrast, a surface approach is characterized by rote memorization and recall of information, often focused on passing examinations rather than developing genuine understanding [5]. Numerous studies among medical students have since associated deep learning with superior diagnostic reasoning and greater knowledge retention [6, 7], whereas surface learning has been associated with poorer academic outcomes and reduced ability to transfer foundational knowledge to real clinical problem-solving contexts [6, 8]. Accordingly, this learning approach distinction is particularly relevant in medical education where learning is cumulative, and a superficial grasp of earlier material can undermine clinical reasoning and the development of long-term competence [9, 10].

Building on the deep–surface distinction, Biggs proposed the 3P model of learning which conceptualizes learning as a dynamic and reciprocal interaction among Presage, Process, and Product [11, 12]. In this framework, student characteristics and contextual factors (presage) influence the approach students adopt (process), which in turn shapes the quality of learning outcomes (product). Among these presage factors, the educational climate has been shown to significantly influence how students experience and respond to study demands, thereby shaping the learning approaches they adopt [13].

The relationship between learning approaches and the perceived academic environment was first empirically established by Ramsden and Entwistle [14], who found a strong association between students' perceptions of a heavy academic workload and their adoption of a surface studying approach. Subsequent research in medical education has consistently demonstrated similar patterns. For instance, in a cross-sectional study among Norwegian medical students, perceiving an excessive workload was significantly associated with higher surface approach scores [15]. In contrast, a multicenter European study found that students' perceptions of student-centered teaching emphasizing long-term understanding positively predicted deep learning approaches and negatively predicted surface approaches [16]. Moreover, the study reported that integrated lecture-based curricula fostered deeper learning compared to traditional formats. Consistent with these findings, a cross-sectional study in Egypt comparing medical students enrolled in the newly implemented integrated system with those in the traditional system found that the former reported significantly higher perceptions of learning and greater learning motivation [17].

However, despite the recent adoption of CBME and integrated curricula in Egypt, several challenges continue to shape the Egyptian medical education climate and may, in turn, influence the learning approaches adopted by students [2]. Since the 2018 reform, both the number of medical schools and enrolled students have nearly doubled, yet this expansion has not been matched by proportional growth in teaching hospitals or faculty capacity, raising concerns about the quality of learning experiences provided [18]. Despite this, research assessing the post-reform Egyptian medical education climate is limited and has mostly utilized the Dundee Ready Education Environment

Measure (DREEM) to evaluate students' perceptions [17, 19, 20]. However, as Krupat et al. argue, instruments such as the DREEM assess the learning environment broadly but may overlook the specific dimensions of the educational climate that directly influence learning approaches [21].

In response to this limitation, Krupat et al. developed the Educational Climate Inventory (ECI) [21], an instrument designed to assess whether the learning environment emphasizes mastery and collaboration or performance and competition, drawing on Carol Dweck's mastery versus performance orientation model [22]. Utilizing this instrument alongside Biggs' well-established Revised Two-Factor Study Process Questionnaire (R-SPQ-2F) [23], which measures students' surface and deep learning approaches, may provide a theoretically grounded understanding of how the post-reform Egyptian educational climate shapes students' learning approaches. In this light, this study aims to investigate the relationship between the perceived educational climate and students' approaches to learning within the context of Egypt's recent medical education reforms. Specifically, we first seek to describe the prevailing educational climate and the learning approach profiles among medical students in Egypt. Next, we aim to examine factors associated with learning approaches, including the educational climate.

Methods

Study design and period

A descriptive cross-sectional study with an analytical component was conducted from December 2024 to March 2025. This study followed the STROBE guidelines for reporting observational studies [24].

Target population and settings

The study sample consisted of first to fifth year medical students from seven public universities across Egypt. To minimize bias and ensure a proper representation of the medical student population in Egypt, one university was included from each of Egypt's seven regional units [25] according to the availability of collaborators. The universities included in the study, categorized by region, were: Alexandria University (Alexandria

region), Cairo University (Greater Cairo region), Suez Canal University (Suez Canal region), Mansoura University (Delta region), Minia University (North Upper Egypt region), Assiut University (Central Upper Egypt region), and Sohag University (Southern Upper Egypt region).

Sample size

The sample size was calculated using the `samplingbook` package [26] in R [27]. The R-SPQ-2F yields scores ranging from 10 to 50 for each of the two main approaches. To estimate the standard deviation, the range (40) was divided by 4, adhering to the range rule of thumb, resulting in a standard deviation of 10. Considering a 95% confidence level, a margin of error of 1, and a standard deviation of 10, a sample size of 385 was calculated. Assuming a design effect of 4, the targeted sample size was 1,540. A total of 1,782 students completed the questionnaire; after data cleaning, the final analytic sample was 1,752.

