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# A mixed-methods study on recessive truancy and differentiation of learning motivation among vocational midwifery students: an explanatory sequential design

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**Research Article**

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# Abstract

**Background:** Recessive truancy refers to a situation where students are physically present in class but are cognitively and emotionally disengaged from instructional activities; its covert nature makes it difficult for teachers to identify and intervene. The midwifery program is characterized by a high degree of integration between theory and practice, and weaknesses in theoretical knowledge directly limit clinical competence. This study aims to uncover the mechanisms underlying recessive truancy among vocational midwifery students and its relationship with differences in learning motivation.

**Methods:** An explanatory sequential mixed-methods research design was employed. In the quantitative phase, a questionnaire survey was administered to 1,420 enrolled first- through third-year midwifery students at four higher vocational colleges in Anhui Province, yielding 1,326 valid responses (a response rate of 93.4%). In the qualitative phase, purposive sampling was used to select 28 students exhibiting recessive truancy behavior for semi-structured interviews, and themes were extracted using the Colaizzi seven-step analysis method.

**Results:** Quantitative data revealed that 77.0% of students exhibited moderate-to-high levels of recessive truancy. Qualitative analysis identified three pathways of motivational differentiation (continuous weakening, maintenance, and strengthening), two categories of influencing factors (external conditions and internal factors), and three types of behavioral strategies, leading to the construction of a dynamic evolutionary model: "external conditions—internal cognitive and emotional factors—behavioral strategies —motivational outcomes."

**Conclusion:** Recessive truancy is a crisis in teaching quality that is easily underestimated. There is an urgent need for comprehensive measures at both the pedagogical and institutional levels to optimize the integration of coursework and clinical training, and to implement educational programs focused on professional cognition and attribution guidance.


# Background

Competent midwives are key to ensuring the safety of mothers and infants[1]. The World Health Organization emphasizes that midwifery education must be grounded in a solid theoretical foundation and active classroom participation to develop critical thinking and clinical decision-making skills[2–4]. Higher vocational colleges in China bear the primary responsibility for training midwives at the grassroots level. As of 2022, the number of students enrolled in midwifery programs at higher vocational colleges nationwide exceeded 100,000, while fewer than 1,000 were enrolled at the undergraduate level[5]. However, a hidden yet highly corrosive educational problem is spreading throughout vocational midwifery classrooms—recessive truancy[6]. Multiple domestic surveys indicate that the rate of recessive truancy among students at vocational colleges exceeds 74.2 percent[7, 8].

In midwifery programs, the dangers of recessive truancy warrant particular vigilance[9]. Midwifery work directly concerns the safety of mothers and infants; weaknesses in theoretical foundations may be

magnified in clinical settings, leading to decision-making errors or even operational mistakes[10, 11]. Therefore, recessive truancy is by no means a simple issue of classroom discipline; rather, it represents a deep-seated educational crisis that affects both the quality of talent development and the safety of mothers and infants.

Existing research has explored the causes of recessive truancy from three dimensions: individual, instructional, and environmental[12–14]. However, most studies have labeled their samples as "vocational college students" or "university students," and their conclusions are based on the assumption of a consolidated analysis of students from different disciplines[15–17]. The midwifery program possesses a dual distinctiveness—it is both a form of vocational education and directly linked to the safety of mothers and infants—and the triggering conditions and sustaining mechanisms of recessive truancy in this field may be unique[18]. Furthermore, existing research is predominantly quantitative, with few studies conducting inductive explorations based on the actual experiences of midwifery students. Based on this, this study adopts an interpretive sequential mixed-methods research design: first, a large-sample survey is conducted to clarify the current status of recessive truancy, followed by in-depth interviews to explore its underlying causes and generative logic.

## Materials and methods

# Study design and participants

This study employed an explanatory sequential mixed-methods research design[11]. The quantitative phase took place from January to March 2026, using cluster sampling to select a total of 1,420 first- through third-year students enrolled in midwifery programs at four higher vocational colleges in Anhui Province; 1,326 valid questionnaires were collected (a response rate of 93.4%). The qualitative phase, based on the quantitative results, used purposive sampling[19] to select students exhibiting clear patterns of recessive truancy (total scale score ≥ 56.85). Seven students were selected from each institution, for a total of 28 participants, with data collection ending upon reaching information saturation.

