Unlocking academic achievement of nursing master's students: ethical leadership, teacher-student relationship and growth mindset – a cross-sectional survey study

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Abstract

Background Academic achievement is a critical indicator of teaching quality. There has been limited exploration into the mechanisms underlying academic achievements among nursing master's students. This study investigated the relationship between ethical leadership and academic achievements, focusing on how the teacher-student relationship and growth mindset mediate this relationship.

Methods A cross-sectional study was conducted with 262 participants who completed online questionnaires. Data were analyzed using Pearson correlation analysis, structural equation model testing, and deviation correction quantile bootstrap method.

Results The average academic achievement score was 51.26 (SD = 5.963). There were significant correlations between ethical leadership, teacher-student relationship, growth mindset, and academic achievement (r = 0.183 to 0.701, $P < 0.01$). Ethical leadership had a direct positive effect on academic achievement (effect value = 0.224), accounting for 58.49% of the total effect. Mediation analysis revealed that ethical leadership influenced academic achievement through three pathways: ethical leadership → teacher-student relationship → academic achievement (effect value = 0.050), ethical leadership → growth mindset → academic achievement (effect value = 0.080), ethical leadership → teacher-student relationship → growth mindset → academic achievement (effect value = 0.029).

Conclusions These findings support our hypothesis that the teacher-student relationship and growth mindset mediate the relationship between ethical leadership and academic achievement. To enhance the academic achievement of nursing master's students, it is crucial to foster positive teacher-student relationship and promote a growth mindset.

Keywords Ethics, Leadership, Academic achievement, Teacher-student, Growth mindset, Nursing master's student

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Background

Academic achievement of nursing master's students

Academic achievement refers to the knowledge, skills, and experiences acquired during learning process [1]. It is a key indicator for assessing the quality of school education and students' learning outcomes [2]. Graduate education is an integral part of the higher education system, essential in cultivating comprehensive nurses. However, nursing students faced a disproportionately high rate of academic failure, as highlighted by Lewis [3]. This issue not only induced negative emotions and mental health issues among students but also disrupted the balance between the supplies and demands of nursing professionals, leading to wasted educational resources and exacerbating workforce shortages in the healthcare system.

Good academic achievement boosts nursing master's students' sense of personal accomplishment, enabling them to delve deeper into academic research and practical work. Previous studies had explored factors related to academic achievement [1, 4], such as personal, supervisor, and environmental factors, but there is a lack of evidence for formation pathways and causality. To address this gap, further research is needed to identify the key influences and mechanisms that drive academic success, particularly within the context of advanced nursing education.

The influence of ethical leadership on academic achievement

"Foster morality and educate individuals" is the core of higher education. Educators expect to shape students' personalities through knowledge dissemination, cultivating individuals with ethical and cultural qualities. The umbrella term of "supervisor" can include roles as an educator, role model, leadership, and assessor [5]. In graduate nursing education, the supervisor serves as an academic mentor, a key supporter in clinical practice and a guide for professional development [6]. Previous studies indicated that supervisors' traits, such as support, care, and civility, foster a culture of harmony, trust, and respect, enhance the performance and motivation of nursing students [7]. Ethical leaders inspire students to focus more on their studies, increase academic engagement, cultivate good habits, and achieve academic achievement [8]. The diversification and practicality of nursing master's education courses determine that teachers' ethical education for students is related to daily management and academic guidance [9]. This study proposes Hypothesis 1: Ethical leadership can positively predict academic achievement.

The mediating effect of teacher-student relationship

The teacher-student relationship is a multifaceted interpersonal bond. A positive teacher-student relationship is essential for high-quality teaching and learning, building a sense of community, and to promoting the motivation to learn [10]. From a psychological perspective [11], a distant student-teacher relationship can deplete graduate students' psychological resources and mental well-being, leading to increased depression and aggression, thus negatively impacting academic achievements. The "Reciprocity Theory" [12] points that teachers and students exchange resources to promote cooperation and reciprocal relationships. An ethical teacher guides, encourages, and supports students, helping them realize learning values. The student union contributes to the team based on the teacher's advice, leading to high-quality academic progress. A positive teacher-student relationship creates a harmonious ethical leadership environment, and the role modeling of ethical leaders enhance*s* the stability and enthusiasm of the relationship. This study proposes Hypothesis 2: The teacher-student relationship mediates between ethical leadership and academic achievement.

The mediating effect of growth mindset

Mindset is derived from evaluations of abilities and intelligence. Different mindsets form the basis for students to set academic goals and solve problems [13]. Students with a growth mindset believe that intelligence and abilities can be developed through environment, education, and methods such as continuous learning [14]. Previous studies indicated that [15] students with a growth mindset view difficulties and challenges as learning opportunities for learning. They are dedicated to improving academic performance and accomplishing target tasks.

