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Analysis of factors influencing medical students' learning engagement and its implications for teaching work—— a network analysis perspective

Yijun Li¹, Lin Wu¹, Fengzhan Li¹, Peng Fang¹, Xufeng Liu^{1*} and Shengjun Wu^{1*}

Abstract

Purpose Higher medical education has always been a major project in the fields of education and health, and therefore, the quality of education has received much attention. Learning engagement has emerged as a significant indicator of teaching quality, attracting considerable research attention. This study aims to explore the relationship between medical students' learning engagement and their sense of school belonging, professional identity, and academic self-efficacy.

Methods We conducted an online survey using convenience sampling method with 311 medical students. We employed Revised version of the Utrecht Work Engagement Scale-Student (UWES-S), Chinese version of the Psychological Sense of School Membership (PSSM) scale, Academic Self-Efficacy Scale, and the questionnaire of college students' speciality identity for evaluation. Network analysis was used to analyze the relationships among these factors.

Results Medical students' overall performance in school showed a positive trend. However, there is still room for improvement. In the network structure of learning engagement and its influencing factors, the "emotional" aspect of professional identity (EI = 1.11) was considered to be an important node with strong centrality. And "academic competence self-efficacy" aspect of academic self-efficacy (BEI = 0.72) was considered an important node with strong transitivity.

Conclusion Deepening medical students' emotional identification with their profession and enhancing their confidence in their academic abilities may improve their learning engagement and educational quality.

Keywords Medical students, College students' speciality identity, Psychological sense of school membership, Academic self-efficacy, Learning engagement, Network analysis

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Introduction

Higher medical education is intricately linked to both education and public welfare initiatives. It is responsible for nurturing medical professionals and advancing medical education, while also playing a crucial role in the establishment of a “Healthy China” [1]. Consequently, the quality of higher medical education is under increased scrutiny as both education and healthcare, essential components of public welfare, demand higher standards. Historically, efforts to enhance educational quality have focused predominantly on external resources such as hardware facilities, faculty strength, and teaching methods [2]. The emergence of educational theories, particularly the “student-centered” approach, has elevated the significance of students’ agency in shaping learning outcomes. The publication of the “Implementation Opinions on the Construction of First-class Undergraduate Courses in 2019” represents a notable advancement in education research, notably integrating the concept of “student learning engagement” into national policy discussions [3]. Consequently, the issue of learning engagement has garnered significant attention, given its close association with academic performance. It serves as a pivotal indicator and determinant in assessing the effectiveness and quality of learning [4–6]. It is essential to study the learning engagement of medical students and its influencing factors.

Learning engagement

Learning engagement, a key factor tied to academic success [4–7], is the positive, fulfilling state shown by students during learning, marked by energy, devotion, and concentration [8]. Students who are more engaged get better grades and improve their personal and professional qualities [6, 7]. It assists teachers in understanding and tailoring teaching to students’ abilities and helps schools foster a conducive learning environment. Influences on student engagement include external factors like school, sense of belonging, and relationships with teachers and peers, and internal factors like motivation, interest, self-efficacy, and identity [8–12]. Various research methods, such as questionnaires, interviews, and observations, have highlighted the impact of individual, family, and school factors on engagement. However, existing research mainly focuses on middle or regular college students, with less emphasis on the unique challenges faced by medical students, who often deal with heavy workloads and intense academic demands. Further study on factors affecting medical students’ engagement is vital for enhancing their academic outcomes.

Academic self-efficacy and learning engagement

Bandura’s theory of social learning underscores the significance of self-efficacy and underscores the interplay

among behavior, individual characteristics, and environmental factors. Academic self-efficacy plays a crucial role in driving learning engagement and academic achievement [13–16], serving as a key determinant of students’ success in various academic contexts [17, 18]. This concept pertains to individuals’ perceptions of their own capabilities to attain academic objectives [19], with previous accomplishments bolstering positive beliefs in their academic performance potential and consequently fostering increased engagement in learning activities and higher prospects for future success. Previous academic setbacks, low expectations, and assessments of academic capabilities can result in considerable personal fatigue [9]. Furthermore, research indicates that individuals with high academic self-efficacy demonstrate increased levels of innovation and participation in scientific endeavors [17], as well as heightened engagement in various modes of learning [20–23]. Additionally, it has been found that high academic self-efficacy can enhance innovation and scientific involvement [24, 25], and reduce the current state of academic and occupational burnout.

Psychological sense of school membership and learning engagement

According to Bandura, behavior, internal cognitive processes, and the environment mutually influence one another, shaping an individual’s behavioral outcomes [26]. The educational environment plays a significant role in shaping the learning engagement of medical students, with schools being a primary source of influence. Consequently, the assessment and acknowledgment of schools have a direct impact on students’ learning behaviors. Psychological sense of school membership pertains to the degree to which students perceive acceptance, inclusion, respect, and support within the school setting [27, 28]. This has a positive effect on students’ mental health and learning behavior [29]. Drawing from Maslow’s hierarchy of needs theory, psychological sense of school membership aligns with students’ foundational needs within the educational context, laying the groundwork for their academic development [30]. Studies have indicated that a strong psychological sense of school membership is associated with increased levels of learning engagement [27, 31, 32], academic achievement [33], academic self-efficacy, and reduces academic fatigue [34]. This factor plays a significant role in shaping students’ learning behaviors. Specifically, an enhanced psychological sense of school membership in preclinical medical students has been linked to improved academic performance, while a decline in this sense is correlated with heightened levels of learning fatigue. Improving students’ psychological sense of belonging to their educational institution has been shown to be an effective strategy for mitigating school fatigue and enhancing academic achievement [35].