Sampling method and data collection approach

A convenience sampling approach was used in data collection. Students participated in the study by answering the questionnaire online on the FormNX form hosting platform. These forms were sent to official channels and groups on Telegram and other social media platforms of the selected Egyptian medical schools. At least one author took charge of collecting data from each university, disseminating the questionnaire in official groups for all academic years, guaranteeing extensive reach, and making it accessible to all students. Participants were able to answer the questions freely and anonymously. They were also able to view their learning approaches scores after submitting the form.

Study questionnaire

The questionnaire collected sociodemographic data including age (in years), sex, academic year, and residence. Participants were also asked whether they had received formal guidance on how to study.

The R-SPQ-2F was used to measure students' learning approaches [23]. The R-SPQ-2F consists of 20 items rated on a 5-point Likert scale (1 = Never true of me to 5 = Always true of me). The scale yields two main scores: Deep Approach and Surface

Approach, each comprising 10 items. Each approach is further divided into two subscales, Motive and Strategy, containing 5 items each. Higher scores on the Deep Approach indicate a more intrinsic and meaningful engagement with learning, while higher Surface Approach scores reflect a more rote, performance-focused learning style. The scale has demonstrated acceptable internal consistency, with Cronbach's alpha values of 0.737 for the Deep Approach and 0.746 for the Surface Approach among Saudi medical students [28].

Medical students' perceptions of the educational climate were assessed using the ECI [21]. The ECI consists of 20 items rated on a 4-point Likert scale (1 = Strongly Agree to 4 = Strongly Disagree), with negatively worded items reverse-coded so that higher scores consistently reflect a more mastery-oriented learning environment. The scale is divided into three subscales: Centrality of Learning and Mutual Respect (10 items), Competitiveness and Stress (6 items), and Passive Learning and Memorization (4 items). The ECI was developed based on Dweck's framework of performance vs. learning orientation [22] and has demonstrated strong internal consistency, with Cronbach's alpha values of 0.88, 0.80, and 0.71 for the three subscales respectively, and 0.95 for the overall scale.

Statistical Analysis

Statistical analysis was performed using R [27]. Categorical data were presented as frequencies and percentages, whereas continuous data were presented as means and standard deviations (SD). Pearson's correlation coefficients were calculated to examine linear relationships between the R-SPQ-2F and ECI scores. Univariable and multivariable linear regression models were used to identify factors associated with deep and surface learning approach scores. Within these models, unstandardized coefficients (B) and their 95% confidence intervals (CI) were calculated. A p-value < 0.05 was considered statistically significant.

Results

Participant demographics

A total of 1,752 medical students in Egypt were included in the study. The mean age of participants was 20.9 years (SD = 1.8). The majority of students were female (55.7%), resided in urban areas (75.3%), and were from the Central Upper Egypt region university (22.8%). Only 31.3% of participants reported receiving formal guidance on how to study. The demographic characteristics are detailed in Table 1.

Table 1. Demographic characteristics of medical students in Egypt (N = 1,752)

Variable	Overall¹
Age (years)	20.9 (1.8)
Academic year	
1st year	334 (19.1%)
2nd year	366 (20.9%)
3rd year	284 (16.2%)
4th year	340 (19.4%)
5th year	428 (24.4%)
Sex	
Female	976 (55.7%)
Male	776 (44.3%)
Residence	
Urban (City)	1,319 (75.3%)
Rural (Countryside)	433 (24.7%)
Region	
Central Upper Egypt	400 (22.8%)
Greater Cairo	360 (20.5%)
Alexandria	266 (15.2%)
Southern Upper Egypt	250 (14.3%)
Delta	225 (12.8%)
North Upper Egypt	160 (9.1%)
Suez Canal	91 (5.2%)
Received formal guidance on how to study	
No	1,204 (68.7%)
Yes	548 (31.3%)

¹Mean (SD); n (%)

Learning approaches and educational climate scores

As shown in Table 2, deep and surface approach scores were comparable, with mean totals of 27.3 ± 7.1 and 26.2 ± 7.3 , respectively. The educational climate was perceived as highly stressful (mean 18.5 ± 3.1 ; 77.1% of total score) and passive (mean $12.9 \pm$

2.4; 80.6% of total score), whereas centrality of learning and mutual respect was lower (mean 23.6 ± 6.8 ; 59.0% of total score). Pearson correlation analysis (Table 3) details the associations observed between learning approaches and educational climate measures. Notably, there was a significant positive correlation between the total deep approach and total ECI ($r = 0.25$, $p < 0.001$) and a significant negative correlation between the total surface approach and total ECI ($r = -0.23$, $p < 0.001$). Additionally, a negative correlation was observed between deep and surface approaches ($r = -0.29$, $p < 0.001$).