## Research Tools

Recessive truancy scale: The Recessive Truancy Scale for College Students developed by Su Minghong et al. was used[20]. It consists of 28 items across five dimensions, scored on a 5-point Likert scale, with a total score ranging from 28 to 140; a higher score indicates a more severe degree of recessive truancy. The Cronbach's α coefficient for the scale used in this study was 0.835.

Semi-structured interview guide[21]: revised following review by two nursing education experts, the core questions included: "In what situations have you found yourself not wanting to listen or zoning out in class?" "What do you think caused these behaviors?" "How did you cope with these situations?"

## Ethical considerations

All participants provided their informed consent. Approval to conduct the research was obtained from the Ethics Committee of the Lu'an People's Hospital (approval number: 2026016), and all participants signed informed consent forms, and the study was conducted in accordance with the Declaration of Helsinki.

## Data Collection and Analysis

Quantitative data were analyzed using SPSS 26.0. Qualitative interviews were conducted from April to May 2026; each session lasted 30–45 minutes and was fully audio-recorded and transcribed. Colaizzi's seven-step analysis method was used to identify themes[22]. Two researchers independently coded the data, achieving over 85% agreement, and NVivo 20.0 was used to assist with the analysis. The study adhered to the COREQ reporting guidelines.

## RESULT

# Demographic characteristics

Quantitative results

A total of 1,326 valid questionnaires were analyzed. General information of vocational midwifery students (Table 1). Recessive truancy was low in 305 students (23.0%), moderate in 501 (37.8%), and high in 520 (39.2%), yielding an overall prevalence of 77.0% (Table 2).

Table 1
General characteristics of participants (n = 1326)

| Characteristic | n | % | Characteristic | n | % |
|---|---|---|---|---|---|
| College location | | | Intention for college upgrade | | |
| Western Anhui | 716 | 54.0 | Yes | 726 | 54.8 |
| Central Anhui | 350 | 26.4 | No | 600 | 45.2 |
| Southern Anhui | 260 | 19.6 | | | |
| Gender | | | Clear goals and plans | | |
| Male | 0 | 0.0 | | 380 | 28.7 |
| Female | 1326 | 100.0 | | 946 | 71.3 |
| Grade | | | Susceptibility to peer influence in class | | |
| First year | 636 | 48.0 | | 1026 | 77.4 |
| Second year | 460 | 34.7 | | 300 | 22.6 |
| Third year | 230 | 17.3 | | | |
| Only child | | | Satisfaction with teaching facilities and environment | | |
| Yes | 185 | 14.0 | Very dissatisfied | 70 | 5.3 |
| No | 1141 | 86.0 | Dissatisfied | 300 | 61.8 |
| | | | Neutral | 820 | 5.4 |
| | | | Satisfied | 71 | 4.9 |
| | | | Very satisfied | 65 | 5.3 |

Table 2
Distribution of levels of recessive truancy (n = 1326)

| Level of recessive truancy | Score range | n | % |
|---|---|---|---|
| Low | <56.85 | 305 | 23.0 |
| Moderate | 56.85 ~ 89.87 | 501 | 37.8 |
| High | >89.87 | 520 | 39.2 |
| Total | — | **1326** | **100** |

Incidence of recessive truancy = (Number of students at the intermediate level + Number of students at the high level) / 1,326 × 100% = 77.0%.

Qualitative results

Based on an analysis of interview data from 28 participants (Table 3), meaningful units were identified, themes were synthesized (Table 4), and an explanatory model of changes in learning motivation among midwifery students was developed (Fig. 1). The model shows that changes in learning motivation follow three pathways, are influenced by both external conditions and internal cognition, and form a feedback loop through behavioral strategies.