Educators are not only responsible for imparting knowledge but also serve as guides for students' healthy mental development. Educators with high ethical standards maintain an optimistic attitude and use positive words to motivate student growth. Under the leadership of ethical teachers, students will recognize the value of hard work and will be more willing to embrace new challenges, actively participating in exploration. We propose Hypothesis 3: Growth mindset mediates the relationship between ethical leadership and academic achievement.

The chain mediating effect of teacher-student relationship and growth mindset

A positive teacher-student relationship, built on mutual respect and trust, is crucial for fostering a growth mindset among students. When educators provide supportive feedback and create an environment conducive to learning and exploration, students are more inclined to embrace challenges and learn from setbacks [16]. Such interactions reinforce students' belief that their abilities can be enhanced through effort and perseverance. Ethical leaders build relationships with students based on trust and respect through their exemplary conduct and

integrity-driven leadership style. These relationships offer students support and encouragement throughout their learning journey, enhancing their ability to tackle challenges effectively and achieve greater academic success. Combining Hypotheses 2 and 3, we propose Hypothesis 4: The teacher-student relationship and growth mindset mediate the chain between ethical leadership and academic achievement.

Educators should place greater emphasis on fostering the relationship between ethical leadership and academic achievement, given its importance in shaping educational outcomes. This study addresses a critical gap by examining the impact of ethical leadership on academic achievement among nursing master's students, with a specific focus on the mediating roles of the teacher-student relationship and growth mindset. By exploring these mechanisms, the study provides valuable insights into the pathways of academic success, offering a foundation for designing systematic and evidence-based intervention strategies to enhance academic performance and support professional development in nursing education.

Materials and methods
The hypothesis of this study
This study investigated the internal mechanisms between ethical leadership and academic achievement by establishing a chain-mediated model (Fig. 1). Hypotheses 1, 2, 3, and 4 were tested to explore the relationships between ethical leadership, teacher-student relationship, growth mindset, and academic achievement, providing a theoretical basis for improving the academic achievement of nursing master graduates.

Study design and setting
This study was a web-based cross-sectional survey in May 2023, targeting nursing master's students from two universities and two comprehensive hospitals with a nursing master's degree in Wuhan, Hubei Province, China (web sites for online questionnaires: the 'Questionnaire Star', https://www.wjx.cn).

Participants
The sample size for the cross-sectional survey was calculated using the formula $N = (Z_{1-\alpha/2}*\sigma/\delta)^2$, where $Z_{1-\alpha/2} = 1.96$, allowable error $\delta = 2.00$, and the pre-survey results indicated that the standard deviation of academic achievement scores for nursing master's students σ is 11.980. Considering a 20% non-response rate and potential sampling error, the estimated sample size required was 173 cases. A larger sample size is needed to analyze mediating effects.

Instrument
#### General information questionnaire
We designed a general information questionnaire in the previous research [17] and discussions among the research group members. The questionnaire included 18 variables: age, grade, et al.

Ethical leadership scale
The scale was designed by Zhang [18] to assess the relationship between leaders and employees or students. It comprised three dimensions: ethical fairness, role definition, and power sharing, and consists of 17 items. Each item was assigned a score of 1–5 points from "completely non-compliant" to "completely compliant". A higher score indicated that the leader had more excellent qualities. The cumulative variance contribution rate of the scale was 70.029%, and Cronbach's α coefficient was 0.925. In this study, the Cronbach's α coefficient was 0.869.

Teacher-student relationship scale
The scale was designed by Xu et al. [19] based on the " relationship quality theory ", mainly used to measure the quality of teacher-student relationship among Chinese master's students. It consisted three dimensions: satisfaction, trust, and commitment, with 17 items. Each item was assigned a score of 1–5 points from "completely disagree" to "strongly agree". The higher the score, the better the quality of the teacher-student relationship. The cumulative variance contribution rate of the scale is
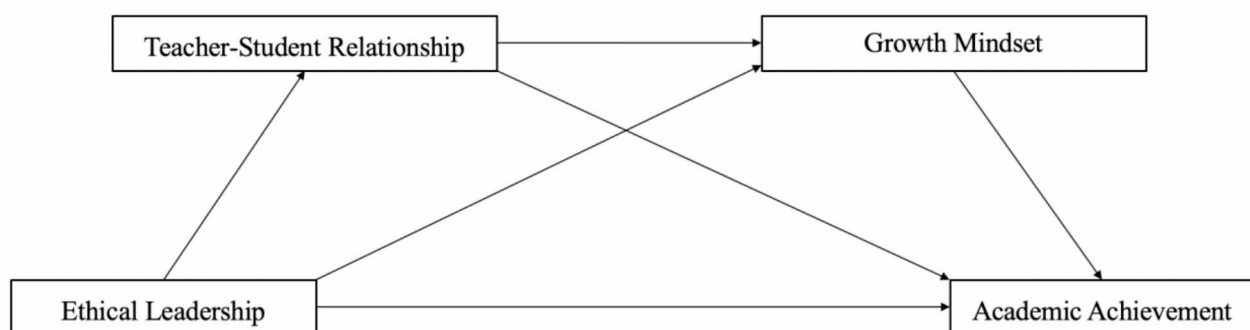
Fig. 1 Chain mediation model diagram

63.01%, the content validity index was 0.961, Cronbach's α coefficient was 0.939, and the test-retest reliability after 2 weeks was 0.923. In this study, the Cronbach's α coefficient was 0.933.