Table 2. Descriptive statistics of R-SPQ-2F and ECI among medical students in Egypt (N = 1,752)

Scale	Item	Mean (SD)	95% CI	Range
R-SPQ-2F	Deep Motive	14.1 (4.0)	13.9, 14.2	5 - 25
	Deep Strategy	13.2 (3.9)	13.0, 13.4	5 - 25
	Total Deep Approach	27.3 (7.1)	26.9, 27.6	10 - 50
	Surface Motive	11.9 (4.2)	11.7, 12.1	5 - 25
	Surface Strategy	14.4 (3.9)	14.2, 14.5	5 - 25
	Total Surface Approach	26.2 (7.3)	25.9, 26.6	10 - 50
ECI	Centrality of Learning and Mutual Respect	23.6 (6.8)	23.3, 24.0	10 - 40
	Competitiveness and Stress ¹	18.5 (3.1)	18.3, 18.6	6 - 24
	Passive Learning and Memorization ¹	12.9 (2.4)	12.8, 13.0	4 - 16
	Total ECI	42.3 (9.6)	41.8, 42.7	20 - 75

¹The score for this subscale was reversed when calculating the Total ECI score

Abbreviations: CI = Confidence Interval, R-SPQ-2F = Revised Two-Factor Study Process Questionnaire, ECI = Educational Climate Inventory

Table 3. Pearson correlation matrix for R-SPQ-2F and ECI scales and subscales among medical students in Egypt (N = 1,752)

Variable	1	2	3	4	5	6	7	8	9	10
1. Total Deep Approach										
2. Deep Motive	0.91***									
3. Deep Strategy	0.90***	0.64***								
4. Total Surface Approach	-0.29***	-0.28***	-0.24***							
5. Surface Motive	-0.32***	-0.32***	-0.25***	0.91***						
6. Surface Strategy	-0.20***	-0.18***	-0.19***	0.90***	0.63***					
7. Total ECI	0.25***	0.22***	0.23***	-0.23***	-0.21***	-0.20***				

8. Centrality of Learning and Mutual Respect	0.26***	0.24***	0.24***	-0.22***	-0.23***	-0.18***	0.88***		
9. Competitiveness and Stress	-0.06*	-0.04	-0.06*	0.07**	0.04	0.09***	-0.61***	-0.21***	
10. Passive Learning & Memorization	-0.16***	-0.14***	-0.16***	0.17***	0.14***	0.18***	-0.70***	-0.39***	0.54***

*p < 0.05; **p < 0.01; ***p < 0.001

Abbreviations: R-SPQ-2F = Revised Two-Factor Study Process Questionnaire, ECI = Educational Climate Inventory

Differences in learning approaches by educational climate

Analysis of ECI items (Table 4) showed significant differences in learning approach scores based on student perceptions. Students who agreed that their school focuses on "discovery and the excitement of inquiry" had significantly higher deep approach scores (29.7 vs. 26.0, $p < 0.001$) and lower surface approach scores (24.5 vs. 27.1, $p < 0.001$) compared to those who disagreed. Conversely, agreement with the statement that education is "all about memorizing as much content as you can" was associated with lower deep scores (26.9 vs. 29.2, $p < 0.001$) and higher surface scores (26.5 vs. 24.7, $p < 0.001$).

Table 4. Differences in surface and deep learning approach scores across Educational Climate Inventory (ECI) items among medical students in Egypt (N = 1,752)

Item ¹	n (%)	Surface Approach Score ²	p-value ³	Deep Approach Score ²	p-value ³
In this medical school, we focus on a sense of discovery and the excitement of inquiry.			<0.001		<0.001
Agree	600 (34.2%)	24.5 (6.6)		29.7 (7.3)	
Disagree	1,152 (65.8%)	27.1 (7.4)		26.0 (6.7)	
I often get valuable and supportive advice from faculty on how to improve.			<0.001		<0.001
Agree	797 (45.5%)	25.1 (6.7)		28.8 (7.3)	
Disagree	955 (54.5%)	27.2 (7.6)		26.0 (6.7)	
Most faculty here are deeply interested in the welfare of their students.			<0.001		<0.001