Table 3
Basic information on interview participants (n = 28)

| Number | Gender | Grade | Number of people | Age | Interview Duration(min) | Origin | Number of people |
|---|---|---|---|---|---|---|---|
| S1-S28 | Female | First year | 10 | 20.182 ± 0.896 | 34.818 ± 3.150 | Western Anhui | 12 |
| | | Second year | 9 | | | Southern Anhui | 8 |
| | | Third year | 9 | | | Central Anhui | 8 |

Table 4
Themes and representative statements

| Theme | Representative statement | Source |
|---|---|---|
| Low professional identity | "Nursing was my first choice, but my score wasn't high enough, so I was assigned to this major." | 14 |
| Low professional identity | "My family chose it for me." | 19 |
| Curriculum–practice disconnect | "It feels like what they teach us is what doctors should learn." | 25 |
| Outdated teaching methods | "The teacher just reads the slides silently." | 16 |
| Fear of internship | "I'm really worried about the internship; people online say some supervisors are very harsh on interns." | 17 |
| Family pressure | "My parents prefer a pressure-driven parenting style." | 24 |
| Negative peer atmosphere | "Nobody studies during evening self-study; everyone plays on their phones." | 15 |
| Pessimism about career prospects | "Hospitals want nurses, not midwives." | 27 |
| Low self-efficacy | "I haven't even passed the English Level B exam." | 16 |
| Frustration | "The frustration is overwhelming." | 12 |
| Sense of meaninglessness | "I don't know why I'm studying." | 12 |
| Ability attribution | "My comprehension isn't particularly good." | 13 |
| Lying flat | "If I can study, I study; if not, I just let it go." | 18 |
| Self-comforting | "As long as I can graduate, that's enough." | 18 |
| Positive strategy | "I want to make them proud." | 6 |
| Positive strategy | "I will definitely keep studying." | 9 |
| Sense of meaning | "People around you will encounter things, and maybe you can help." | 25 |
| Role-model support | "I feel he is my study role model." | 8 |

# Theme 1: Three pathways of motivational differentiation

*1.1 Continuous decline in motivation: a vicious cycle and academic failure*

Some respondents showed a steady decline in their motivation to study, creating a vicious cycle of "academic failure—frustration—even less willingness to study." Respondents generally attributed their

difficulties to a lack of personal ability. "I forget what I've just memorized, so I don't want to study." ( Student 19)

"The third time I really tried, and I missed it by 2.5 points. I just broke down… the frustration was overwhelming." (Student 1)

"When I don't want to study, I just cry at night." (Student 27)

*1.2 Maintaining motivation: scraping by and graduating successfully*

Some students put in the bare minimum to ensure they graduate. "As long as I can graduate. I feel indifferent—if I can study, I study; if not, I let it go… I just want to find a job." ( Student 18)

Examinations became the primary external driver. "I only revise when exams are approaching." (Student 11)

"Sometimes I suddenly want to study, but it only lasts a moment, then I study for a while, then I don't want to anymore, and I collapse." (Student 17)

*1.3 Increased motivation: finding meaning and becoming an excellent midwife*

Some interviewees reported increased motivation stemming from discovering the professional significance of their field and a desire for upward mobility.

"The midwifery practice instructor was really good. She taught with passion, didn't just read from the textbook, and used her own experiences and real hospital cases… I really liked it." (Student 1)

"When you learn from textbooks… people around you may encounter things, and maybe you can help." ( Student 25)

"I want to upgrade my degree and move up… social prejudice keeps pushing me to strive upward." (Student 1)

"My parents are my motivation… I want to make them proud." ( Student 3)

## Theme 2: external factors influencing motivational differentiation

*2.1 Social attitudes: low occupational identity and gender stereotypes*

Social prejudice constitutes a widespread external pressure. "Society has a strong prejudice against higher vocational students." (Student 6)

"Everyone looks at degrees now… I'm afraid of discrimination and of not finding a job." (Student 26)

"The counselor said we'll have difficulty finding jobs… hospitals want nurses, not midwives."( Student 27)

"Relatives say studying art is flashy and restless, and that it's better to marry a rich man." (Student 25)

*2.2 Educational context: disconnect between theory and clinical practice, outdated teaching methods, and marginalization of clinical placements*

"It feels like what they teach us is what doctors should learn, which is beyond our scope." (Student 25)

"All the courses are very theoretical… I think we need practice." (Student 4)

"I don't like purely theoretical classes where the teacher silently reads the slides." ( Student 16)

"I'm really scared of the internship; I wish teachers could tell us what clinical internships are actually like." (Student 17)

"We haven't learned what internship courseware looks like." We haven't been taught yet." (Student 26)

*2.3 Interpersonal context: family pressure and a negative peer environment*

"My family puts too much pressure on me… I want more encouragement, not a pressure-driven approach." (Student 24)