College students' speciality identity and learning engagement

The primary intrinsic determinants of medical students' engagement in their studies are their attitudes and evaluations towards their chosen field of study. Developing a strong sense of identification with their chosen field is crucial for the establishment of a professional identity [36]. Speciality identity, on the other hand, pertains to the emotional acceptance and recognition that learners experience after acquiring a comprehensive understanding of the subject matter they are studying. The development of speciality identity in medical students is characterized by positive external behaviors and a sense of appropriateness, reflecting a process of emotional, attitudinal, and cognitive assimilation [37]. The relationship between speciality identity and career identity is particularly significant for medical students, as they share similarities and intersecting influences. Consequently, the establishment of a strong specialty identity not only influences the realization of potential and quality of education, but also impacts work performance and passion in the workplace. The research indicates that speciality identity is closely related to learning engagement, academic performance, and psychological sense of school membership [2]. Therefore, professional identification can be regarded as a pre-variable for learning engagement, integrating cognition, behavior, and emotion, which deserves further investigation.

Previous studies have primarily examined the impact of psychological sense of school membership, academic engagement, and academic self-efficacy on learning engagement using scale-based assessments. However, this scoring-based approach may have certain limitations. Firstly, it is important to note that the reliance on scale scores restricts the comprehensive understanding of the influence of these factors. The proposed method may overlook the fine-grained relationships among dimensions within these psychological or educational constructs and blur the importance of different dimensions [38, 39]. For example, learning engagement is a complex structure that integrates motivation, energy, and focus. However, research based on a holistic perspective neglects the pathways between psychological or educational constructs, which could serve as adjustable targets for enhancing learning engagement and instructional quality. Additionally, this approach assumes causal relationships among four variables, but in fact, all four variables can function as antecedent, mediator, and outcome variables [21, 40, 41]. Therefore, it is possible that there is not a singular causal relationship among these four variables. By applying network analysis, the variables can be placed within a network structure to observe their relationships with each other. Thus, examining the network structure of the four variables at a granular

level is crucial. In this study, network analysis method was employed to investigate the relationships among psychological sense of school membership, academic engagement, academic self-efficacy, and learning investment. The dimensions are unified in a network, aiming to explore key nodes for enhancing medical students' learning engagement and providing evidence for effective methods to enhance learning engagement.

Methods

Participants

This study recruited participants through an online survey platform (www.wenjuan.com). This platform is a comprehensive online tool that supports multiple publication methods, including links and QR codes. Data is automatically stored in the background, and valid data can be filtered based on IP address and response time. Follow this link to go directly to the questionnaire page (<https://www.wenjuan.com/s/UZBZJvv7SI/>). A survey was conducted among 311 medical students from a certain medical university. Among them, there were 212 male students and 99 female students. The median age of the participants was 20, with a range from 18 to 21. The majority of the students surveyed were in their second and third year (first-year students had a shorter period of time in the university and had less familiarity with the school, teachers, and peers, as well as a limited perception of their professional knowledge and skills; fifth-year students were already engaged in hospital internships, thus their experience of university life was not considered in the survey).

Research tools

Revised version of the utrecht work engagement scale-student (UWES-S)

The scale used in this study is the revised version of the Utrecht Work Engagement Scale-Student (UWES-S) developed by Li Xiyong [42]. This version includes three aspects: motivation (referring to individuals' liking for learning and being interested, understanding the significance of learning, and experiencing happiness), energy (referring to individuals being energetic, not easily fatigued in learning, and persisting), and focus (referring to individuals being fully concentrated on learning, reaching a state of self-forgetfulness). The questionnaire consists of 17 questions, using the Likert 7-point scoring method. In this method, a score of 1 represents "never," and a score of 7 represents "always." The higher the score, the higher the individual's level of learning engagement. In this study, the Cronbach's α coefficient for the scale was found to be 0.983, indicating high internal consistency. Additionally, the three dimensions of the scale demonstrated good internal consistency with Cronbach's α coefficients of 0.969, 0.973 and 0.969 respectively.

Chinese version of the psychological sense of school membership (PSSM) scale

The Psychological Sense of School Membership (PSSM) Scale, which is a Chinese version of the scale translated and revised by scholars from Hong Kong, was utilized in this study [43]. The questionnaire encompasses two dimensions: a sense of belonging (including responsibility and pride in the school, positive teacher-student relationships, and good peer relationships) and a sense of resistance (feeling rejected or unrecognized by the school and its members). The questionnaire consists of 18 items and follows a standardized format. A Likert 6-point scoring method was employed, where 1 point represents complete non-compliance and 6 points represent complete compliance. A higher score indicates a stronger sense of belonging to the school. The Cronbach's α coefficient for the scale in this study was calculated as 0.848, demonstrating good internal consistency. The Cronbach's α coefficients for the dimensions were 0.966 and 0.944, respectively.

Academic self-efficacy scale

The scale used in this study is an adapted version of the Academic Self-Efficacy Scale developed by Liang Yusong [44]. The questionnaire consists of 22 items, measuring two dimensions: self-efficacy in learning ability (individuals' judgment and confidence in their ability to successfully complete their studies, achieve good grades, and avoid academic failure) and learning behavior self-efficacy (individuals' judgment and confidence in their ability to adopt specific learning methods to achieve learning goals). The Likert 4-point scale was used for the questionnaire. Scoring method: A score of 1 indicates complete inconsistency, while a score of 4 indicates complete consistency. The higher the score, the higher the perceived academic self-efficacy. The Cronbach's α value of the scale in this study was 0.961, indicating high internal consistency. The scale consists of twoThe Cronbach's

α coefficients for the dimensions were 0.970 and 0.918, respectively.