Agree	622 (35.5%)	25.0 (6.9)	28.8 (7.2)	
Disagree	1,130 (64.5%)	26.9 (7.4)	26.4 (6.9)	
When you make an error here, it is seen as an opportunity for learning and growth.			<0.001	<0.001
Agree	1,040 (59.4%)	25.3 (6.8)	28.2 (7.1)	
Disagree	712 (40.6%)	27.6 (7.7)	25.9 (6.9)	
The faculty care about how I think, not simply about whether I get the right answer.			<0.001	<0.001
Agree	683 (39.0%)	25.2 (6.5)	28.6 (7.1)	
Disagree	1,069 (61.0%)	26.9 (7.6)	26.4 (7.0)	
Students here are encouraged to embrace uncertainty rather than be afraid of it.			<0.001	<0.001
Agree	849 (48.5%)	25.2 (6.8)	28.1 (7.2)	
Disagree	903 (51.5%)	27.3 (7.5)	26.5 (7.0)	
There is a great deal of trust and respect between students and faculty here.			<0.001	<0.001
Agree	1,020 (58.2%)	25.4 (7.0)	27.9 (7.1)	
Disagree	732 (41.8%)	27.4 (7.4)	26.4 (7.0)	
Faculty and students here see themselves as partners in learning.			<0.001	<0.001
Agree	931 (53.1%)	25.1 (6.9)	28.5 (7.0)	
Disagree	821 (46.9%)	27.6 (7.4)	25.9 (7.0)	
Faculty here are more interested in building up students' confidence rather than tearing them down.			<0.001	<0.001
Agree	817 (46.6%)	25.4 (6.9)	28.3 (7.1)	
Disagree	935 (53.4%)	27.0 (7.5)	26.3 (7.0)	
The faculty here react well when students question or challenge them.			<0.001	0.008
Agree	1,045 (59.6%)	25.6 (7.1)	27.6 (7.1)	
Disagree	707 (40.4%)	27.2 (7.4)	26.7 (7.0)	
The atmosphere here is highly competitive.			0.008	0.13

Agree	1,500 (85.6%)	26.1 (7.3)	27.4 (7.1)		
Disagree	252 (14.4%)	27.3 (7.0)	26.7 (6.9)		
Around here you have to act confidently even if you have little idea what you are doing.			0.83	0.44	
Agree	1,364 (77.9%)	26.2 (7.1)	27.3 (7.0)		
Disagree	388 (22.1%)	26.3 (7.7)	27.0 (7.3)		
Most students worry more about how they did compared to their classmates than whether they mastered the material.			0.88	0.061	
Agree	1,517 (86.6%)	26.2 (7.3)	27.1 (7.1)		
Disagree	235 (13.4%)	26.3 (6.8)	28.1 (7.0)		
Faculty here tell us not to be competitive, then pit students against one another.			0.14	0.44	
Agree	1,060 (60.5%)	26.5 (7.3)	27.2 (7.2)		
Disagree	692 (39.5%)	25.9 (7.1)	27.4 (7.0)		
Faculty tell us they are concerned with our welfare, but then put us under great stress.			0.72	0.042	
Agree	1,533 (87.5%)	26.2 (7.2)	27.1 (7.1)		
Disagree	219 (12.5%)	26.4 (7.4)	28.2 (7.2)		
When students are having difficulties here, it is best if they hide these from anyone else.			<0.001	<0.001	
Agree	947 (54.1%)	27.1 (7.4)	26.7 (7.1)		
Disagree	805 (45.9%)	25.3 (7.0)	27.9 (7.0)		
Most of what we do here is focused on the passive transfer of knowledge.			<0.001	<0.001	
Agree	1,186 (67.7%)	26.9 (7.3)	26.5 (7.0)		
Disagree	566 (32.3%)	24.9 (6.9)	28.9 (7.1)		
Education here is all about memorizing as much content as you can.			<0.001	<0.001	
Agree	1,498 (85.5%)	26.5 (7.2)	26.9 (7.1)		
Disagree	254 (14.5%)	24.7 (7.5)	29.2 (7.0)		

The faculty tell us that they are interested in our thinking, but their tests suggest otherwise.			0.028	0.033
Agree	1,408 (80.4%)	26.4 (7.3)	27.1 (7.2)	
Disagree	344 (19.6%)	25.5 (7.1)	28.0 (6.7)	
The goal of most students here is to figure out what we will be tested on and to study that material.			0.10	0.11
Agree	1,604 (91.6%)	26.3 (7.3)	27.2 (7.1)	
Disagree	148 (8.4%)	25.4 (6.9)	28.1 (6.8)	

¹Agree = strongly agree and somewhat agree, Disagree = strongly disagree and somewhat disagree

²Mean (SD)

³Welch Two Sample t-test

Factors associated with deep learning approach

Multivariable linear regression analysis identified significant associations with the deep learning approach (Table 5). Male students demonstrated higher deep approach scores compared to females ($B = 1.09$; 95% CI = 0.46, 1.72). Students who received formal guidance on how to study also exhibited higher scores ($B = 1.29$; 95% CI = 0.62, 1.97). Regarding educational climate subscales, "Centrality of Learning and Mutual Respect" ($B = 0.19$; 95% CI = 0.14, 0.25) and "Competitiveness and sStress" ($B = 0.12$; 95% CI = 0.00, 0.24) were positively associated with deep scores. Conversely, "Passive Learning & Memorization" showed a negative association ($B = -0.21$; 95% CI = -0.37, -0.04). Higher surface approach scores were significantly associated with lower deep approach scores ($B = -0.24$; 95% CI = -0.29, -0.20).