"They want me to work in a hospital, but I don't want to." (Student 17)

Peer influence was polarized. "Others not studying and playing games does affect those who really want to learn." (Student 3)

"Some read during evening self-study, others play games, and still others watch TV dramas… sometimes the gaming disturbs me." (Student 9)

# Theme 3: Internal factors influencing motivation differentiation

*3.1 Cognitive evaluation: pessimism about career prospects and perceived "lack of value" in course content*

"The future is very unclear; I don't want to pursue this profession." (Student 20)

"I don't want to be a midwife or a nurse afterward because the risk is high and I'm scared." ( Student 6)

"I think studying this is useless because they won't hire you with a low degree." (Student 9)

"Some courses feel useless and repetitive—just filler courses." (Student 14)

*3.2 Emotional experiences: frustration, a sense of meaninglessness, and low self-efficacy*

"I'm just really tired of studying." (Student 1)

"I don't know why I'm studying." ( Student 21)

"My studying is just a mess right now; I don't know what I should be doing." (Student 9)

*3.3 Attribution style: attributing failure to insufficient ability*

Participants commonly attributed failure to stable, internal, and uncontrollable ability factors. "I just can't learn English no matter how hard I try." (Student 24)

"My comprehension isn't particularly good… physics is something I know nothing about." (Student 6)

"I feel like my brain isn't enough." (Student 8)

This attribution style fosters learned helplessness.

# Theme 4: Action and interaction strategies

*4.1 Passive strategies*: "*lying low*," *going through the motions with assignments, and internet addiction*

"I play on my phone in class and can't concentrate; I can't control myself." ( Student 22)

"Nobody studies during evening self-study; everyone plays on their phones." "I don't want to attend evening self-study… I'm so stifled I want to jump off a building." ( Student 15)

"Three days of fishing and two days of drying nets." ( Student 10)

"If I don't want to study, I just don't." ( Student 26)

*4.2 Positive strategies: seeking support from role models and proactive self-regulation*

"My friend keeps encouraging me to study and always helps me." ( Student 10)

"My classmate is very goal-oriented… I feel he is my study role model." ( Student 2)

"When I don't want to study, I listen to music and praise myself, and I calm down." ( Student 26)

"When I really don't want to study, I put it aside; after a while, when I feel better, I pick it up again." (Student 21)

*4.3 Self-comforting strategies: "as long as I can graduate"*

"as long as I can graduate," (Student 17, 18)

"Marrying a good husband is also an option… finding a good person to marry later." (Student 25)

These strategies may temporarily relieve psychological discomfort but can further weaken the motivation to actively improve one's learning state by lowering expectations.

# Theme 5: Feedback loops and dynamic motivational reshaping

The model shows that the three trajectories are not static endpoints but interact dynamically through feedback loops. First, students with eroded motivation may further reinforce teachers' negative evaluations and peers' negative atmosphere, forming a "motivational erosion—negative feedback—weaker motivation" loop. Second, academic failure continuously reinforces ability attribution and low self-efficacy, generating anticipatory anxiety.

"I've taken the exam twice, so I feel I have no confidence to take it again" (Student 7)

Third, proactive strategies can break this vicious cycle: "I will find ways to change this state of not wanting to study." (Student 1)

## Discussion

# Prevalence of recessive truancy and divergence of motivational experiences

Although the quantitative data showed that 77.0% of students exhibited moderate to high levels of recessive truancy, students displayed markedly different motivational trajectories in response to classroom disengagement. Some students, despite frequently disengaging, maintained minimal learning investment through self-comforting strategies to ensure smooth graduation. Others fell into a vicious cycle of "recessive truancy—knowledge gaps—motivational erosion," gradually moving toward academic failure. This divergence between the objectively measured high prevalence of recessive truancy and students' subjectively differentiated motivational experiences suggests that attendance-based indicators alone cannot fully capture students' true motivational states. This finding is consistent with previous research in higher medical education, which also found that some students had intact attendance records while psychologically withdrawing from classroom activities[23]. This inconsistency between objective behavioral performance and subjective learning experience highlights the value of combining quantitative scale assessment with qualitative in-depth interviews for comprehensive evaluation[24].