Growth mindset scale

The scale was designed by Dweck et al. and revised by Xiao et al. [20], primarily used to assess an individual's perception of positive traits such as perseverance and progress achieved through acquired effort. It included three items, each scored from 1 to 6 based on responses ranging from "completely disagree" to "completely agree". Higher scores indicated individuals who possessed a more growth mindset. It had a cumulative variance contribution rate of 68.605% and a Cronbach's α coefficient of 0.771. In this study, the Cronbach's α coefficient was 0.823.

Academic achievement self-assessment scale

The scale was designed by Li et al. [21] mainly used to measure the knowledge and skills that students acquire during their school years. The scale encompassed four dimensions, namely, learning cognitive skills, communication skills, self-management skills, and interpersonal facilitation skills, with 14 items. Each item was assigned a score of 1–7 points from "completely non-compliant" to "completely compliant". A higher cumulative score indicated better academic achievement. The scale had a cumulative variance contribution rate of 54.529% and a Cronbach's α coefficient of 0.824. In this study, the Cronbach's α coefficient was 0.781.

Data collection and quality control

A total of 20 nursing master's students were randomly selected for a pre-survey. Based on their feedback, the questionnaires were revised to enhance rationality and comprehensibility. The department leader helped distribute the questionnaire link via WeChat. Participants completed the questionnaire voluntarily using mobile phones or personal computers. Before completing the questionnaire, participants were informed about the study's purpose and content, and electronic consent was obtained, allowing them to withdraw at any time. All responses were collected anonymously, ensuring strict confidentiality. Participants received 10 RMB as compensation upon completion. Each IP address was limited to one response to maintain data integrity. All questions were mandatory, meaning participants were unable to submit the questionnaire unless every question was answered. After data collection, two members reviewed the responses, and discarded invalid questionnaires that were completed in too short (less than 2 min) or too long (more than 10 min) a time, or showed apparent patterns, such

as consistently choosing only option A or B, or following a noticeable answering pattern.

Statistical methods

The study utilized SPSS 26.0 and Mplus 8.3 software for data analysis. The normality of distribution was assessed through P-P and Q-Q plots. Common method bias was examined through Harman's single-factor test. Descriptive statistical analysis used mean, standard deviation, frequency, and percentage. Pearson correlation analysis was carried out to investigate the relationship between ethical leadership, teacher-student relationship, growth mindset, and academic achievement. All statistical tests were two-tailed, with a significance set at $P < 0.05$.

We used Mplus 8.3 software to develop a model for examining the mediation effect. The model's quality was assessed using the Chi-square value (χ^2/df), Comparative Fit Index (CFI), Tucker Lewis Fit Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). The saturation model is a hypothetical condition where all parameters estimated are equal to the elements in the covariance matrix. It represents perfect fitting, only path coefficients need to be estimated [22]. Generally speaking, the fitting of the saturation model is represented by CFI, with TLI of 1 and RMSEA and SRMR of 0 [23].

Ethical considerations

This research received ethical approval from the Ethics Committee of Tongji Hospital, affiliated with Tongji Medical College, Huazhong University of Science and Technology (TJ-IRB202303131) following the principles in the Declaration of Helsinki (World Medical Association, 2013).

Results

We collected 283 questionnaires, excluding 8 with too short, 3 with too long filling time, and 10 with obvious answer patterns, resulting in 262 valid questionnaires and an effective recovery rate of 92.58%. A sample size of approximately 200 is widely regarded as sufficient for conducting reliable analyses in structural equation modeling (SEM) [24]. Our sample exceeded this threshold, ensuring adequate statistical power to detect significant mediation effects while allowing for precise parameter estimation. The data points of the four variables were mainly located on the theoretical distribution diagonal, demonstrating normal distribution conformity.

Data were collected through self-reports. We performed an exploratory factor analysis to assess common method bias and diagnose data collinearity. Twelve variables with eigenvalues greater than 1 explained 65.600% of the difference. The variance explained by the first factor was 19.321%, which was below the critical value of

40% [25], indicating no significant common methodological biases in this study. The collinearity diagnosis showed that the data tolerance (Tol) was between 0.130 and 0.684 (less than 1), while the variance inflation factor ranged from 1.462 to 7.679 (less than 10), indicating no collinearity in the data.