Questionnaire of college students' speciality identity

The scale used in this study is the College Students' Speciality Identity Scale developed by Qin Panbo [37]. It consists of four dimensions: cognitive dimension (knowledge about the profession), affective dimension (liking for the profession), behavioral dimension (professional behaviors), and appropriateness dimension (degree of match between the profession and oneself). The scale includes 23 items, rated on the Likert 5-point scale, with 1 indicating completely disagree and 5 indicating completely agree. Higher scores indicate stronger professional identification. The Cronbach's α coefficient for the scale in this study was 0.980, and the Cronbach's α coefficients for the four dimensions were 0.927, 0.962, 0.949, and 0.936, respectively.

Network analysis

The Gaussian graphical model (GGM) was employed to estimate this undirected network [45]. In this model, each dimension of the 4-questionnaire is treated as a node, and the partial correlation between two nodes is considered as an edge after statistically controlling for the influence of other nodes. The construction of the network involved nonparametric Spearman correlation, with regularization performed using the Least Absolute Shrinkage and Selection Operator (LASSO) and Extended Bayesian Information Criterion (EBIC) methods [45, 46]. This study utilizes the R-package qgraph to construct and visualize networks. The R-package qgraph is employed to calculate the expected influence (EI) as a centrality index. EI values indicate the importance of a node in the entire network. The higher the EI value, the greater the influence of the node [47]. Bridge expected influence (BEI) is computed using the R-package networktools to measure the expected influence of bridges. BEI serves as a centrality index for bridges. A higher BEI value indicates a higher risk of spreading from the current community to other communities [48] (See Supplementary Material 1 for details). In the current network, nodes are divided into four communities before analysis: psychological sense of school membership (2 nodes), learning engagement (3 nodes), students' speciality identity (4 nodes), and academic self-efficacy (1 node).

Results

Overall situation of medical students' psychological sense of school membership, speciality identity, academic self-efficacy and learning engagement

The mean scores and standard deviations for each variable are shown in Table 1. The average score for medical students' psychological sense of school membership

Table 1 Descriptive statistics and network analysis indicators for each dimension variable

dimension	M \pm SD	EI	BEI
A1:sense of belonging	4.63 \pm 1.09	0.20	0.52
A2:sense of resistance	2.27 \pm 1.32	-0.41	-0.09
B1:motivation	5.48 \pm 1.32	1.01	0.51
B2:energy	4.96 \pm 1.53	0.95	0.10
B3:focus	5.02 \pm 1.41	1.02	0.37
C1:appropriateness	4.15 \pm 0.75	0.76	0.17
C2:cognitive	4.17 \pm 0.77	0.97	0.10
C3:behavioral	4.16 \pm 0.79	1.01	0.16
C4:affective	4.03 \pm 0.84	1.11	0.64
D1:self-efficacy in learning ability	3.18 \pm 0.66	1.06	0.72
D2:learning behavior self-efficacy	2.98 \pm 0.64	0.51	0.17

was 4.38 ± 1.00 . The average score for their speciality identity was 4.12 ± 0.74 . The average score of academic self-efficacy is 3.08 ± 0.61 . The average score for learning engagement was 5.16 ± 1.34 . They were all higher than the corresponding theoretical average scores of 3, 2.5, 2, and 3.5 respectively.

Network analysis of medical students' psychological sense of school membership, speciality identity, academic self-efficacy and learning engagement

According to Fig. 1, this network structure has characteristics. First, among the 55 potential edges, there are 34 edges that are non-zero. It included 4 negatively correlated edges and 30 positively correlated edges. And all 4 negative edges are related to resistance to school belonging. There are four distinct clusters within the network, suggesting different subgroups or patterns of relationships. Secondly, the strongest connections in the network appear in the "learning engagement" and "professional identification" within the community. In "learning engagement", "vigor" and "focus" have the strongest correlation (weight=0.495). In "professional identification", "cognitive" and "behavioral" have a stronger correlation (weight=0.407). There are also strong connections across communities. "Emotional" in "professional identification" strongly associated with "academic self-efficacy" and "ability self-efficacy" (weight=0.334). "Sense of belonging" in "school belonging" strongly related to "motivation" in "learning engagement" (weight=0.205). All edge weights are seen in Supplementary Table 1. The bootstrapped 95% CI was narrow, suggesting that the estimation of edge weights was accurate and stable

(Supplementary Fig. 1). The bootstrapped difference test for edge weights is shown in Supplementary Fig. 2.

Importance of nodes is evaluated by their EI values in the network. As shown in Fig. 2a; Table 1, emotionality (EI=1.11) and self-efficacy of learning ability (EI=1.06) are relatively high, making them the most important central nodes. Moreover, the stability coefficient of EI (CS=0.75) is high, indicating a stable estimation of EI (see Supplementary Fig. 3). The result of the bootstrapped difference test for node EI is shown in Supplementary Fig. 4. BEI values indicate the importance of nodes in transmitting to other communities in the network. As shown in Fig. 2b; Table 1, self-efficacy (BEI=0.72) and affectivity (BEI=0.64) are relatively high, being key bridge nodes. Additionally, the stability coefficient of BEI (CS=0.75) is high, indicating a stable estimation of BEI (see Supplementary Fig. 5). The result of the bootstrapped difference test for node BEI is shown in Supplementary Fig. 6.

(a) Expected influence (EI).

(b) Bridge expected influence (BEI).