# External conditions: antecedents of hidden disengagement

The negative learning situation shaped by external constraints is an important antecedent of recessive truancy among midwifery students. This finding aligns with previous conclusions regarding the impact of environmental factors on medical students' classroom engagement[25]. Occupational prejudice at the social level, disconnection between curriculum theory and clinical practice, marginalized internship experiences, combined with low family expectations and negative peer atmosphere, collectively constitute external stressors. Sustained external pressures can trigger psychological detachment from the classroom, giving rise to recessive truancy behaviors[26].

Notably, the qualitative findings revealed that external conditions do not directly produce behavioral outcomes; rather, they operate through individual cognition and emotion as mediators. This explains why, under similarly adverse conditions, some students experience progressive motivational erosion while others maintain active engagement. This suggests that interventions targeting recessive truancy should not be limited to classroom discipline management; optimizing the external educational environment is equally important.

## Internal cognition and emotion: psychological roots of recessive truancy

Interview data indicated that negative cognitive appraisal, adverse emotional experiences, and maladaptive attribution styles are the internal psychological roots of recessive truancy. Students' pessimistic judgments about professional prospects, doubts about the value of learning content, accompanied by frustration, meaninglessness, low self-efficacy, and the tendency to attribute academic setbacks to insufficient ability, collectively drive students toward avoidance-oriented learning strategies. This echoes previous findings on the psychological mechanisms of learning burnout among medical students[27]. Therefore, interventions should emphasize psychological and cognitive guidance, helping students develop objective professional perceptions and positive failure attribution patterns, thereby weakening the internal psychological basis that triggers recessive truancy.

## Reverse harm of recessive truancy: closed-loop feedback cycle

Furthermore, this study found that negative learning behaviors such as recessive truancy can further harm students' academic development and mental health. Long-term recessive truancy leads to broken knowledge chains, further aggravating frustration, reinforcing negative cognition, and forming a closed-loop feedback cycle; in severe cases, academic warning may occur[28]. Meanwhile, although self-comforting rationalization strategies can help students graduate smoothly, they solidify low levels of learning investment and limit professional competence development. This finding corroborates previous research on the bidirectional interaction between learning behavior and psychological states[29]. Schools should attend to the long-term impact of such covert learning problems, promptly identify high-risk students, and provide targeted psychological and academic support.

## Practical implications for midwifery talent cultivation

Recessive truancy and motivational erosion also have practical implications for the quality of midwifery talent cultivation. Higher vocational midwifery education aims to directly supply frontline clinical skilled professionals, and a solid classroom theoretical foundation is essential for clinical internships and future maternal-neonatal care decisions[30]. During interviews, students mentioned that being physically present but mentally absent in class led to weak theoretical foundations, further causing difficulties in internship performance, hindering the development of core clinical competencies, and posing hidden risks to future clinical job competence. This is consistent with existing research suggesting that

classroom learning quality directly affects nursing and midwifery talent cultivation outcomes[31]. Improving students' classroom learning engagement and protecting learning motivation has practical significance for enhancing midwifery talent cultivation quality and ensuring future clinical care quality[32]. Student interviews also reflected that students expect updated teaching models, improved internship supervision quality, and reduced professional prejudice to improve their learning situation. However, current problems such as outdated course design and limited internship resources hinder students from obtaining good learning experiences, suggesting the need to optimize the midwifery training system at the institutional level[33].

# Student coping strategies: three types of action and interaction strategies

To cope with learning difficulties, students developed three types of action and interaction strategies. Some students adopted passive strategies, such as lying flat and perfunctory assignments; some used self-comforting strategies to alleviate inner conflict; others actively sought role-model support and strove for hands-on internship opportunities to reconstruct professional meaning and enhance learning motivation[34]. Although some students were able to break through difficulties through their own efforts, most participants expressed the limitations of individual power—in the face of structural training environments and social prejudice, individual adjustments are often insufficient, and students can only passively adapt to the status quo[35]. This pragmatic mindset suggests that relying solely on students' individual subjective efforts is insufficient to resolve recessive truancy and motivational erosion; external support is indispensable[36].

Students also expressed demands for training programs more aligned with their realities and better internship resources. This finding aligns with previous research suggesting that medical education should attend to students' individual needs[37]. Tailoring instruction to students' varying cognitive levels and developmental aspirations, and optimizing course and internship arrangements, can help reduce recessive truancy and maintain learning motivation[38].