General information on participants

This study included 262 Participants, with an average age of 26.79 (SD = 3.629) years. Among them, 32 (12.21%) were male and 230 (87.79%) were female. 121 participants (46.18%) were from rural areas, and 141 (53.82%) were from urban areas. Further details are provided in Table 1.

Scores and correlations between ethical leadership, teacher-student relationship, growth mindset, and academic achievement

Among the 262 participants, the ethical leadership score was 69.79 (SD = 6.651), the teacher-student relationship score was 69.82 (SD = 11.334), the growth mindset score was 51.26 (SD = 5.963), and the academic achievement score was 13.11 (SD = 2.050). Four variables were positively correlated ($P < 0.01$), supporting subsequent hypothesis testing. Table 2 contains the specific content.

Testing for mediation effects

Using Mplus 8.3, we constructed a structural equation model to examine the chain-mediated effects of the teacher-student relationship and growth mindset on the relationship between ethical leadership and academic achievement (see Fig. 2). The model was fully saturated ($\chi^2 = 0$, df = 0, RMSEA = 0.00, CFI = 1.00, TLI = 1.00, SRMR = 0.00), no fit indices were estimated, and only path coefficients were of interest [22, 26]. Our results indicated that ethical leadership had a significant direct effect on academic achievement, positively predicting it ($\beta = 0.223$, $t = 5.542$, $P < 0.001$).

Ethical leadership positively predicted the teacher-student relationship ($\beta = 0.214$, $t = 3.702$, $P < 0.001$), and the teacher-student relationship positively predicted academic achievement ($\beta = 0.232$, $t = 6.167$, $P < 0.001$). This finding implied that the teacher-student relationship mediated the effect of ethical leadership on academic achievement of nursing master's students. Ethical leadership positively predicted growth mindset ($\beta = 0.134$, $t = 2.054$, $P = 0.040$), and growth mindset positively predicted academic achievement ($\beta = 0.601$, $t = 5.542$, $P < 0.001$). This finding implied that growth mindset mediated the effect of ethical leadership on the academic achievement of nursing master's students. Furthermore, the teacher-student relationship positively affected growth mindset ($\beta = 0.228$, $t = 4.615$, $P < 0.001$). Taken together, both the teacher-student relationship and growth mindset mediated the relationship between ethical leadership and academic achievement.

The bootstrap (5000 repeated samples) confidence interval method was used to explore the significance of the mediating effect (Table 3). If the 95% confidence interval of the mediation effect did not include 0, the mediation effect was considered established. The direct effect of ethical leadership on academic achievement was 0.224 with a 95% CI of [0.144, 0.302], indicating a significant direct effect. Additionally, ethical leadership had a significant indirect effect on academic achievement, with an effect value of 0.159 and a 95% CI of [0.070, 0.244]. The estimated value obtained using the teacher-student relationship as the mediator variable was 0.050 with a 95% CI of [0.023, 0.085]. The estimated value obtained using growth mindset as the mediator variable was 0.080 with a 95% CI of [0.002, 0.156]. The estimated value obtained using teacher-student relationship and growth mindset as chained mediators was 0.029 with a 95% CI of [0.013, 0.056]. The effects of the three mediators were 13.05%, 20.89%, and 7.57%, respectively. As the estimated values of each model did not include 0 in the 95% CI, all mediation effects were considered established.

Discussion

This study explored the effects of ethical leadership, teacher-student relationship, and growth mindset on the academic achievements of nursing master's students in China. The results indicated that ethical leadership has a significantly positive predictive effect on academic achievements, while teacher-student relationship and growth mindset serving as mediators. This insight helps to clarify how ethical leadership affects academic achievements and underscores the importance of targeted interventions to enhance the academic achievements of nursing master's students.

Results showed that the average academic achievement score was 51.26 (SD = 5.963), suggesting that while students have acquired knowledge and skills, but with room for improvement. Learning cognitive skills scored the highest at 14.95 (SD = 2.938), while self-management scored the lowest at 11.04 (SD = 3.260). In China, nursing students are expected to acquire extensive professional knowledge and complete various academic papers and research tasks within specific deadlines [19]. Their efforts are primarily focused on academic and practical training. Graduate education in nursing is crucial for developing expertise in teaching, research, management, and clinical innovation [27]. Nursing programs are adopting holistic approaches that prioritize emotional well-being, time management, and resilience to support student development [28]. Improving self-management skills, in particular, will better prepare them to meet the demands of future careers [29]. Nursing educators should implement