Discussion

The research status of students' learning engagement and its influencing factors

Medical students exhibit positive perceptions and behaviors in school, consistent with previous research findings [2]. Specifically, medical students have a strong sense of belonging to their school, indicating their acceptance and satisfaction with the institution. They generally have a high level of identification with their chosen major, with

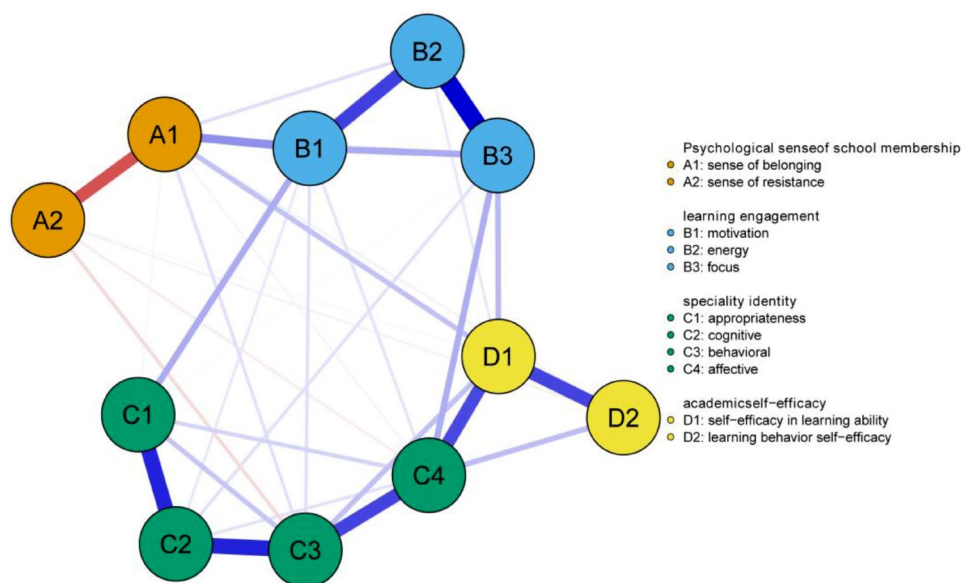


Fig. 1 The network structure diagram of medical students' psychological sense of school membership, speciality identity, academic self-efficacy and learning engagement

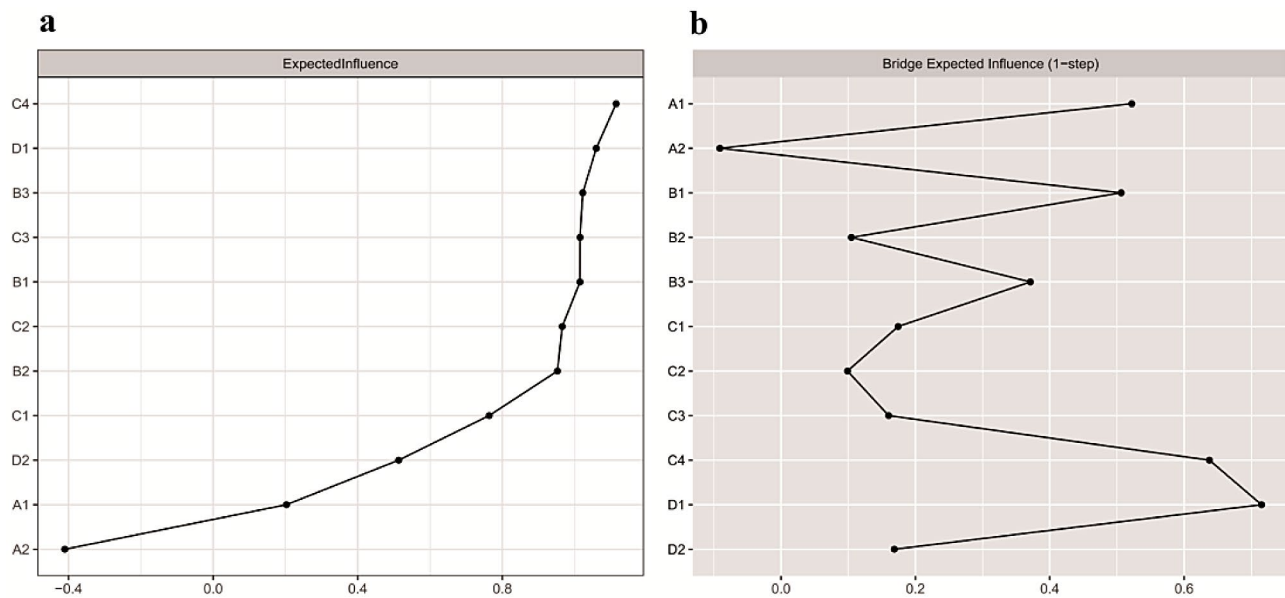


Fig. 2 The expected influence and bridge expected influence of each node in the present network (raw value)

the highest cognitive identification and lowest affective identification. This suggests that while medical students have a good understanding of their chosen field, they may have lower emotional engagement, possibly due to academic pressure and related emotions. Medical students are confident in completing their studies, with higher self-efficacy in learning ability and lower self-efficacy in learning behavior. This indicates that medical students have a positive and objective evaluation of their own learning ability, but lack confidence in adopting effective methods to achieve learning goals. The above results are similar to those of previous studies [49, 50]. The performance of Chinese college students in speciality identity, psychological sense of school membership and academic self-efficacy is above average. Lastly, medical students generally exhibit a positive and engaged attitude towards learning, although they may have slightly lower motivation, energy, and focus. But the results are different from those of previous studies. Researchers believe that the phenomenon of insufficient learning engagement is common among Chinese college students, especially among vocational nursing students [49, 51–53]. This may have something to do with the difference in major. Medical undergraduates have heavy academic tasks and many assessments. In order to meet the assessment standards, medical students have to increase their learning engagement to improve their academic performance.