Table 5. Linear regression analysis of Deep Approach scores among medical students in Egypt (N = 1,752)

Variable	Deep Approach Score ¹	Univariable regression		Multivariable regression ²	
		B (95% CI)	p-value	B (95% CI)	p-value
Academic year					
1st year	27.8 (7.5)	Reference		Reference	

2nd year	27.7 (6.9)	-0.07 (-1.12, 0.98)	0.90	0.57 (-0.43, 1.57)	0.26
3rd year	27.2 (7.6)	-0.54 (-1.66, 0.59)	0.35	-0.18 (-1.24, 0.89)	0.74
4th year	26.7 (7.0)	-1.08 (-2.15, -0.01)	0.048	-0.09 (-1.13, 0.95)	0.87
5th year	27.0 (6.7)	-0.72 (-1.74, 0.29)	0.16	0.08 (-0.91, 1.08)	0.87
Sex					
Female	27.0 (7.1)	Reference		Reference	
Male	27.6 (7.2)	0.55 (-0.12, 1.22)	0.11	1.09 (0.46, 1.72)	<0.001
Residence					
Urban (City)	27.4 (7.1)	Reference		Reference	
Rural (Countryside)	27.0 (7.1)	-0.38 (-1.15, 0.39)	0.33	-0.70 (-1.46, 0.05)	0.068
Region					
Central Upper Egypt	27.4 (7.0)	Reference		Reference	
Greater Cairo	26.7 (6.9)	-0.66 (-1.67, 0.35)	0.20	0.05 (-0.94, 1.03)	0.93
Alexandria	26.9 (7.4)	-0.50 (-1.60, 0.60)	0.37	-0.13 (-1.18, 0.91)	0.80
Southern Upper Egypt	27.3 (7.5)	-0.11 (-1.23, 1.01)	0.85	0.71 (-0.36, 1.78)	0.19
Delta	27.6 (7.3)	0.17 (-0.99, 1.33)	0.77	0.55 (-0.55, 1.65)	0.33
North Upper Egypt	27.9 (6.8)	0.45 (-0.86, 1.75)	0.50	1.00 (-0.23, 2.24)	0.11
Suez Canal	28.0 (6.5)	0.55 (-1.07, 2.17)	0.50	0.82 (-0.70, 2.34)	0.29
Received formal guidance on how to study					
No	26.7 (6.9)	Reference		Reference	
Yes	28.5 (7.4)	1.84 (1.13, 2.56)	<0.001	1.29 (0.62, 1.97)	<0.001
Surface Approach		-0.28 (-0.33, -0.24)	<0.001	-0.24 (-0.29, -0.20)	<0.001
Centrality of Learning and Mutual Respect		0.27 (0.23, 0.32)	<0.001	0.19 (0.14, 0.25)	<0.001
Competitiveness and Stress		-0.12 (-0.23, -0.02)	0.021	0.12 (0.00, 0.24)	0.046
Passive Learning & Memorization		-0.49 (-0.63, -0.35)	<0.001	-0.21 (-0.37, -0.04)	0.013

¹Mean (SD)

²R² = 0.147; Adjusted R² = 0.139; F(17, 1734) = 17.64, p < 0.001; Residual SD = 6.59

Abbreviations: B = Unstandardized Coefficient, CI = Confidence Interval

Factors associated with surface learning approach

Factors associated with the surface learning approach were analyzed using multivariable linear regression (Table 6). Male students were associated with higher surface scores (B = 2.00; 95% CI = 1.36, 2.63). Students in higher academic years showed lower surface scores compared to 1st-year students, specifically those in the 3rd year (B = -1.53; 95% CI = -2.61, -0.45), 4th year (B = -1.38; 95% CI = -2.43, -0.32), and 5th year (B = -1.18; 95% CI = -2.19, -0.17). Regionally, students from the Delta (B = 1.87; 95% CI = 0.75, 2.98) and Suez Canal (B = 2.08; 95% CI = 0.54, 3.63) regions had higher scores compared to those from Central Upper Egypt. Regarding educational climate perceptions, "Passive Learning & Memorization" was associated with higher surface scores (B = 0.26; 95% CI = 0.10, 0.43), while "Centrality of Learning and Mutual Respect" was associated with lower scores (B = -0.16; 95% CI = -0.21, -0.11). Higher deep approach scores were significantly associated with lower surface approach scores (B = -0.25; 95% CI = -0.30, -0.21).