Table 1 General Information on Nursing Master's students in study ($n = 262$, cases, %)

| Variables		Frequency (cases)	Percentage (%)
Grade			
	First-year graduate student	89	33.97
	Second-year graduate student	83	31.68
	Third-year graduate student	90	34.35
Residence			
	Rural	121	46.18
	Urban	141	53.82
Gender			
	Male	32	12.21
	Female	230	87.79
Admission Type			
	UEPP	170	64.89
	RAPP	92	35.11
Master's degree type			
	Academic Master's Degree	102	38.93
	Professional Master's Degree	160	61.07
Learning methods			
	Part-time study	116	44.27
	Full-time study	146	55.73
Whether to serve as a student cadre			
	Yes	97	37.02
	No	165	62.98
University type			
	985/211/ Double First-Class University	187	71.37
	Regular school	75	28.63
Reasons for choosing nursing major			
	Voluntary choice	135	51.53
	Being reassigned	39	14.89
	Others' advice	88	33.59
Whether to participate in supervisor projects			
	Yes	111	42.37
	No	151	57.63
Weekly communication frequency with the supervisor			
	< 3	182	69.47
	3~5	45	17.18
	≥6	35	13.36
Academic/work/study pressure			
	mild	58	22.14
	moderate	137	52.29
	severe	67	25.57
Family financial status			
	good	50	19.08
	average	194	74.05
	poor	18	6.87
Father's occupation			
	employee of a state-owned or private enterprise	81	30.91
	business owner	40	15.27
	farmer/laborer/social service worker, etc.	111	42.37
	retired/unemployed	30	11.45
Mother's occupation			
	employee of a state-owned or private enterprise	68	25.95
	business owner	29	11.07
	farmer/laborer/social service worker, etc.	100	38.17

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Table 1 (continued)

Variables		Frequency (cases)	Percentage (%)
	retired/unemployed	65	24.81
Father's education background			
	Junior high school or below	103	39.31
	High school/Vocational school	106	40.46
	Bachelor's degree or above	53	20.23
Mother's education background			
	Junior high school or below	123	46.94
	High school/Vocational school	81	30.92
	Bachelor's degree or above	58	22.14

Table 2 Descriptive statistical results and correlation analysis ($n = 262$)

Variable	Scores [Mean (SD)]	Ethical Leadership	Teacher-Student Relationship	Academic Achievement	Growth Mindset
Ethical Leadership	69.79(6.651)	1	—	—	—
Ethical Fairness	25.02(3.603)				
Role Definition	21.39(3.437)				
Power Sharing	23.38(3.939)				
Teacher-Student Relationship	69.82(11.334)	0.214[*]	1	—	—
Satisfaction	23.75(5.010)				
Trust	23.81(4.717)				
Commitment	22.19(3.134)				
Academic Achievement	51.26(5.963)	0.383[*]	0.433[*]	1	—
Learning Cognitive Skills	14.95(2.938)				
Communication Skills	11.20(4.267)				
Self-management Skills	11.04(3.260)				
Interpersonal Facilitation Skills	14.06(3.570)				
Growth Mindset	13.11(2.050)	0.183[*]	0.257[*]	0.701[*]	1

Notes: [*]$P < 0.01$
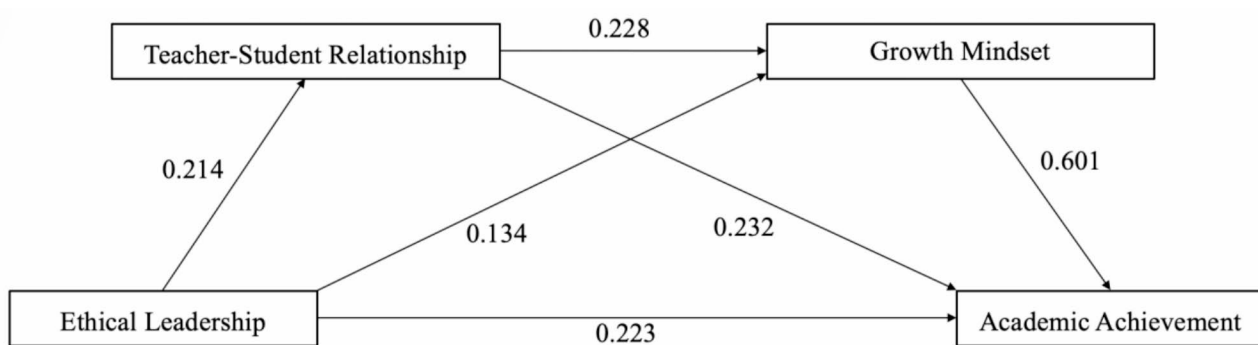
Fig. 2 The structural equation model of the ethical leadership, teacher-student relationship, growth mindset, and academic achievement

targeted interventions to foster these competencies, enabling students to excel both academically and professionally in an evolving global healthcare landscape.

