

# Mediating Effects of Metacognitive Learning Strategies in the Relationship between Learning-related Emotions and Academic Self-efficacy with Academic Performance in Medical Students

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## Research article

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# Abstract

Recognition of the factors affecting the medical students' academic success is one of the most important challenges and concerns in medical schools. Hence, this study aimed to investigate the mediating effect of metacognitive learning strategies in the relationship between learning-related emotions and academic self-efficacy with academic performance in medical students. Methods: The present study was carried out on 279 students of medicine studying in Shiraz University of Medical Sciences. The students filled out three questionnaires: academic emotions (AEQ), metacognitive learning strategies, and academic self-efficacy questionnaires. The data were analyzed using SPSS and Smart PLS3. Results: The results of structural equation modeling revealed that the students' self-efficacy has an impact on their positive emotions and metacognitive learning strategies, and these in turn affect the students' academic performance. Moreover, positive emotions influence the metacognitive learning strategies which in turn mediate the effect of positive emotions on the academic performance. Discussion: The results of this study revealed that metacognitive strategies can play a mediating role in the students' self-efficacy, positive emotions, and academic performance. Therefore, in case we can strengthen the students' self-efficacy and their positive academic emotions, their performance will improve.

## Background

Academic success and obtaining good grades are one of the main goals in all levels of education while having positive outcomes both for the learners and educational systems. Therefore, detection of the factors influencing the students' academic success has ever been one the most important concerns by the researchers and educational psychologists (1), and also one of the challenges with which medical schools are faced. (2,3). To this end, the researchers attempts have led to the recognition of the role of motivation, learning strategies, academic emotions in the students' learning and performance. (4–7)

However, most of these researches have been conducted using correlation analysis (6), qualitative methods (4), and experimental approaches (8); they reveal a positive and simple relationship of these variables with academic performance (9) and do not show the direct and indirect effect of these variables on each other (10). Moreover, most of these studies have been carried out in the field of psychology, social sciences and education (11–13). Thus, studies in medical education are scanty.

Therefore, there is still little knowledge about the effect of motivation and emotions on the students both in the classroom and clinical settings (2,14). On the other hand, most of the studies have been conducted in western countries (15), so generalizing the findings to other countries, especially developing ones, has been criticized (16). Therefore, in this study, we aimed to investigate the effect of self-efficacy, learning-related emotions and metacognitive strategies on the medical students' academic performance. More specifically, we made an attempt to determine how metacognitive strategies can mediate the relationship between self-efficacy and positive learning related emotions and academic performance.

# The relationship between positive academic emotions and academic performance

Emotion is a subjective status accompanied by physiological reactions and responses to some conditions, actions, and events.

Pekrun (2006) defines academic emotions as those which are directly related to achievements, activities and outcomes (17). This term was first used by Pekrun et al. (2002) in the field of education (4) and defined as positive (enjoyment, pride, hope); negative (boredom, anger, anxiety); activating (joy, pride, anger); and deactivating (shame) (5,17). Emotions have complex associations with cognitive, motivational and behavioral processes, especially in the classroom and educational settings (4,5,14,17,18), in all educational situations (before, during and after attending the classroom, studying and testing) (4,11), and in clinical settings (14), as experienced by the students.

Moreover, some researchers consider emotions as a significant factor which are directly or indirectly associated with learners' achievements; satisfaction; physical and mental health; motivation; learning strategies; cognitive sources; self-directed learning; quality of teacher-learner interactions; class education; concentration; information processing, storing, and retrieving; learning; and consequently academic achievement (1,2,4,5,11,17, 19,20). Pekrun (2006) indicated that pleasant positive emotions, like enjoyment, positively affect academic achievement. On the contrary, unpleasant deactivating emotions, like boredom, can reduce our motivation and disturb the data processing, showing the negative impact of such emotions on academic achievement (17).

Chin et al. (2017) concluded that there was a significant relationship between the students' positive emotions and their performance (21). The findings of a study conducted by Pekrun et al. (2009) revealed that positive activating emotions like enjoyment, hope and pride had a significant relationship with the students' midterm exam's scores (11). Generally, the previous research showed that positive emotions such as enjoyment, hope and pride are the predictors of academic achievement (4,5,22).

## The relationship between positive academic emotions and academic performance mediated by metacognitive strategies

As we noted, researchers consider the emotions as the significant factors which can determine the students' academic performance. The control-value theory of achievement emotions is a comprehensive framework for analysis of the effects of positive emotions on the students' academic performance. It is hypothesized in this theory introduced by Pekrun that positive emotions affect the students' achievement indirectly through mediating role of cognitive, metacognitive and self-regulating behaviors (17,19).

Generally speaking, emotions can influence on student achievement through two main pathway of cognitive and motivational and four mechanisms. As to the cognitive pathway, emotions can affect one's performance through three mechanisms of memory dependent on the mood, various learning strategies and cognitive and metacognitive perspectives, and the use of cognitive sources.