Table 6. Linear regression analysis of Surface Approach scores among medical students in Egypt (N = 1,752)

Variable	Surface Approach Score ¹	Univariable regression		Multivariable regression ²	
		B (95% CI)	p-value	B (95% CI)	p-value
Academic year					
1st year	26.4 (7.9)	Reference		Reference	
2nd year	26.4 (7.2)	-0.04 (-1.11, 1.04)	0.95	-0.60 (-1.62, 0.42)	0.25
3rd year	25.7 (7.3)	-0.72 (-1.87, 0.42)	0.22	-1.53 (-2.61, -0.45)	0.006
4th year	26.4 (7.2)	-0.10 (-1.20, 1.00)	0.86	-1.38 (-2.43, -0.32)	0.010
5th year	26.2 (6.8)	-0.23 (-1.27, 0.81)	0.66	-1.18 (-2.19, -0.17)	0.023
Sex					
Female	25.4 (7.1)	Reference		Reference	

Male	27.4 (7.3)	1.99 (1.31, 2.67)	<0.001	2.00 (1.36, 2.63)	<0.001
Residence					
Urban (City)	26.2 (7.2)	Reference		Reference	
Rural (Countryside)	26.5 (7.4)	0.35 (-0.43, 1.14)	0.38	0.63 (-0.13, 1.40)	0.11
Region					
Central Upper Egypt	25.6 (7.1)	Reference		Reference	
Greater Cairo	26.8 (7.1)	1.22 (0.19, 2.25)	0.020	0.65 (-0.35, 1.65)	0.21
Alexandria	25.7 (7.4)	0.12 (-1.00, 1.25)	0.83	-0.26 (-1.32, 0.81)	0.64
Southern Upper Egypt	26.1 (7.4)	0.48 (-0.66, 1.63)	0.41	-0.01 (-1.10, 1.09)	0.99
Delta	27.3 (7.5)	1.77 (0.58, 2.95)	0.003	1.87 (0.75, 2.98)	0.001
North Upper Egypt	25.8 (6.8)	0.23 (-1.10, 1.55)	0.74	0.12 (-1.14, 1.38)	0.85
Suez Canal	27.3 (7.4)	1.74 (0.09, 3.38)	0.039	2.08 (0.54, 3.63)	0.008
Received formal guidance on how to study					
No	26.4 (7.2)	Reference		Reference	
Yes	26.0 (7.3)	-0.38 (-1.12, 0.35)	0.31	0.47 (-0.22, 1.16)	0.19
Deep Approach		-0.30 (-0.34, -0.25)	<0.001	-0.25 (-0.30, -0.21)	<0.001
Centrality of Learning and Mutual Respect		-0.24 (-0.29, -0.19)	<0.001	-0.16 (-0.21, -0.11)	<0.001
Competitiveness and Stress		0.17 (0.06, 0.28)	0.002	0.01 (-0.11, 0.14)	0.81
Passive Learning & Memorization		0.53 (0.39, 0.67)	<0.001	0.26 (0.10, 0.43)	0.002

¹Mean (SD)

²R² = 0.151; Adjusted R² = 0.143; F(17, 1734) = 18.13, p < 0.001; Residual SD = 6.71

Abbreviations: B = Unstandardized Coefficient, CI = Confidence Interval

Discussion

This study aimed to measure medical students' learning approaches in Egypt, describe the perceived educational climate, and examine factors associated with learning approaches, including the educational climate.

The students in our study reported nearly equal deep and surface learning approach scores, with mean scores of 27.3 and 26.2, respectively. This learning profile

contrasts the broader literature, where medical students almost consistently report significantly higher deep learning scores than surface learning scores [6, 7, 28–31]. Further, our mean Deep Approach score (27.3) is notably lower than those reported among medical students in Ghana (31.23) [29], Switzerland (33.46) [7], and Spain (median 33) [31]. Conversely, our students' mean Surface Approach score (26.2) exceeds those reported in Saudi Arabia (17.7) [28], Switzerland (22.24) [7], and Ghana (22.62) [29]. These differences likely stem from variations in the educational climate and assessment practices across contexts. Notably, the students in our study perceived a significantly less favorable overall educational climate than that reported in prior studies. Our total score (42.3) was substantially lower than the mean score of 56.8 reported across six U.S. medical schools [21], the score observed in a single-center study of internal medicine residents and attendings in Minnesota (65.4) [32], and both the pre-reform (51.9) and revised "Pathways" curriculum (62.4) scores reported at Harvard Medical School [33]. This disparity was most pronounced in the Centrality of Learning and Mutual Respect domain, where our score (23.6) was markedly lower than the score reported across six U.S. medical schools (30.5) [21] and that observed in the single-center study of internal medicine residents and attendings (34.0) [32].