Ethical leadership directly affects nursing graduate students' academic achievements, confirming Hypothesis 1. Ethical leadership emphasizes teachers' honesty, trustworthiness, and fairness. By promoting justice and proper conduct, teachers foster students' positive values and self-regulation, which enhances their enthusiasm for learning and motivation, leading to better academic achievements [30]. Social Cognitive Theory [31] suggests that human behavior is mainly learned through direct experience and observing others' behavior. Teachers, through their leadership roles and actions, influence students' behavior and set positive examples [32]. To develop high-quality nurses and ensure their comprehensive development, it is essential to enhance teachers' ethical literacy and regulate their ethical behavior. Managers should foster a positive cultural environment, provide relevant training for teachers, and implement reward,

Table 3 Bootstrap analysis of multiple mediation effects

Path	Effect value	Effect Amount (%)	SE	95% CI	P
Ethical Leadership→ Teacher-Student Relationship→ Academic Achievement	0.050	13.05	0.015	0.023~0.085	0.001
Ethical Leadership→ Growth Mindset→ Academic Achievement	0.080	20.89	0.040	0.002~0.156	0.043
Ethical Leadership→ Teacher-Student Relationship→ Growth Mindset→ Academic Achievement	0.029	7.57	0.011	0.013~0.056	0.006
Indirect effect	0.159	41.51	0.045	0.070~0.244	< 0.001
Direct effect	0.224	58.49	0.040	0.144~0.302	< 0.001
Total effect	0.383	100.00	0.054	0.267~0.483	< 0.001

evaluation, and feedback systems to strengthen assessments of teachers' ethical behavior.

Our study confirmed hypothesis 2, demonstrating that teacher-student relationship mediates the relationship between ethical leadership and academic achievement. This finding emphasizes the crucial role of teacher-student relationship in promoting academic success. A positive teacher-student relationship creates a supportive learning environment, enhances students' positive attitudes toward the nursing profession, boots their self-efficacy, and improves academic achievement [11]. Teachers, as the facilitators and leaders of educational activities, play a crucial role in maintaining a positive teacher-student relationship. Educators should address students' needs with tailored support, appropriately control the complexity and volume of learning tasks to foster a sense of belonging and self-confidence, which in turn increases students' motivation. Implementing feedback mechanisms and encouraging reflective practices will further enable educators to provide timely and constructive support [16], helping students clarify learning objectives and overcome academic challenges. Globally, students should be encouraged to cultivate strong ethical values and engage in open communication with their teachers [33]. This reciprocal interaction not only strengthens the teacher-student relationship but also enhances students' academic motivation and personal growth, ultimately benefiting their overall development.

Our study confirmed hypothesis 3, demonstrating that a growth mindset mediates the relationship between ethical leadership and academic achievement. Behavioral outcomes were driven by an individual's ability to meet organizational needs, and setting goals is beneficial for forming and developing students' critical thinking skills [34]. Growth mindset, as an intrinsic factor for success, reflects students' positive attitude towards problem-solving and ongoing learning. According to the concept of ethical leadership [35], teachers provide personalized support to nursing graduate students, including setting goals, coaching, and paying particular attention to their progress. When students' growth mindset al.igns learning goals, they actively seek solutions to challenging difficulties and continuously improve their skills

and knowledge. Cognitive function training is the primary method to improve growth thinking, such as short courses on neuroplasticity and metacognitive intervention [36]. Nursing educators should foster a sense of autonomy and resilience in students to support their journey towards becoming competent nurses and achieving academic achievements. Understanding the three principles of growth mindset patterns is fundamental [37]: Confidence, when presenting new ideas to students, encourage them to believe that the brain can "grow" (Neuroplasticity) and enhance academic success; Sense of belonging, students must feel that they are integrated into the classroom. Provide effective guidance to students while fully encouraging and praising them.

Ethical leadership impacts the academic achievements of nursing master's students through a chain-mediated effect of teacher-student relationship and growth mindset, thus confirming hypothesis 4. Building positive relationships with educators helps students navigating academic challenges effectively. Supportive feedback from teachers encourages students to set more learning goals and approach failures with a growth mindset [38]. A lack of rapport between teachers and students can hinder students' access to essential resources and social support, impeding their personal growth. Teachers should assign challenging tasks tailored to students' developmental needs and provide support when difficulties arise [39]. This approach helps students gradually develop the ability to learn independently, solve problems, and collaborate effectively. The results of the chain-mediated test indicate that ethical leadership can improve the quality of teacher-student relationship, which can help cultivate and stimulate students' growth mindset, ultimately leading to improved academic achievements. Nursing educators should strive to build strong guidance relationships while possessing excellent ethical qualities to effectively enhance the academic achievements of nursing graduate students by improving their ability to think in terms of growth.