As to motivational pathway, also the emotions impact one's learning and performance through intrinsic and extrinsic motivation (23). Pekrun et al. believe that emotions variously affect these mediators; negative activating emotions (anger, anxiety, and shame) diminish the students' motivation for learning and lead to the use of rigid and superficial strategies, which reduces the self-regulation during learning. (11)

In contrast, positive emotions as the result of using deep, flexible, complex learning strategies and self-regulation facilitate the individuals' learning (4), so that the students who experience positive emotions utilize deeper strategies and more metacognitive processing (4, 24). This in turn enhances the students' achievement. Therefore, the effect of emotions on the academic performance can be mediated by the use of metacognitive strategies. The results of some studies have confirmed the positive association between positive academic emotions and cognitive and metacognitive strategies (1,4,6,25,26). Nevertheless, some researchers believe that little attention has been paid to the role of emotions in facilitation or blockage of the use of cognitive and metacognitive strategies.

## **The relationship between academic self-efficacy and academic performance**

One of the important factors affecting the academic performance is academic self-efficacy. Academic self-efficacy refers to the students' beliefs and attitudes toward their capabilities to achieve academic success, belief in their ability to fulfill the academic tasks and the successful learning of the materials (27–29).

Self-efficacy beliefs lead to the individuals' excellent performance through increase in commitment, endeavor and perseverance (30,31). The learners with high levels of self-efficacy attribute their failures to lower attempts rather than lower ability, while those with low self-efficacy attribute their failure to their own low abilities (32). Therefore, self-efficacy can impact the choice of tasks and perseverance in doing it. In other words, the students with low self-efficacy are more likely to be afraid of doing their tasks, avoid it, postpone it, and give it up soon (29,30, 34)

In contrast, those with high levels of self-efficacy are more likely to rely on themselves when faced with complex issues to find the solution to the problem, be patient in the process, make more efforts, persist longer to overcome the challenges (9,28,30). Therefore, it seems that one of the most important factors in the students' academic success is self-efficacy. For example, in the studies conducted by Chemers and Garcia, it was found that the students' self-efficacy in the first year of university is a strong predictor of their future performance. (35)

In a study carried out by Alyami et al. (2017) on 214 university students, it was revealed that academic self-efficacy has a positive and significant effect on their academic performance. (36) Other studies have shown that academic self-efficacy has a considerable effect on the students' learning, motivation and academic performance. (9,18, 30, 37–40)

## **The relationship between academic self-efficacy and academic performance with the mediating effect of positive emotions**

As mentioned above, many studies have confirmed the role of academic self-efficacy on the students' academic success, but few studies have revealed the role of mediating variables in the relationship between self-efficacy and performance. Based on Pekrun's control-value theory (17,24), it can be claimed that part of the relationship between self-efficacy and achievement can be affected by positive emotions. It is supposed in this theory that one of the significant antecedents of academic emotions is cognitive assessment which is categorized into control assessments (perceived control) and value assessments (perceived value). (24)

Control assessments are related to the individuals' perception of the controllability of achievement activities and their consequences. These assessments are shown through our expectations and perception of competence such as self-efficacy. Therefore, academic self-efficacy (as a cognitive assessment) can influence academic emotions. (14) It can be expected that when the students believe in their ability in doing their tasks successfully, they will enjoy the learning process more; also, it is reasonable that these individuals have more feeling of hope and pride compared to the students with low self-efficacy. The findings of some studies indicate a positive relationship between academic self-efficacy and positive emotions. (1,5,25)

## **The relationship between self-efficacy and academic achievement with the mediating effect of metacognitive strategies**

Many researchers have investigated the role of self-efficacy in academic achievement since Bandura (1977) introduced the concept of self-efficacy (9,18, 38,39,40). Some of them believe that a part of the relationship between self-efficacy and academic achievement can be attributed to metacognitive strategies (41–42). More specifically speaking, evidence shows that the students with higher self-efficacy show more endeavor and perseverance when faced with challenging situations (28,29). In spite of the positive effect of self-efficacy on the amount of attempt, evidence shows that the quality of the efforts of the self-efficacious students is different as well; such students use deeper various cognitive and

metacognitive processing strategies compared to their peers with lower self-efficacy. This leads to better learning and academic achievement (42,43).

On the contrary, the students with low self-efficacy seek easier tasks in order to avoid failure and use superficial strategies while disregarding deep learning (6). Zimmerman et al. found out that the students' self-efficacy potentiates their self-regulated learning required to achieve academic success, which in turn affects their motivation and performance (41). In another research on medical students, Tembo and Negvira (2016) indicated that self-efficacy positively predicts deep learning strategies (44).