Important nodes in network analysis: emotion and ability self-efficacy

Network analysis reveals the relationships between dimensions of the four variables. The most important among them are the values of EI and BEI in the network.

In the current network, the highest EI and BEI values are found in “Emotion” in the dimension of “Professional Identity” and “Ability Self-efficacy” in the dimension of “Academic Self-efficacy”.

Firstly, professional identity is frequently in positive correlation with learning engagement [54, 55]. Especially in the majors of medicine or education, the positive role of professional identity in learning engagement is extremely important [56]. Some studies suggest that professional identity refers to the acceptance and recognition of the learned courses from the learner’s heart, which is transformed into external behavioral motivation. It is a process of gradual transfer of emotions, attitudes, and even cognitions [54, 57]. Therefore, particular attention is paid to the positive prediction of emotional identity in professional identity on learning engagement, and this is consistent with the results of this study. Social and Emotional Learning (SEL) emphasizes the importance of emotions in education and recognizes the interconnection between cognition and emotions [58]. Therefore, a large body of research has shown the impact of SEL on students’ academic achievement, and it has been proven to be a predictive factor for students’ success in school [58–60]. Therefore, within the dimension of Professional Identity, emotion plays a significant role in influencing cognition and behavior. The social and emotional learning also contributes to students’ attention regulation and reshaping of learning behavior. In this network, emotion serves as a highly influential node, which can affect the nodes of focus, behavior, and self-efficacy, consequently influencing learning engagement, professional identification, and academic self-efficacy. In addition to the direct impact of professional identity (especially emotional

identity) on learning engagement [61, 62], there is also an indirect impact, mainly mediated by self-efficacy [49, 50, 63].

Secondly, the theory of self-efficacy suggests that self-efficacy regulates the relationship between learning goals and learning behavior, serving as a determinant of learning behavior [64]. Academic self-efficacy refers to individuals' subjective judgment of their own learning abilities, which primarily functions to regulate and control learning behavior, thereby influencing learning outcomes [49–51]. High academic self-efficacy students are more likely to select challenging learning tasks persist in completing them with confidence, achieving positive results [65–67]. And in this process, they exhibit courage in facing challenging learning tasks, demonstrating resilience and a proper understanding of their abilities. They are not easily discouraged by setbacks and remain confident in overcoming obstacles, leading to progress and success in their academic endeavors [68]. Students with high academic self-efficacy attribute success to their own high abilities and failure to insufficient effort. As a result, they do not experience negative academic emotions such as inferiority. With a positive mindset, they approach every academic progress and failure, learning from their experiences and continuously striving for better academic performance [64, 69]. Therefore, academic self-efficacy plays an important role in the network, with strong transmission ability to various aspects such as emotions, behavior, and cognition, ultimately influencing learning engagement. However, researchers have not carried out separate studies on the two distinct dimensions of academic self-efficacy. This study reveals that academic ability self-efficacy has stronger transmissibility than academic behavior self-efficacy and can impact other communities (professional identity, sense of belonging, and learning engagement) within the current network. This could be because academic ability self-efficacy is the recognition of and self-confidence in one's own abilities, thereby stimulating greater enthusiasm and interest in learning engagement [68]. Moreover, the positive feedback in learning and the recognition of one's major lead to the continuous improvement of one's abilities during the learning process, and the stronger the self-identity becomes [70].

Limitations

Although this study has obtained some results and implications, there are still some limitations. First of all, although the educational and psychological constructs measured in this paper are students' subjective feelings, we have to admit that self-reported measurement methods may bring some biases, such as social approval effects. In the follow-up study, we can consider the objective indicators such as academic performance

and other evaluation methods to determine the relationship between medical students' learning engagement and its influencing factors. Secondly, this paper adopts cross-sectional data, which may not capture the long-term change and development trend of students, nor can it accurately infer the directional relationship in the network. Tracking students and recording data could be considered in the future to achieve richer results. Last but not least, this sample selected medical students from the first to the fourth year. Medical students in different grades may face different pressures of study and life, professional knowledge and clinical experience, which may affect the research results. Moreover, the non-inclusion of students in other grades or other types of medical education (such as graduate students, advanced students, etc.) limits the generalization of the findings in the broader field of medical education. Future studies can include more types of medical students and expand the sample size, respectively discuss the learning input of medical students at each stage and its influencing factors, and determine better and more accurate methods to promote the learning input of medical students, so as to improve the quality of higher medical education.

Conclusion and recommendations

In conclusion, medical students exhibit predominantly positive attitudes and behaviors within their academic environment, yet there remains substantial room for improvement. Within the network of learning engagement factors, "affective" in college students' speciality identity is the node with the greatest expected impact in the entire network, and "self-efficacy in learning ability" in academic self-efficacy is the node with the greatest expected bridge impact (transmissibility) in the network. Both of them are the target goals that affect medical students' learning engagement and important elements for academic performance emerge as. Consequently, targeting these domains could enhance medical students' learning engagement, ultimately contributing to the overall quality of education.

Deepening medical students' identification with their own profession from an emotional perspective. Medical students have already understood the medical profession and future career prospects from the aspects of cognition and behavior. However, the degree of identification with this profession is influenced by academic pressure, responsibility risks, public opinion, and the potential doctor-patient relationship. Therefore, it is necessary to strengthen the cultivation of humanistic spirit for medical students in the new era, and pay attention to the following cultivation methods:

- 1) Clarify the purpose of traditional medical education, strengthen the guidance of medical students'

professional thoughts, reduce anxiety and panic about future employment positions, and further enhance medical students' sense of professional identity.