Limitations and future research directions
This study proposed a chain-mediated model that revealed the internal mechanisms of ethical leadership's

impact on the academic achievements of nursing master's students. However, there were several limitations to this study. Firstly, the cross-sectional design limited our ability to establish causality. A lack of temporal sequencing prevents us from drawing firm conclusions about causality. Future research could employ longitudinal or experimental designs, such as leadership training programs, to observe changes in students' academic achievement over time. Secondly, the study focused solely on the mediating effects of teacher-student relationships and growth mindset, without considering other factors such as learning motivation, self-efficacy, and knowledge sharing. Future research should incorporate these additional mediators to provide a more comprehensive understanding of how ethical leadership affects academic achievement. Thirdly, the majority of survey respondents were from Hubei Province, China, which may introduce regional biases that could affect the findings. Specifically, the cultural and educational context of Hubei may not represent the diversity found in other regions of China or internationally. This limitation highlights the need for future studies to include samples from various geographic areas to enhance the generalizability of the results and mitigate the implications of response bias associated with a homogeneous sample. Finally, the data were collected via participant surveys using a single scale, which may introduce subjectivity. Future studies should consider employing a multi-method approach, such as combining self-reports with objective performance data or peer evaluations. Additionally, including observational methods or experimental designs could help reduce the potential bias inherent in self-reported data.

Conclusions

This study explored the relationship between ethical leadership and academic achievement among nursing graduate students, focusing on the mediating effect of teacher-student relationship and growth mindset. A chain-mediated effect model was constructed, which revealed that ethical leadership can directly predict academic achievement. Furthermore, three mediating effects were identified: the independent mediating effect of teacher-student relationship, the independent mediating effect of growth mindset, and the chain-mediated effect of teacher-student relationship and growth mindset. Conclusively, this study suggests that enhancing nursing master's students' academic achievements involves not only improving teachers' ethical training but also strengthening teacher-student relationship and supporting students in developing a growth mindset.

Data availability
Availability of data and materials：The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This research received ethical approval from the Ethics Committee of Tongji Hospital, affiliated with Tongji Medical College, Huazhong University of Science and Technology (TJ-IRB202303131). All of the participants have signed the informed consent and they agreed with the publication of the results of this study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

References
1. Shirazi F, Heidari S. The relationship between critical thinking skills and learning styles and academic achievement of nursing students. J Nurs Res. 2019;27(4):e38.
2. Reina-Gutiérrez S, Martínez-Vizcaíno V, Torres-Costoso A, Núñez de Arenas-Arroyo S, Saz-Lara A, Sánchez-López M. Maternal education and academic achievement in Schoolchildren: the role of Cardiorespiratory Fitness. J Pediatr. 2021;232:109–e1171.
3. Lewis LS. Nursing students who fail and repeat courses: a scoping review. Nurse Educ. 2020;45(1):30–4.
4. Canzan F, Saiani L, Mezzalira E, Allegrini E, Caliaro A, Ambrosi E. Why do nursing students leave bachelor program? Findings from a qualitative descriptive study. BMC Nurs. 2022;21(1):71.
5. Jackson D, Davison I, Adams R, Edordu A, Picton A. A systematic review of supervisory relationships in general practitioner training. Med Educ. 2019;53(9):874–85.
6. Dyar A, Stenfors T, Lachmann H, Kiessling A. What about the supervisor? Clinical supervisors' role in student nurses' peer learning: a phenomenographic study. Med Educ. 2021;55(6):713–23.
7. Ingraham KC, Davidson SJ, Yonge O. Student-faculty relationships and its impact on academic outcomes. Nurse Educ Today. 2018;71:17–21.
8. Moore C, Mayer DM, Chiang FFT, Crossley C, Karlesky MJ, Birtch TA. Leaders matter morally: the role of ethical leadership in shaping employee moral cognition and misconduct. J Appl Psychol. 2019;104(1):123–45.
9. Gu M, Sok S. Factors affecting the Academic Achievement of Nursing College Students in a flipped Learning Simulation Practice. Int J Environ Res Public Health. 2021;18(11):5970.
10. Ong SG, Quek GC. Enhancing teacher–student interactions and student online engagement in an online learning environment. Learn Environ Res. 2023;26(3):681–707.
11. Longobardi C, Settanni M, Lin S, Fabris MA. Student-teacher relationship quality and prosocial behaviour: the mediating role of academic achievement and a positive attitude towards school. Br J Educ Psychol. 2021;91(2):547–62.