Sungur and Kahraman (2011) revealed that the students with the feeling of self-efficacy were more inclined to use metacognitive strategies and that there was a positive association between self-efficacy and academic performance and metacognitive strategies (45).

In short, the studies conducted in this field have shown a positive association between self-efficacy and the metacognitive strategies (42, 44, 47). On the other hand, many studies have indicated that metacognitive learning strategies are one of the most important predictors of the students' academic success. (4,9, 51,42, 43, 48). Therefore, as shown in some studies, metacognitive strategies mediate the effect of self-efficacy on academic performance (49).

Our study revealed that although many studies have been conducted on the direct impact of variables as academic emotions, academic self-efficacy, metacognitive strategies and their roles on academic achievement, few studies have focused on the direct and indirect relationship among these variables in a structural equation model. The studies carried out so far in this field have either investigated the effect of the above-mentioned variable on each other separately (26,34,44,45,50) or they have focused on fields other than medical education (1,6,14,44). Therefore, in this study we aimed to specifically focus on the mediating effects of metacognitive learning strategies in the relationship between positive learning-related emotions and academic self-efficacy with academic performance in medical students.

## Methods

### Participants and procedures

This is a cross-sectional study on 279 medical students studying in their first to fifth semesters (64.5% females and 35.5% males) in the first semester of 2018 and the first semester of 2019 academic years. We studied their major courses in each semester. In general, the pathology, anatomy, cardiovascular system, digestive system, urinary tract, glands, reproductive system, blood, musculoskeletal system, neurology, respiration, and head and neck anatomy courses were selected. The students' age range was 18–35 years (Mean 19.6, SD 3.2). Although for SEM a sample of over 200 is satisfactory, some researchers have suggested 20 subjects for each variable. Our sample size satisfied both views (Violato & Hacker 2007, Kline 2011). Of course, the advantage of Partial Least Square approach is that in other approaches such as those of Lisrel and Amos a smaller sample size is required.

In fact, PLS has no limitation for the sample size and the selected sample can be equal to or less than 30 so that the results are valid (Gerry 2003). PLS is more suitable for real applications, especially in the case of more complex models, the use of this approach is more satisfactory (Van 2010).

The subjects were selected, using convenience sampling. Since this study was conducted on human, we first obtained the approval of the research ethics committee of Shiraz University of Medical Sciences with the code of IR.SUMS.REC.1397.595. Also, the students were assured that their information would remain confidential. Before the commencement of the study, the students gave their written informed consent.

They were asked to fill out the forms anonymously. The participation in the study was completely voluntary and those who agreed to participate filled out the questionnaire. The questionnaires were distributed among the students and they were asked to answer the questions as to how they experienced these emotions during the semester. Also, the questionnaires of metacognitive learning and academic self-efficacy were simultaneously distributed.

## Measure

We used three questionnaires in this study.

### Academic Emotions Questionnaire (AEQ)

AEQ developed by Pekrun, Goetes and Fernoze (2005, 2011) is a valid and reliable questionnaire which measures the students' academic emotions (5,6,51). It consists of 3 parts measuring the emotions related to the classroom, learning and exams separately (5). In this study, we used the adapted version of AEQ to evaluate the students' positive emotions experienced when they study (positive learning related emotions).

This subscale includes three positive emotions related to learning (enjoyment, pride, hope) with 22 questions answered with five-point Likert scale ranging from completely disagree (1) to completely agree (5). Pekrun et al. have reported a good validity and reliability coefficient for this questionnaire (5).

## Metacognitive learning strategies questionnaire

Motivated learning strategies Questionnaire is a valid and reliable questionnaire used for evaluation of the students' motivational orientations and self-regulatory learning strategies (52,53). This questionnaire contains two subscales of motivation and self-regulated learning and has been used in many studies in medical and other fields (2,25). In this study, we use the metacognitive strategies subscale which consists of 12 items scored using 5 point Likert scale. Pintrich et al. have reported a Chronbach alpha of 0.79 for this subscale (52).

# Academic self-efficacy questionnaire

The self efficacy for learning and performance is a self-evaluation questionnaire which is one of the subscales of the above-mentioned questionnaire (52). It contains 8 questions evaluating the students' beliefs regarding their abilities and performance.

These items are scored using 5 point Lickert scale. Pintrich et al. also reported a desirable validity and reliability for this instrument (52). It has been used in many studies (6,9,44).

## Academic performance

To assess the students' academic performance, we used their final exam scores in that semester.

## Results

The matrix correlation results showed that self-efficacy had a significant and positive relationship with academic performance ( $r = 0.46, p \leq 0.01$ ), meta- cognitive learning strategies ( $r = 0.59, p \leq 0.01$ ), and positive learning-related emotions ( $r = 0.65, p \leq 0.01$ ). In addition, the findings showed that positive learning-related emotions had a positive and significant correlation with meta-cognitive learning strategies ( $r = 0.55, p \leq 0.01$ ) and academic performance ( $r = 0.48, p \leq 0.01$ ). Also, as shown in Table 1, the results showed a significant and positive correlation between meta-cognitive learning strategies and academic performance ( $r = 0.45, p \leq 0.01$ ).