# Limitations and future directions

This study has several limitations. The quantitative survey sample was concentrated among nursing and midwifery undergraduates in Anhui Province, and the qualitative interview sample size was limited, restricting the generalizability of the findings. Additionally, this study focused on exploring the evolutionary pathways of external conditions, internal psychology, and behavioral strategies at the individual student level, with limited discussion of macro-level institutional teaching management reform. Future research could conduct institution-level intervention studies to explore teaching reform programs that can reduce the prevalence of recessive truancy and maintain midwifery students' learning motivation. Meanwhile, expanding the sample scope to compare the motivational development trajectories of midwifery students across different regions and different levels of institutions would be valuable.

# Practical implications

The findings of this study offer practical implications for midwifery teaching management and talent cultivation, helping to alleviate recessive truancy among midwifery students and maintain their learning motivation.

At the teaching practice level, professional identity education and learning attribution training can be integrated into the curriculum to help students view professional development objectively, recognize the harms of recessive truancy, acquire effective classroom engagement strategies, and actively use internship opportunities to construct professional meaning. Institutions should also improve the curriculum system, bridge the gap between theoretical teaching and clinical practice, improve internship supervision models, and reduce students' marginalized internship experiences.

At the management policy level, educational administrators need to acknowledge the impact of external factors such as social perceptions, family, and peers on students' learning states, and optimize course design and internship management systems. Teaching model reform should be promoted, internship supervision assessment mechanisms improved, and role-model peer support channels established. Meanwhile, academic atmosphere construction should be reasonably conducted to weaken the negative effects of peer negative atmosphere. Additionally, early academic warning mechanisms should be established to identify high-risk students with moderate-to-high recessive truancy and progressive motivational erosion, providing timely academic and psychological support to break the vicious cycle of "external pressure—negative cognition—recessive truancy—motivational erosion," helping more midwifery students discover professional value and grow into competent clinical midwifery professionals.

## Conclusions

Higher vocational midwifery students face multiple practical difficulties in maintaining good classroom engagement and stable learning motivation. The resulting recessive truancy is an easily underestimated crisis in teaching quality, with profound implications for students' professional development, talent cultivation quality, and future maternal-neonatal care safety. Although students adopt various action strategies—passive, positive, and self-comforting—to cope with learning pressure, many still exhibit moderate to high levels of recessive truancy, with learning motivation showing divergent outcomes of progressive erosion, maintenance, or enhancement. Most students recognize that social prejudice and curriculum limitations are objective realities in higher vocational education and demonstrate varying degrees of adaptation and adjustment capacity under the impact of internal and external difficulties.

This study employed a mixed-methods design combining quantitative surveys with qualitative interviews, revealing a dynamic evolutionary pathway of recessive truancy comprising "external conditions—internal cognition and emotion—action strategies—motivational outcomes." These findings emphasize the urgent need for comprehensive measures at both pedagogical and institutional levels to address the challenges of recessive truancy and motivational divergence among higher vocational midwifery students. Future interventions should focus on optimizing the integration of coursework with clinical practice in higher

vocational training systems, improving internship supervision environments, implementing professional cognition and attribution guidance education, and mitigating the negative effects of peer atmosphere. If institutions prioritize protecting the learning motivation of higher vocational midwifery students and intervene in recessive truancy behaviors, they can not only enhance students' professional sense of achievement and the quality of vocational talent cultivation but also supply clinical settings with midwifery reserve talent possessing solid theoretical foundations and good professional qualities, reducing potential risks in future clinical maternal-neonatal care.

# Abbreviations

SPSS
Statistical Package for the Social Sciences
COREQ
Consolidated Criteria for Reporting Qualitative Research
WHO
World Health Organization
SPSS
Statistical Package for the Social Sciences
COREQ
Consolidated Criteria for Reporting Qualitative Research

# Declarations

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**Author contributions**

Conceived and designed the research: HY, XZS. Wrote the paper: MC, SYY. Analyzed the data: MC, XDH, and CCL. Revised the paper: MC, HY, PZ, QSY, WPW, and YFF. The authors read and approved the final manuscript.

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**Availability of data and materials**

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy reasons.