- 2) Increase the cultivation of high-level medical and health talents. The process from medical students to medical professionals requires a long-term cultivation process. Only with further development of incentive systems and improvement of teaching quality can medical students have greater learning motivation and professional identity.
- 3) Create a good school atmosphere, improve medical students' favorable impression and identification with the school and profession from internal and external conditions.

Improving academic self-efficacy is instrumental in fostering deeper engagement in learning among medical students. To enhance their academic self-efficacy, the following strategies can be employed:

- 1) Increase direct experiences of success: Educators should progressively escalate the difficulty of learning tasks to afford students more opportunities for successful outcomes.
- 2) Facilitate vicarious experiences: Teachers can model effective practices or showcase successful student role models, allowing medical learners to relate to similar success and failure scenarios, which in turn influences their self-efficacy.
- 3) Strengthen social support: Encouragement, trust, and backing from teachers, family, friends, and peers contribute to a student's belief in their ability to overcome challenges, thereby prompting greater effort in tackling demanding academic tasks.
- 4) Cultivate positive emotions: Given the reciprocal relationship between emotions and self-efficacy, cultivating positive emotions enhances motivation, learning efficiency, and outcomes, fostering confidence. This can be achieved by promoting a supportive learning environment, providing constructive feedback, and maintaining harmonious teacher-student relationships.

These approaches, grounded in Bandura's self-efficacy theory, maybe helpful for enhancing the academic performance and dedication of medical students.

Based on our analysis, we have identified affective and academic self-efficacy as pivotal elements in the construct of college students' speciality identity, psychological sense of school membership, academic self-efficacy, and academic engagement. Focusing on the cultivation of humanistic spirit among medical students and the enhancement of their academic self-efficacy, particularly

targeting professional identity, can lead to a student-centered approach that promotes increased academic investment and improved academic performance. Such an approach is instrumental in augmenting the overall quality of medical education, thereby solidifying the foundation for the development of competent medical professionals.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12909-024-05908-y>.

Supplementary Material 1

Supplementary Material 2

Author contributions

Li, Y.: Formal analysis, Visualization, Writing - original draft. Wu, L.: Conceptualization, Investigation. Li, F.: Investigation, Writing - Review & Editing. Fang, P.: Resources, Investigation, Data curation. Liu, X.: Supervision, Writing - Review & Editing, Project administration. Wu, S.: Funding acquisition, Supervision, Writing - Review & Editing, Project administration.

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Data availability

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

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the ethical standards put forth in the Declaration of Helsinki. Written informed consent was obtained from all individual participants included in the study. The study design and procedures were reviewed and approved by the Independent Ethics Committee of the First Affiliated Hospital of the Fourth Military Medical University.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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References

1. Gan Y. Optimization strategies for the Training Program of Clinical Medical undergraduates in the context of Healthy China. Army Medical University, Department of Military Preventive Medicine; 2020.
2. Li R. The Impact of College Students' Major Identification on Learning Engagement: A Chain Mediating Role of School Belonging and Academic Self-Efficacy. Department of Public Administration, South China University of Technology; 2018.
3. Yang L. Optimization Study of College Students' Learning Engagement from the Perspective of Embodied Cognition Theory. Hunan University of Science and Technology; 2022.
4. Mizani H, Cahyadi A, Hendryadi H, Salamah S, Retno Sari S. Loneliness, student engagement, and academic achievement during emergency remote teaching during COVID-19: the role of the God locus of control. *Humanit Social Sci Commun* 2022, 9(1).