Insert Table 1 here

## The measurement model

The measurement model in PLS was evaluated in terms of internal consistency reliability, convergent validity, and discriminant validity. Internal consistency reliability measures the degree to which the items measure the latent construct (Hair et al., 2006), which was assessed through composite reliability scores. A composite reliability of 0.7 or greater is considered acceptable (Fornell & Larcker, 1981). The findings showed that the CR scores of all constructs exceeded the recommended criterion of 0.7 which demonstrate appropriateness of the scales used in current study.

Insert Table 2 here

Next, the factor loadings and average variance extracted (AVE) were assessed to determine the convergent validity of the constructs. Individual item loadings greater than 0.7 are considered as adequate (Fornell & Larcker, 1981). Based on the results of the measurement model (Table 2), all the construct items exhibited loadings exceeding 0.7 with adequate AVE ranging from 0.68 to 0.79. The findings also showed adequate discriminant validity as all the square roots of AVE were higher than the

inter-correlation value between the constructs (Fornell & Larcker, 1981) (Table 3). Therefore, reliability and validity of the research constructs were confirmed.

Insert Table 3 here

## The Structural Model

Structural model assessment was used to test the hypothesized theoretical relationship in the suggested conceptual framework which included the relationship between positive emotions, self-efficacy, meta-cognition, and academic performance (Figures 1, 2). The coefficient of determination ( $R^2$  values) and path coefficients (beta values) were the parameters used to determine how well the data supported the hypothesized relationships (Hair et al., 2014). Also, PLS path-analysis of bootstrapping was applied to find the path correlation between the research variables in order to understand whether the path coefficient for the hypothesized relationship is significant or not.

Insert Figure 1 and 2 here

The estimated path coefficients from the PLS analysis are shown in Figure 2. Based on the obtained results, hypotheses H1, H2, H3, H4, H5, H6, H7, H8, and H9 were all supported (Table 4). To determine the significance of all the relationships in the model, re-sampling techniques such as bootstrapping procedure was applied (Henseler et al., 2009). Based on the t-test statistics, self-efficacy demonstrated a direct, positive and statistically significant effect on academic performance (H1  $p < 0.05$ ), positive learning-related emotions (H4  $p < 0.001$ ), and meta-cognition (H5  $p < 0.001$ ). Similarly, positive emotions had a direct, positive, and statistically significant impact on academic performance (H2  $p < 0.001$ ) and on metacognition (H6  $p < 0.001$ ). Also, as hypothesized, meta-cognition had a direct, positive and statistically significant effect on academic performance (H3  $p < 0.001$ ).

Moreover, the mediation test indicated the indirect effect of the self-efficacy on the academic performance through meta-cognition (H7) ( $b = 0.09$ ,  $t = 3.77$ ,  $p < 0.001$ ), and through positive learning-related emotions (H9) ( $b = 0.168$ ,  $t = 3.50$ ,  $p < 0.001$ ). Similarly, the mediation test indicated the indirect effect of the positive learning-related emotions on the academic performance through meta-cognition (H8) ( $b = 0.063$ ,  $t = 3.27$ ,  $p < 0.001$ ).

Insert Table 4 here

The goodness-of-fit  $R^2$  of the latent endogenous variables can be applied to assess the utility of the proposed model. In the proposed Model, 30% of the variance in academic performance was explained by self-efficacy, positive emotions and meta-cognition. Moreover, the results indicated that 40% of the variance in metacognition was explained by self-efficacy and positive emotions. Furthermore, the findings showed that 43.2% of the variance in positive emotions was explained by self-efficacy.

Hair et al. (2014) suggested that researchers also report on the predictive relevance ( $Q^2$ ) besides basic parameters. According to Fornell and Cha (1994), the model has predictive quality if the cross-redundancy value is found to be more than 0; otherwise, the predictive relevance ( $Q^2$ ) of the model cannot be achieved. Based on the Smart PLS 3.0 results, the obtained cross-validated redundancy was found to be 0.289, 0.422 and 0.389 for academic performance, positive emotions and meta-cognition, respectively.

## Discussion

Although the relationship among academic emotions, metacognitive strategies and self-efficacy with academic performance has been studied in different studies, a study based on a model like that used in the present one is scanty. This study aimed to test the theoretical model of the relationship between positive emotions, academic self-efficacy and academic performance with the mediating role of metacognitive strategies.