In the context of this less favorable educational climate, we found that a higher perceived Passive Learning & Memorization score of the educational climate was associated with greater surface and lower deep approaches, whereas a higher perceived Centrality of Learning and Mutual Respect score was associated with higher deep and lower surface approaches. Our findings are similar to the results of the path analysis conducted by Isba et al. [16], who found that higher students' perceptions of the DREEM "learning" dimension was positively associated with deep approaches, while traditional curricula emphasizing factual reproduction were negatively associated with deep learning strategies. Similarly, Scouller [34] and Jensen et al. [35] reported that students were more likely to adopt a deep approach when preparing for assignments they viewed as requiring higher-order cognitive processing rather than rote memorization. Unfortunately, 80.4% of the students in our study felt exams prioritize recall over critical thinking, and 85.5% saw education as entirely memorization-based. This dominance of surface-level assessments and dissatisfaction with teaching in

Egyptian medical education is not a new finding; rather, it was the main concern reported by students in a national context evaluation that later informed the 2017 Egyptian medical education reform [2]. They were also identified as major sources of dissatisfaction with the integrated curriculum by Egyptian faculty in a multinational post-reform survey [36]. Yet, despite the nationwide reform, a recent study assessing students' perceptions at an Egyptian university still recommended "focusing on factual teaching" and "promoting students' memorization" as areas for improvement [20]. Such assessments and recommendations that promote surface learning directly contradict Biggs' view that effective teaching should aim to foster deep rather than surface approaches to learning [23, 37], and run counter to the core objectives of CBME, which aim to cultivate reflective, competent learners. Collectively, these findings highlight that memorization-based assessments remain deeply entrenched in Egyptian medical education, significantly and negatively shaping students' learning approaches, and ultimately undermining the overarching goals of the educational reform.

Our regional findings further underscore the alignment between assessment practices and learning approaches. Students in the Delta and Suez Canal regions reported significantly higher surface-approach scores than those in Central Upper Egypt. A recent multi-center study on determinants of academic performance in Egypt similarly found that students in Lower Egypt, where the Delta is located, achieved significantly higher academic performance scores than peers elsewhere [38]. Taken together, these results suggest that surface strategies may not only be incentivized but actively rewarded in certain faculties. This pattern carries important implications for equity in the national postgraduate residency selection process, which ranks students solely by cumulative scores without accounting for regional differences in curriculum delivery or assessment rigor.

Our regression analysis showed that perceived Competitive and Stress educational climate scores were not significantly associated with surface approaches but were significantly positively associated with deep approaches, suggesting that competitiveness and stress do not inherently promote shallow learning. This contrasts with multiple studies linking stressful environments to surface learning [14, 15, 39], and may appear at odds with our finding that nearly 86% of students reported peers focus

more on relative performance than on mastering the material. Nevertheless, as Biggs explains, students often adopt surface strategies primarily as a coping response to passive, rote-focused environments [3]. However, when the influence of a passive learning environment is accounted for, as in our regression model, appropriate levels of competitiveness and stress may instead foster deeper engagement. This is supported by the achievement goal theory, which posits that students motivated to excel relative to their peers can engage in deep learning when they perceive educational demands as opportunities rather than threats [40, 41]. Further, research shows that moderate levels of stress optimize cognitive engagement and learning [42, 43], suggesting that in challenging yet supportive educational climates, competitiveness may indeed encourage deep learning. Nevertheless, because the ECI is perception-based, responses may be strongly influenced by individual student characteristics. High-achieving students who perceive greater stress and competitiveness may adopt deeper learning approaches to maintain their performance, whereas students who are less academically engaged and therefore perceive lower stress and competitiveness may rely more on surface learning strategies to meet minimum requirements; an interpretation which mimics the findings of Foong et al. among pre-clinical medical students [44]. However, given the cross-sectional design of this study, longitudinal and mixed-method research is needed to test this hypothesis and to examine how these relationships evolve over time.