**Consent to publish**

Not applicable

**Ethics approval and consent to participate**

All participants provided their informed consent. Approval to conduct the research was obtained from the Ethics Committee of the Lu'an People's Hospital (approval number: 2026016), and all participants signed informed consent forms, and the study was conducted in accordance with the Declaration of Helsinki.

**Competing interests**

All authors report no potential conflicts of interest relevant to the research.

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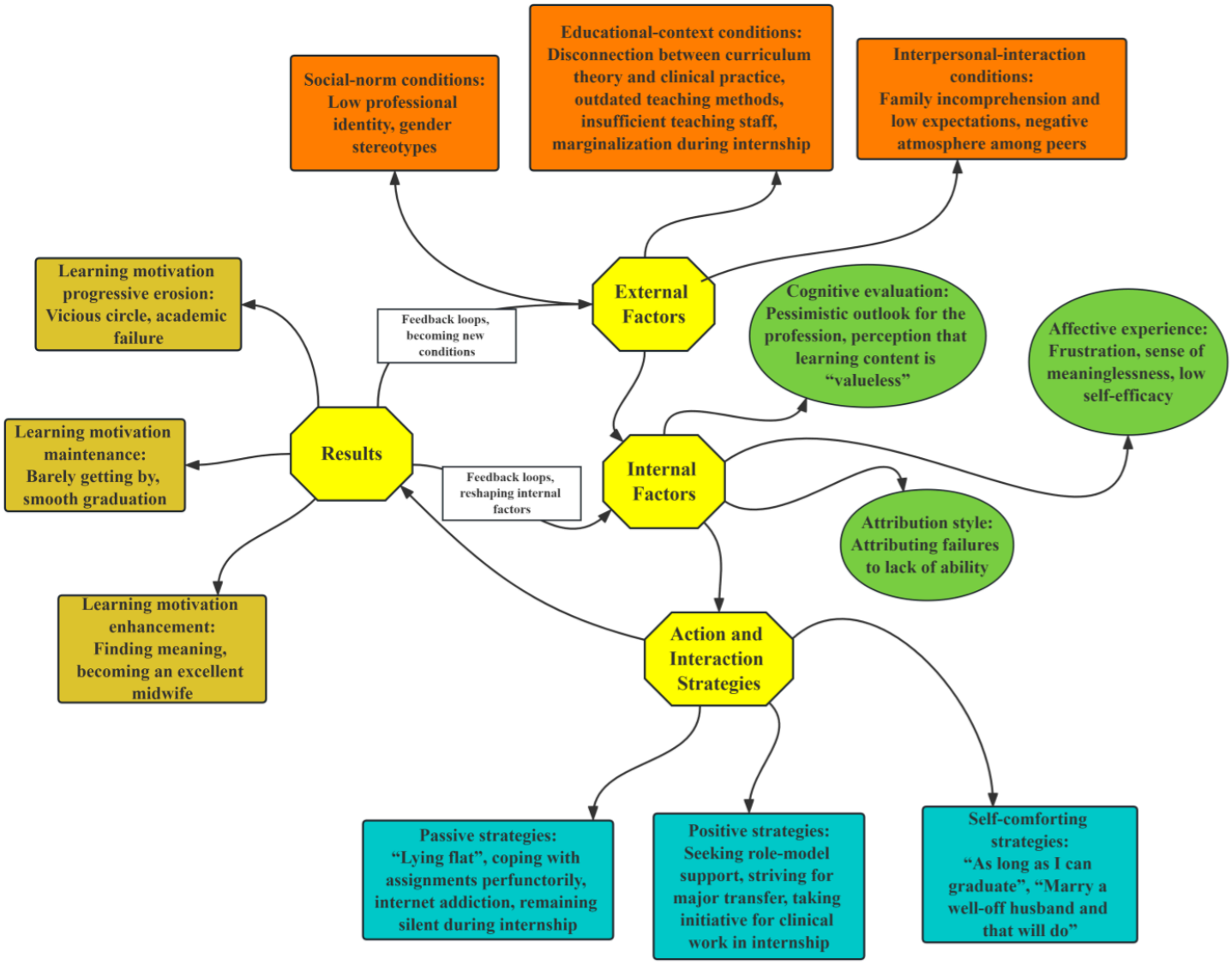
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# Figures



## Figure 1

## An explanatory model of changes in learning motivation