One of the primary objectives of this research was to determine the impact of self-efficacy on academic performance. Based on the results, the direct and indirect effect of this factor on academic performance was significant and positive. This finding is in the same line with those of previous studies (9,18,35,36,39,40), showing that the students with a higher feeling of self-efficacy in their performance and abilities are more successful than those without it. Students have different feelings as to their own abilities and academic achievements, and choose different aims and approaches based on what they believe they can do and what they hope to achieve. (54)

Therefore, It can be interpreted that the students who believe in their capabilities and know they can perform their academic task show more perseverance, effort, behaviors and motives compared with those who believe they have fewer abilities and do not expect themselves to be successful (30,31). Self-efficacious students attribute their failure to lack of efforts, rather than lower ability. (32) Thus, such feeling causes them to try more in future when confronted with problems and their motivation for success increases.

Consequently, such individuals get less hopeless when faced with problems and make more attempts and persist longer to overcome the academic challenges and find good solutions to the problems. (9,28,30). On the contrary, attributing the failures to lack of capability leads to hopelessness and fear when faced with academic problems or challenges, and acceptance of the tasks. They avoid doing their tasks, postpone them, and soon abandon them, resulting in negative effects on their performance. (29,30,34)

The second objective of this study was determining the mediating role of metacognitive learning strategies in the relationship between self-efficiency and academic performance. The results showed that metacognitive learning strategies mediate the effect of self-efficiency on academic performance. This relationship can be indirect and through metacognitive learning strategies, as confirmed in other studies (9,55)

One of the key determinants of the use of metacognitive strategies by the learners is their self-efficiency. Previous studies have revealed that self-efficiency has a very important role in the use of the above-mentioned strategies and that self-efficient students use more metacognitive strategies compared with their other peers. (9,42, 44–47, 56,57) Pintrich and De Groot believe that the students who trust in their abilities are most probably self-efficient and try to recognize their academic tasks and plan for their educational affairs. Such students vary in the quality of their efforts and use a variety of deep cognitive and metacognitive strategies compared with their peers.(31)

Moreover, they are more involved in effective self-regulative strategies like monitoring their academic task time effectively. (42) The students who use more metacognitive strategies effectively have better study plans, have an efficient monitoring and evaluation of their learning and perception of the materials, assume their responsibility, detect and solve their problems, and try hard to learn deeply. (45,56) They surely achieve more than their peers who are not skillful in the use of such strategies. (43) In this respect, the role of metacognitive strategies in the learners' academic success has been well confirmed by the theories and researches. (1,4,9,29,31,41–43, 48).

Therefore, considering the fact that the students with high level of self-efficacy use more metacognitive and self-regulatory strategies positively and also taking the positive association of these strategies with academic performance into account, the increase in the students' self-efficacy can indirectly lead to an improvement in their academic performance. The results showed that academic self-efficacy has a positive impact on positive emotions; this is in the same line with the findings of the previous research. (1,5,25)

Moreover, the results showed that positive emotions mediate the effect of academic self-efficacy on the academic performance. This is reasonable to assume that the students who believe in their own capabilities in learning and doing some of their scientific tasks enjoy learning new materials more than the others.

Since these students believe that they have the necessary abilities for learning their materials, they have a sense of pride while learning. Also, due to their belief in their abilities, they are optimistic about their learning and also the materials to be learned. Therefore, it is concluded that highly self-efficacious students experience more positive emotions while studying and learning, which can in turn lead to their better academic performance.

The results also revealed that there is a statistically significant relationship between positive academic emotions and academic performance. This is in the same line with the results of previous studies. (1,2,4,6,11, 25, 38,48,58,59) Pekrun et al. stated that the emotions are involved in almost all aspects of teaching and learning process. (24) Positive emotions related to learning can affect the learners' performance through effects on the quality of learning process, quality of teacher-learner and the peer-peer relationships in the classrooms and effective teaching. (19)

Likewise, Meinhardt and Pekrun (2003) stated that emotions continuously accompany learning and affect concentrating, processing, storing and retrieving of the information. (20) In summary, emotions deal with 4 types of essential mental processes including attention, concept formation, and allocation of cognitive and metacognitive sources which are necessary for learning. There is evidence showing the impact of emotions on cognitive performance. (60)

Also, based on Pekrun's control-value theory, emotions can affect the individuals' academic performance through their effect on some mediating factors as academic motivation, memory, cognitive and metacognitive sources. (24)

Results showed that the indirect effect of positive emotions on the students' academic performance was significant so that metacognitive strategies mediate the relationship between the students' positive academic emotions and their academic performance. This finding is consistent with the other studies' results. (1.4) Therefore, we can conclude that in case the positive emotions are mediated by metacognitive strategies, they positively impact the students' academic performance.