5. Xie K, Vongkulluksn VW, Lu L, Cheng S. A person-centered approach to examining high-school students' motivation, engagement and academic performance. *CONTEMP EDUC PSYCHOL*. 2020;62:101877.
6. Zheng Z, Zeng M, Huang W, Sun N. The influence of university library environment on student interactions and college students' learning engagement. *Humanit Social Sci Commun* 2024, 11(1).
7. Skinner EA, Belmont MJ, Levin JR. Motivation in the Classroom: reciprocal effects of Teacher Behavior and Student Engagement across the School Year. *J EDUC PSYCHOL*. 1993;85(4):571–81.
8. Schaufeli WB, Martínez IM, Pinto AM, Salanova M, Bakker AB. Burn-out and Engagement in University students. *J CROSS CULT PSYCHOL*. 2002;33(5):464–81.
9. Dominguez Lara SA, Fernández Arata M, Seperak Viera RA. Análisis psicométrico De Una Medida ultra-breve para El engagement académico: UWES-3S. *Revista Argentina De ciencias Del Comportamiento*. 2021;13(1):25–37.
10. Hu Z, Shan N, Jiao R. The relationships between perceived teacher autonomy support, academic self-efficacy and learning engagement among primary school students: a network analysis. *EUR J PSYCHOL EDUC* 2023.
11. Zhao H, Zhang Z, Heng S. Grit and college students' learning engagement: serial mediating effects of mastery goal orientation and cognitive flexibility. *CURR PSYCHOL*. 2024;43(8):7437–50.
12. Huang L, Li X, Meng Y, Lei M, Niu Y, Wang S, Li R. The mediating effects of self-directed learning ability and critical thinking ability on the relationship between learning engagement and problem-solving ability among nursing students in Southern China: a cross-sectional study. *BMC Nurs* 2023, 22(1).
13. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *PSYCHOL REV*. 1977;84(2):191–215.
14. Derakhshan A, Fathi J. Grit and Foreign Language Enjoyment as predictors of EFL Learners' Online Engagement: the mediating role of online learning self-efficacy. *Asia-Pacific Educ Researcher* 2023.
15. Koh J, Farruggia SP, Back LT, Han C. Self-efficacy and academic success among diverse first-generation college students: the mediating role of self-regulation. *SOC PSYCHOL EDUC*. 2022;25(5):1071–92.
16. Ibrahim RK, Aldawari AN. Relationship between digital capabilities and academic performance: the mediating effect of self-efficacy. *BMC Nurs*. 2023;22(1):434.
17. Zhao B, Zhang Y, Liu X, Zhang J. The Mediating Role of Academic Self-Efficacy in the relationship between emotional resilience and learning burnout among vocational nursing students. *J Bengbu Med Coll*. 2024;49(01):133–6.
18. Zhao S, Chen Z. The mediating role of self-efficacy in college students' positive academic emotions and achievement goal orientation. *Chin J Health Psychol*. 2022;30(01):156–60.
19. DiBenedetto MK, Schunk DH. Assessing Academic Self-efficacy. In *Academic Self-efficacy in Education: Nature, Assessment, and Research*. Edited by Khine MS, Nielsen T. Singapore: Springer Singapore; 2022:11–37.
20. Cai L, Jia X. The relationship between academic self-efficacy and Online Learning Engagement: the Mediating Role of Learning Motivation and Flow Experience. *Psychol Behav Res*. 2020;18(06):805–11.
21. Li D, Wang P. The influence of medical education environment perception on medical students' learning engagement: the mediating role of academic self-efficacy. *J China Med Univ*. 2020;49(04):357–61.
22. Liu F, Jin S, Yan T. A study on the correlation between distance learning engagement and professional identity and self-efficacy of medical students. *Health Vocat Educ*. 2024;42(04):30–3.
23. Seyum Getenet RCP. Students' digital technology attitude, literacy and self-efficacy and their effect on online learning engagement. *Int J Educational Technol High Educ* 2024, 21(3).
24. Han X, Xu Q, Xiao J, Liu Z. Academic atmosphere and graduate students' innovation ability: the role of scientific research self-efficacy and scientific engagement. *EUR J PSYCHOL EDUC* 2023.
25. Huang J, Zhou L, Zhu D, Liu W, Lei J. Changes in academic self-efficacy and value and crossover of Burnout among adolescent students: a two-wave longitudinal study. *J YOUTH ADOLESCENCE*. 2023;52(7):1405–16.
26. Bandura A. Social foundations of thought and action: a social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall, Inc; 1986.
27. Zeng WG, Hu R. The influence of school belonging on learning engagement of higher vocational college students: the chain mediating role of academic self-efficacy and positive academic emotion. *J Wuhan Vocat Coll Transp*. 2022;24(03):79–85.
28. Goodenow C, Grady KE. The relationship of School Belonging and friends' values to academic motivation among Urban adolescent students. *J Experimental Educ*. 1993;62(1):60–71.
29. Murat Yıldırım HYHB. School Belongingness and Internalizing and externalizing problems in adolescents: exploring the influence of Meaningful School. *CHILD INDIC RES*. 2023;16(5):2125–40.
30. An L, Xu B, Han Z, Qi H. The influence of college students' sense of belonging on learning engagement: the mediating role of life history strategies. *J Xianyang Normal Univ*. 2023;38(02):94–8.
31. Guo J, Liu Y, Yang L. Influencing mechanism and model of college students' learning engagement: based on a survey of 311 undergraduate colleges and universities. *Educational Res*. 2021;42(08):104–15.
32. St-Amand J, Smith J, Goulet M. Is teacher humor an asset in classroom management? Examining its association with students' well-being, sense of school belonging, and engagement. *CURR PSYCHOL*. 2024;43(3):2499–514.
33. Qiu X, Zhu H, Gao M, Rao B. The relationship between school belonging and academic achievement: a meta-analysis of Chinese students. *J Corps Educ Coll*. 2024;34(01):41–50.
34. Yu W, Yao W, Chen M, Zhu H, Yan J. School climate and academic burnout in medical students: a moderated mediation model of collective self-esteem and psychological capital. *BMC Psychol*. 2023;11(1):77.
35. Servet Aker. Mustafa Kürşat Şahin: the relationship between school burnout, sense of school belonging and academic achievement in preclinical medical students. *ADV HEALTH SCI EDUC*. 2022;27(4):949–63.
36. van Oorschot F, Brouwers M, Muris J, Veen M, Timmerman A, Dulmen SV. How does guided group reflection work to support professional identity formation in postgraduate medical education: a scoping review. *MED TEACH* 2023:1–11.
37. Qin P. The characteristics and related research of college students' professional identity. Southwest University; 2009.
38. Fried EI, Epskamp S, Nesse RM, Tuerlinckx F, Borsboom D. What are 'good' depression symptoms? Comparing the centrality of DSM and non-DSM symptoms of depression in a network analysis. *J AFFECT DISORDERS*. 2016;189:314–20.
39. Fried EI. Problematic assumptions have slowed down depression research: why symptoms, not syndromes are the way forward. *FRONT PSYCHOL* 2015, 6.
40. Lin H, Wang F. The impact of perceived discrimination on learning burnout of part-time graduate students: the chain mediating role of time management inclination and academic self-efficacy. *Chin J Health Psychol*. 2023;31(03):429–34.
41. Huo Y, Shen Y. The influence of learning engagement on vocational college students' psychological capital: the mediating effect of learning outcomes. *J Higher Educ*. 2024;10(52):61–7.
42. Li X, Huang R. A revised report on the Learning Engagement Scale for College Students (UWES-S). *Psychol Res*. 2010;3(01):84–8.
43. Hoi Yan Cheung SKFH. Mainland immigrant and Hong Kong local students' psychological sense of School Membership. *ASIA PAC EDUC REV*. 2003;4(1):67–74.
44. Liang Y. A study on college students' achievement goals, attribution style and academic self-efficacy. Central China Normal University; 2000.
45. Epskamp S, Waldorp LJ, Mottus R, Borsboom D. The gaussian graphical model in cross-sectional and time-Series Data. *Multivar Behav Res*. 2018;53(4):453–80.
46. Friedman J, Hastie T, Tibshirani R. Sparse inverse covariance estimation with the graphical lasso. *BIostatistics*. 2008;9(3):432–41.
47. Foygel R, Drton M. Extended bayesian information criteria for gaussian graphical models. Ithaca: Cornell University Library, arXiv.org; 2010.
48. Byrne ME, Tanofsky Kraff M, Lavender JM, Parker MN, Shank LM, Swanson TN, Ramirez E, LeMay Russell S, Yang SB, Brady SM, et al. Bridging executive function and disinhibited eating among youth: a network analysis. *INT J EAT DISORDER*. 2021;54(5):721–32.
49. Liao M, Xie Z, Ou Q, Yang L, Zou L. Self-efficacy mediates the effect of professional identity on learning engagement for nursing students in higher vocational colleges: a cross-sectional study. *Nurse Educ Today*. 2024;139:106225.
50. Chen Q, Zhang Q, Yu F, Hou B. Investigating Structural relationships between Professional Identity, Learning Engagement, Academic Self-Efficacy, and University support: evidence from Tourism students in China. *Behav Sci*. 2023;14(1):26.
51. Liu K, Zhang XM, Zheng SS, Zhu L, Li W. Mediating effect of self-efficacy between personality traits and learning engagement in nursing undergraduates. *Chin J Mod Nurs*. 2021;27(26):3622–7. <https://doi.org/10.3760/cmaj.cn115682-20210125-00395>.
52. Li Z-Y, Pan J-B, Jiang S-Y, Wang C-F, Jia X-J, Li Q. The status of online learning engagement and learning adaptability of associate nursing