12. Schweinfurth MK, Call J, Reciprocity. Different behavioural strategies, cognitive mechanisms and psychological processes. Learn Behav. 2019;47(4):284–301.
13. Kim MH, Karr JE. Examining associations between intelligence mindset, mental health symptom severity, and academic self-efficacy and performance. Curr Psychol. 2023; 1–14.
14. Schleider JL, Abel MR, Weisz JR. Implicit theories and youth mental health problems: a random-effects meta-analysis. Clin Psychol Rev. 2015;35:1–9.
15. Hecht CA, Yeager DS, Dweck CS, Murphy MC. Beliefs, affordances, and adolescent development: lessons from a decade of growth mindset interventions. Adv Child Dev Behav. 2021;61:169–97.
16. Wang YF, Hsu YF, Fang KT, Kuo LT. Gamification in medical education: identifying and prioritizing key elements through Delphi method. Med Educ Online. 2024;29(1):2302231.
17. Duckworth AL, Taxer JL, Eskreis-Winkler L, Galla BM, Gross JJ. Self-control and academic achievement. Annu Rev Psychol. 2019;70:373–99.
18. Zhang Y. The Impact of Ethical Leadership on Employees' Job Performance: Organizational Identification as a Mediating Variable[Master's thesis]. Tianjin: Tianjin University of Commerce; 2021.
19. Xu W, Wang Y, Lu G. Development and the reliability and validity test of the relationship quality between tutors and postgraduate scale. Chin Nurs Educ. 2016;13(11):828–32.
20. Xiao Q. Study on the effect of educators' speech act on the growth mindset of junior school students [Master's thesis]. Nanchang: Nanchang University; 2018.
21. Li X, Yang N. Structure study of college students' academic achievement scale: Scale development and its reliability and validity test. University. 2016;(3):41–53.
22. Steeger CM, Gondoli DM. Mother-adolescent conflict as a mediator between adolescent problem behaviors and maternal psychological control. Dev Psychol. 2013;49(4):804–14.
23. Morgan J, Wagoner JA, Pyszczynski T. Psychosocial determinants of COVID-19 vaccine hesitancy and the Mediating Role of various attitudes towards Science. Vaccines (Basel). 2023;11(8):1310.
24. Sim M, Kim SY, Suh Y. Sample size requirements for simple and complex mediation models. Educ Psychol Meas. 2022;82(1):76–106.
25. Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. J Appl Psychol. 2003;88(5):879–903.
26. Zhang L, Fan X, Yu Z. Living alone but not feeling lonely: the Effect of Self-Concealment on Perceived Social Support of Youth living alone in China. Int J Environ Res Public Health. 2022;19(21):13805.
27. Bobbi S, Kristine L'Ecuyer. Experiences of Master's prepared clinical nurse leaders at three years Post-graduation. J Prof Nurs. 2019;35(1):51–6.
28. Mueller-Burke D, Bindon S, Akintade B, Idzik S. The AACN essentials: an intentional framework for successful implementation. J Prof Nurs. 2024;52:62–9.
29. O' Sullivan S, Hageh CA, Dimassi Z, Alsoud LO, Presley D, Ibrahim H. Exploring challenges in learning and study skills among first-year medical students: a case study. BMC Med Educ. 2024;24(1):869.
30. Zeeman JM, Kiser SN, Steeb DR, Hubal R. Identifying Priority Student Leadership and Professionalism attributes among Faculty, Preceptors, and students via modified Delphi. Am J Pharm Educ. 2020;84(11):8076.
31. Horsburgh J, Ippolito K. A skill to be worked at: using social learning theory to explore the process of learning from role models in clinical settings. BMC Med Educ. 2018;18(1):156. https://doi.org/10.1186/s12909-018-1251-x.
32. Mohammadi E, Mirzazadeh A, Shahsavari H, Sohrabpour AA. Clinical teachers' perceptions of role modeling: a qualitative study. BMC Med Educ. 2021;21(1):261. https://doi.org/10.1186/s12909-021-02648-1.
33. Hakkarainen T, Salminen L, Alastalo M, Virtanen H. Online degree programmes in nurse education-students' perceptions and academic performance: an integrative review. Nurse Educ Today. 2024;136:106148.
34. Howard E, Luksyte A, Amarnani RK, Spitzmueller C. Perceived overqualification and experiences of incivility: can task i-deals help or hurt? J Occup Health Psychol. 2022;27(1):89–103. https://doi.org/10.1037/ocp0000304.
35. Kim S, Jeong SH, Seo MH. Nurses' ethical leadership and related outcome variables: systematic review and meta-analysis. J Nurs Manag. 2022;30(7):2308–23.
36. Miller HB, Srougi MC. Growth mindset interventions improve academic performance but not mindset in biochemistry. Biochem Mol Biol Educ. 2021;49(5):748–57. https://doi.org/10.1002/bmb.21556.
37. Williams CA. Nursing students' mindsets Matter: cultivating a growth mindset. Nurse Educ. 2020;45(5):252. https://doi.org/10.1097/NNE.000000000000798.
38. Li H. Perceived teacher-student relationship and growth mindset as predictors of student engagement in foreign student engagement in foreign language learning: the mediating role of foreign language enjoyment. Front Psychol. 2023;14:1177223. https://doi.org/10.3389/fpsyg.2023.1177223.
39. Mazalová L, Gurková E, Štureková L. Nursing students' perceived stress and clinical learning experience. Nurse Educ Pract. 2022;64:103457.

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