Control-value theory can predict how academic emotions affect learning and performance. It is assumed that academic emotions deeply influence the students' performance. More specifically, it is essentially supposed in this theory that emotions indirectly affect the academic success through some cognitive and motivational mediating factors. Emotions variously affect these mediating factors. Studies have shown that there is a direct relationship between positive emotions and cognitive and metacognitive strategies. (1,4,6,25); for instance, the results of the research conducted by King and Eripattamanl (2014) revealed that there was a positive significant relationship between positive emotions (enjoyment, hope, pride) and metacognitive strategies (planning, monitoring, regulating). (26)

The students who experience positive emotions in the learning process are more inclined to use flexible, complex and self-regulation learning strategies; in general, emotions bring about more involvement in and use of deeper processing strategies. (4)

## Conclusion

Research on antecedents and consequences of metacognitive strategies, especially academic emotions, in medical contexts is scanty. (1,44) Therefore, in the present study we made an attempt to use the structural equation modeling to determine the relationship between academic self-efficacy and positive learning related emotions and academic performance with the mediating role of metacognitive strategies. The results revealed that the students who believed in their abilities and had more positive emotions used more metacognitive strategies, resulting in better performance. Therefore, teachers in medical schools can reduce the students' stress through supportive and calm environments since competitive and stressing contexts influence the students' self-efficacy; they can invigorate positive emotions in the students by giving appropriate, positive, supportive feedback, creating interactive approaches in the classrooms, and encouraging the students to cooperate in class discussions instead of competition since

the teacher's enthusiasm, positive feedback to success, cooperation, sense of belonging to class is positively related to the students' enjoyment of learning and hope for success in learning.

The results also suggest that teachers in medical schools should take measures to create a peaceful environment where the students feel comfortable and secure since positive feeling toward the learning climate and environment can increase positive emotions like enjoyment, pride and hope in students when they are learning, leading to academic success.

In addition, creating a climate in which the students experience freedom and respect causes them to enjoy their presence in class and learning which in turn leads to involvement in teaching, more academic engagement and use of deeper learning strategies.

Moreover, some factors can influence academic emotions indirectly. For example, classroom teaching quality can directly affect the students' dominance, perceived academic control, and self-efficacy, impacting their emotions indirectly. Thus, behavior in class, expressed emotions and the teachers' quality of teaching can influence the students' learning which, in turn, can be a significant factor in the increase of the students' positive emotions and self-efficacy.

## Limitations

In general, this study can be regarded as an evidence for the direct and indirect relationship of self-efficacy and positive academic emotions on the medical students' academic performance; it also supports the control-value theory and other studies conducted in this field. Despite these strengths, this study had some limitations. First, this is a cross-sectional quantitative study, so we cannot precisely show the cause effect relationship between the variables.

Second, we used self-report questionnaires which might have bias in responses provided (61). However, self report questionnaires can elicit the participants' beliefs and personal perceptions as to their learning process. (26) Also, the use of class grades as an index of academic performance might be an invalid and inappropriate indicator which is non-standard. It is recommended that the researchers use a more standard and reliable measures in future studies, such as national and standard tests. Lastly, we used convenience sampling which does not reveal the random sampling features, making the generalizing the results impossible.

## Abbreviations

Not applicable

## Declarations

- *Ethics approval and consent:* Informed consent was obtained from the students before the study and all the subjects agreed to participate in the study and fill out the questionnaires.

- *Consent for publication:* Written informed consent was taken from the participants for the publication of their details and ideas.
- *Availability of data and materials:* The datasets used and analyzed during the current study are available from the corresponding author on request.
- *Competing interest:* The authors declare that there is no financial and non-financial competing interest.
- *Funding:* No organization supported this study financially.
- *Authors' contributions:* AAH contributed to the conception, design of the study, analysis of the data and checking the final draft. KSh contributed to the data collection, interpretation and analysis of the data. MA contributed to the design, acquisition of data, interpretation of data and approved the submitted version. NSh contributed to the design, interpretation of data, drafting the work, and revising and approving the final draft. All the authors approved the final version.
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## Tables

Table 1. Relationship between academic performance, self-efficacy, metacognitive learning strategies and positive emotions

	Mean	SD	1	2	3	4
1- Academic performance	16.95	1.433	1			
2- Self-efficacy	2.68	1.041	0.46**	1		
3- Meta-cognitive learning strategies	2.89	0.990	0.45**	0.59**	1	
4- Positive learning -related emotions	2.97	0.945	0.48**	0.65**	0.55**	1

\*p < .05 \*\*p < .01

Table 2: Factor loadings, CR, and AVE (n=279)