Regarding demographic factors associated with learning approaches, male students demonstrated significantly higher scores on both deep and surface learning approaches compared with females. This contrasts with studies reporting higher surface learning among males and others finding no gender differences [45]. One possible explanation is that male students may adopt an “effortless achievement” orientation [46], reporting high deep engagement to align with masculine mastery norms while concurrently employing surface strategies to maintain the appearance of natural success [47]. This interpretation is further supported by our finding that nearly 86% of students perceived their peers as prioritizing relative performance over mastery of the material. Alternatively, this finding can also be interpreted through the lens of the strategic learning approach [12], where students are driven by deep learning motives but

adapt their study behaviors to focus on content most likely to be assessed [5].

Consistent with this interpretation, nearly 92% of the students in our study agreed that the goal of most of their peers is to identify what will be tested and focus their studying on that material.

We also found that students in the later years of study reported significantly lower surface-approach scores than first-year students. This pattern is consistent with some studies among students that have reported a similar decline in surface strategies utilization over time [48, 49], yet contrasts with others that have observed a shift toward greater surface learning after the first year [50, 51]. A plausible explanation for our finding is that, although the first language of most students in Egyptian medical schools is Arabic, the medical curricula are entirely in English. First-year students may therefore rely more on surface strategies to memorize unfamiliar terminology and concepts rather than fully comprehend them as they try to keep pace with the heavy lecture load and frequent examinations. In contrast, senior students—having adapted to both English medical terminology and the academic workload—may process material more effectively and rely less on surface strategies. This pattern is supported by an Egyptian study in which 44.5% of faculty reported that English posed a barrier to learning only in the first year, suggesting that students gradually overcome initial linguistic challenges [52]. Nevertheless, our finding that deep-approach scores did not differ significantly across students in different years aligns with a systematic review of 43 longitudinal studies among university students [53], which concluded that there is no clear empirical evidence to support the assumption that students naturally progress toward deeper learning during higher education, highlighting the importance of active interventions by medical educators to foster deeper learning approaches.

In line with this, we found that students who reported receiving formal guidance on how to study, as well as those who frequently received supportive advice from faculty on how to improve, had significantly higher deep-approach scores than their peers who did not. These findings are consistent with prior research showing that structured study guidance and faculty feedback enhance deep learning and overall academic engagement [54, 55]. Unfortunately, less than half of our participants reported receiving either type of support, highlighting a critical gap in the current educational

environment. Taken together with our findings on the wide use of perceived memorization-based assessments, these results highlight the need for medical schools to provide formal guidance on effective study strategies, expand faculty mentorship and feedback, and restructure assessments to emphasize understanding rather than rote recall. Such interventions could promote deeper, mastery-oriented learning and help achieve the overarching goals of CBME and ongoing educational reform.

Nevertheless, the findings of this study should be interpreted in light of several limitations. The cross-sectional design precludes conclusions about causality or the direction of associations between variables, limiting our ability to determine whether the educational climate shapes learning approaches or vice versa. Further, the use of self-reported measures introduces the possibility of reporting bias and social desirability effects, which may have influenced responses regarding learning strategies and perceptions of the educational environment. The study also included only public universities and utilized convenience sampling, which may have introduced selection bias and limits generalizability to the broader population of medical students in Egypt. Finally, although validated instruments were employed, cultural and linguistic factors may have affected how students interpreted and responded to certain items, particularly given that most students' first language is Arabic.

In conclusion, our study demonstrates that perceived memorization-oriented learning environments are predominant in Egyptian medical schools and continue to promote surface approaches and hinder deep learning, thereby limiting the impact of curricular reform. In contrast, a greater perceived learning-centered climate that fosters mutual respect was associated with higher deep approaches and lower surface approaches. Formal study guidance and faculty mentorship were also strongly associated with deep learning, yet remain underutilized, highlighting an important area for intervention.

Taken together, these findings emphasize the need for medical schools to restructure assessments away from rote recall, provide systematic support for effective study strategies, and cultivate an environment that values mastery and understanding. Implementing such measures is essential to help students move from surface tactics toward deep, reflective, and competence-driven learning.

Conflict of interest

The authors declare no conflicts of interests.

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Data Availability

The data of this study is available from the corresponding author upon reasonable request.

Author contributions

YMO and ND contributed equally to this work. The conception and design of the study were done by YMO, ND, and AE. Acquisition of data was done by all authors except AE. Analysis and interpretation of data were done by ND and AE. Drafting the manuscript was done by all authors. YMO, ND, and AE revised the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

Ethical Approval

Ethical approval was obtained from the Institutional Research Board (IRB) of Mansoura University's Faculty of Medicine (approval code: R.25.04.3155), and the study was conducted according to the principles of the Helsinki Declaration. All participants were invited to voluntarily and anonymously complete an online survey, provided electronic informed consent, and were free to respond at their convenience.

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