- students. *Chin J Nurs Educ*. 2020;17(11):1014–7. <https://doi.org/10.3761/j.issn.1672-9234.2020.11.011>.
53. Ma Y. The impact of academic self-efficacy and academic motivation on Chinese EFL students' academic burnout. *Learn Motiv*. 2024;85:1–9. <https://doi.org/10.1016/j.lmot.2024.101959>.
 54. Yu F, Chen Q, Hou B. Understanding the impacts of Chinese undergraduate tourism students' professional identity on learning engagement. *Sustainability*. 2021;13:13379.
 55. Liu LJ. A study on the impact of Role Identity on Learning Engagement among College Students. *Yichun Univ*. 2017;7:116–20.
 56. Wang P, Sun JH, Ji F. A study on the relationship between Learning Engagement and Professional Identity among Medical College Students. *China High Med Educ*. 2018;9:39–40.
 57. Wang DM, Liu YC. Survey on Professional Identity of Master's students. *Res High Educ China*. 2007;8:18–22.
 58. Yang T, Huang X. From natural person to Social Person: the practical framework and promotion strategy of Social Emotional Learning at Harvard University. *Global Educ Outlook*. 2024;53(02):151–60.
 59. Raver CC. Emotions matter: making the case for the role of young children's emotional development for early school readiness. *Soc Policy Rep*. 2002;16:1–20. <https://doi.org/10.1002/j.2379-3988.2002.tb00041.x>.
 60. Bierman KL, Domitrovich CE, Nix RL, Gest SD, Welsh JA, Greenberg MT, et al. Promoting academic and social-emotional school readiness: the head start REDI program. *Child Dev*. 2008;79:1802–17. <https://doi.org/10.1111/j.1467-8624.2008.01227.x>.
 61. Engels MC, Spilt J, Denies K, Verschueren K. The role of affective teacher-student relationships in adolescents' school engagement and achievement trajectories. *Learn Instr*. 2021;75:101485. <https://doi.org/10.1016/j.learninstruc.2021.101485>.
 62. Hasnine MN, Nguyen HT, Tran TTT, Bui HT, Akçapınar G, Ueda H. A real-time learning analytics dashboard for automatic detection of online learners. *Affect States Sens*. 2023;23:4243. <https://doi.org/10.3390/s23094243>.
 63. Luo Q, Chen L, Yu D et al. The mediating role of learning engagement between self-efficacy and academic achievement among Chinese college students. *Psychol Res Behav Manage*, 2023: 1533–43.
 64. Feng Z, Wu X, Yao M, Wang J. *Educational Psychology (3rd edition)*. Beijing: People's Education Press; 2015.
 65. Martínez BMT, del Carmen Pérez-Fuentes M, Jurado MMM. The influence of perceived social support on academic engagement among adolescents: the mediating role of self-efficacy. *Anales De Psicología/Annals Psychol*. 2024;40(3):409–20.
 66. Gan Y, Zhang J, Wu X, et al. Chain Mediating effects of Student Engagement and Academic Achievement on University Identification. *SAGE Open*. 2024;14(1):21582440241226903.
 67. Wei L. Relationship among Perceived Teacher Support, Academic Self-Efficacy, and Online Learning Engagement in College EFL Learning. *Open J Mod Linguistics*. 2024;14(3):290–314.
 68. WU J, FU H. A meta-analysis of the relationship between achievement goal orientation and academic achievement: the mediating role of self-efficacy and student engagement. *Adv Psychol Sci*. 2024;32(7):1104.
 69. Karakus M. Understanding the mastery-avoidance goals construct: An investigation among middle school students in two domains (Unpublished doctoral dissertation). Temple University, Philadelphia
 70. Dai X. A study on mindful agency's influence on college students' engagement with online teaching: the mediating roles of e-learning self-efficacy and self-regulation. *Acta Psychol*. 2024;243:104146.

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