Construct	items	loadings	CR	AVE	Convergent Validity
Enjoyment	q1	0.94	0.97	0.82	Yes
	q2	0.93			
	q3	0.91			
	q4	0.89			
	q5	0.95			
	q6	0.94			
	q7	0.87			
	q8	0.83			
	q9	0.82			
	q10	0.97			
Hope	q11	0.94	0.98	0.89	Yes
	q12	0.93			
	q13	0.96			
	q14	0.92			
	q15	0.97			
	q16	0.93			
Pride	q17	0.95	0.98	0.88	Yes
	q18	0.94			
	q19	0.92			
	q20	0.93			
	q21	0.96			
	q22	0.93			
Self-efficacy	q23	0.94	0.98	0.88	Yes
	q24	0.90			
	q25	0.95			
	q26	0.93			
	q27	0.96			
	q28	0.91			
	q29	0.97			
	q30	0.94			
Meta-cognitive learning strategies	q31	0.90	0.98	0.87	Yes
	q32	0.95			
	q33	0.98			
	q34	0.70			
	q35	0.96			
	q36	0.95			
	q37	0.93			
	q38	0.98			
	q39	0.92			
	q40	0.95			
	q41	0.98			
	q42	0.97			

Note: CR = composite reliability; AVE = average variance extracted

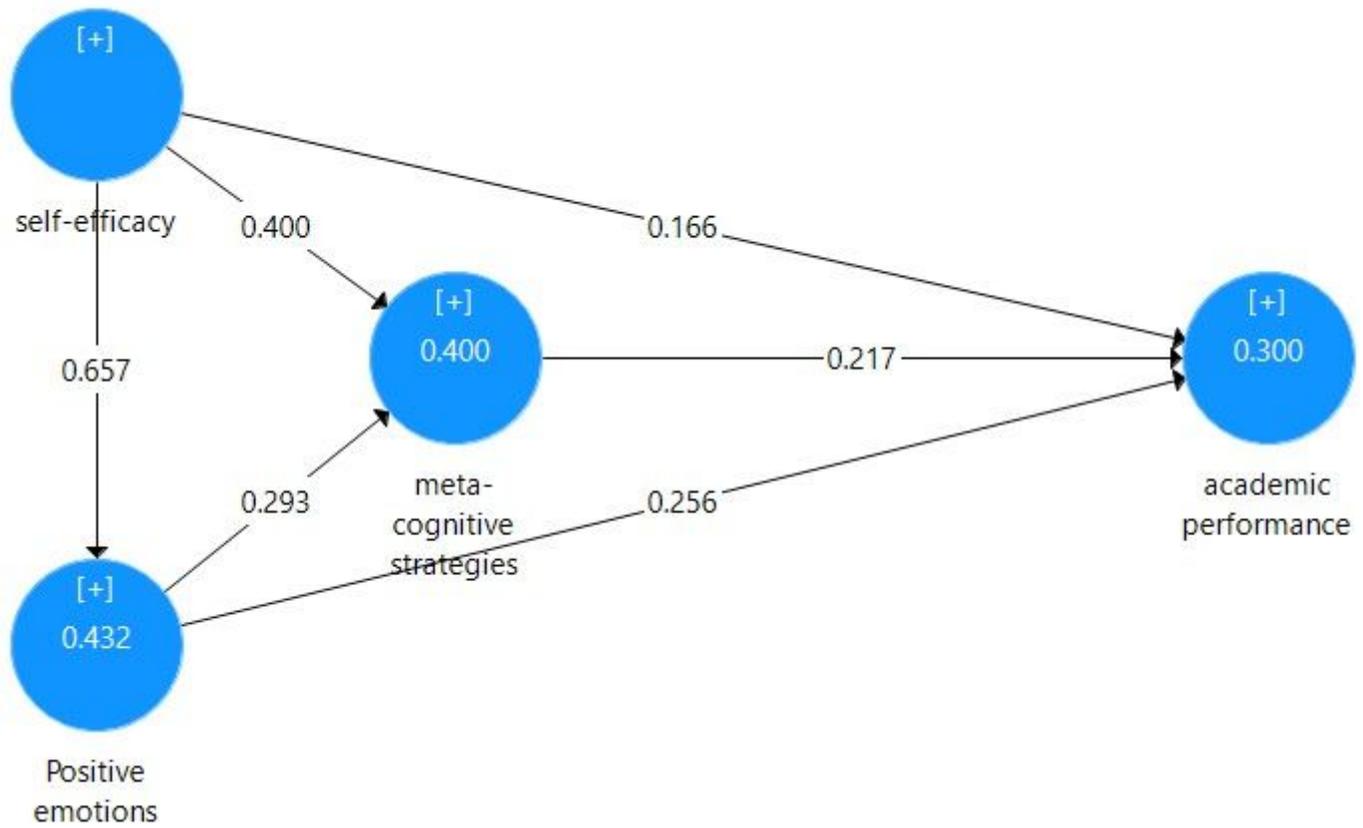
Table 3: Discriminant validity coefficients of the research constructs

construct	Positive emotions	Self-efficacy	Meta-cognition
Positive learning- related emotions	0.97		
Self-efficacy	0.55	0.94	
Meta-cognitive learning strategies	0.65	0.59	0.93

Table 4: Path coefficients for hypothesis testing

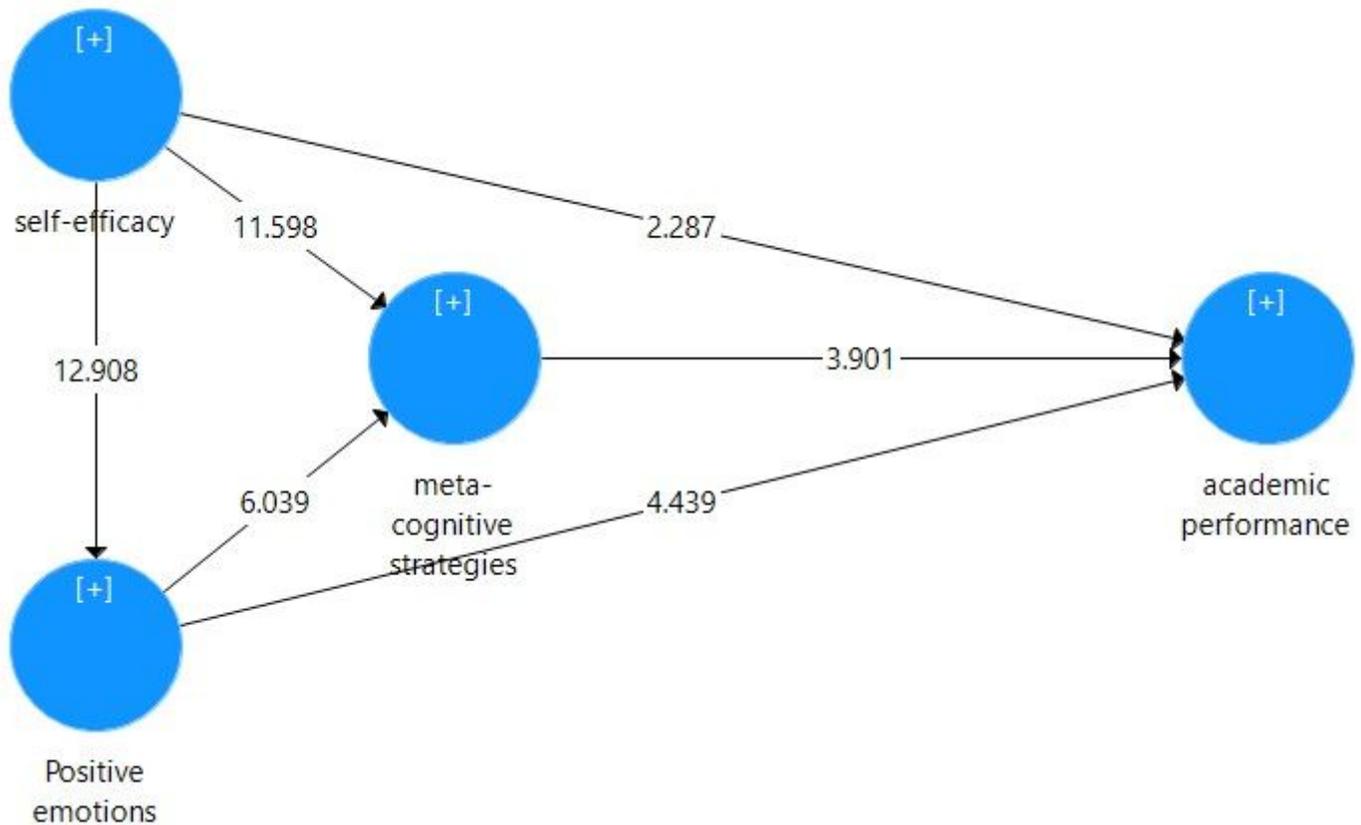
Hypotheses	Path	Beta	t	P. value	Decision
H <sub>1</sub>	self-efficacy → academic performance	0.166	2.29	0.014	Supported
H <sub>2</sub>	positive emotions → academic performance	0.256	4.44	<0.001	Supported
H <sub>3</sub>	meta-cognition → academic performance	0.217	3.90	<0.001	Supported
H <sub>4</sub>	self-efficacy → positive emotions	0.657	12.91	<0.001	Supported
H <sub>5</sub>	self-efficacy → meta-cognition	0.400	11.59	<0.001	Supported
H <sub>6</sub>	positive emotions → meta-cognition	0.293	6.04	0.001	Supported
H <sub>7</sub>	self-efficacy → meta-cognition → academic performance	0.09	3.21	<0.001	Supported
H <sub>8</sub>	positive emotions → meta-cognition → academic performance	0.063	3.62	<0.001	Supported
H <sub>9</sub>	self-efficacy → positive emotions → academic performance	0.168	3.75	<0.001	Supported

## Figures



**Figure 1**

PLS-Path analysis after assessment of convergent and discriminant validity



## Figure 2

PLS-path analysis of bootstrapping

## Supplementary Files

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