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Effect of Case-Based Teaching Method on the Safety Capability of First-Year College Students

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Abstract

Background and Aims: With the deepening of higher education reform in China, campus safety risks have become increasingly complex, and first-year college students are particularly vulnerable to safety incidents due to insufficient independent living experience and weak safety capability. Traditional "indoctrination-style" safety education has limitations such as low student participation and poor practical transformation effect. This study adopted the case-based teaching method (CBTM) to innovate safety education and improve the multi-dimensional safety capability of first-year college students. The purposes of this study were 1) to compare students' safety capability (including safety knowledge reserve, hazard identification ability, and emergency response skills) before and after learning through CBTM, 2) to compare students' safety capability after learning through CBTM with the criterion set at 70%, and 3) to assess students' satisfaction with the application of CBTM in safety education courses.

Methodology: In this quasi-experimental study, 40 first-year college students from Jilin Engineering Normal University who took the compulsory course "Safety Education for College Students" were selected via cluster random sampling. The research adopted a one-group pretest-posttest design. Safety capability was evaluated using a measurement tool (including a knowledge test, a hazard identification test, and an emergency response skill scale), and student satisfaction was measured with a validated questionnaire. Data were collected before and after the 32-hour CBTM intervention and analyzed using the arithmetic mean, standard deviation, paired-samples t-test, and one-sample t-test.

Results: 1) Students' safety capability scores after CBTM (M = 81.28, S.D. = 7.37) were significantly higher than before (M = 42.53, S.D. = 8.68) at the 0.01 statistical significance level (t_{39} = 45.617, $p < 0.01$). All three dimension scores (safety knowledge reserve, hazard identification ability, emergency response skills) showed significant improvements. 2) Students' post-intervention

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safety capability was statistically higher than the 70% criterion (t_{39} = 3.671, $p < 0.01$), with all dimensions meeting or exceeding the corresponding criteria. 3) Students' overall satisfaction with CBTM was at a high level (M = 4.70, S.D. = 0.48), with very high satisfaction across all dimensions (case quality, teaching process, perceived ability improvement, teaching support).

Conclusion: The case-based teaching method has a significant positive effect on improving the multi-dimensional safety capability of first-year college students and is highly recognized by students. It provides a feasible and effective path for solving the dilemmas of traditional college safety education.

Keywords: Case-Based Teaching Method (CBTM); Safety Capability; Satisfaction

Introduction

Campus safety is a foundational pillar of higher education quality, and safety education is critical for developing students' safety literacy and mitigating preventable risks. Empirical evidence indicates that traditional college safety education, characterized by one-way lectures and video playback, fosters passive learning and creates a persistent disconnect between theoretical knowledge acquisition and practical application (Li, 2022; Xie et al., 2020). This pedagogical gap results in fragmented safety knowledge, low hazard identification accuracy, and inadequate emergency response proficiency among students, leaving them vulnerable to cyber fraud, dormitory fires, and sports injuries—three of the most prevalent types of campus safety incidents nationwide.

First-year students represent the highest-risk cohort, as they transition from secondary school's structured management to university autonomy. Lacking prior exposure to campus-specific safety protocols and risk assessment experience, this group exhibits significantly higher rates of safety incidents caused by improper decision-making (Li, 2022). At Jilin Engineering Normal University, institutional incident records document recurrent cases of first-year student victimization by "campus loan" fraud, dormitory fires from unauthorized high-power appliances, and sports sprains due to insufficient protective awareness—data that empirically validates the ineffectiveness of traditional pedagogy for this specific demographic.

Case-Based Teaching Method (CBTM) is theoretically grounded in constructivist learning theory, which posits that knowledge is actively constructed through contextual problem-solving. CBTM is defined as a pedagogical approach centered on real or simulated cases to drive analysis, discussion, and collaborative problem-solving, prioritizing theory-practice integration and student agency (Ulvik et al., 2020; Merseth, 1996). It has demonstrated robust efficacy in law, medicine, and engineering education for enhancing practical skills and critical thinking (Dekker et al., 2019; Wang et al., 2024). In safety education specifically, CBTM's theoretical advantages include

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contextualizing abstract safety principles, fostering emotional resonance through scenario-based learning, and building collaborative decision-making skills—all of which directly address the limitations of traditional methods (Yin, 2015; Zhang et al., 2024).

While existing empirical studies confirm CBTM's positive impact on students' safety awareness and specific skill sets (e.g., cyber fraud identification, Yin, 2015; laboratory safety operation, Wang et al., 2024), a focused research gap remains: a dearth of systematic, empirical research exists that evaluates CBTM's effectiveness in first-year college safety education, particularly through a multidimensional framework that measures changes in comprehensive safety capability and student learning satisfaction. This study addresses this gap by taking first-year students at Jilin Engineering Normal University as the research sample to empirically assess CBTM's application effects in the Safety Education for College Students course. The findings aim to provide data-driven empirical support and actionable practical references for the reform and innovation of college safety education pedagogy.

Research Questions

1. How does the multi-dimensional safety capability of first-year college students differ before and after learning through the case-based teaching method?

2. How does the safety capability of first-year college students after learning through CBTM compare with the criterion set at 70%?

3. What is the level of first-year college students' satisfaction with the case-based teaching method in terms of case quality, teaching process, perceived ability improvement, and teaching support?

Research Objectives

1. To compare the multi-dimensional safety capability of first-year college students before and after learning through the case-based teaching method.

2. To compare the safety capability of first-year college students after learning through CBTM with the criterion set at 70%.

3. To assess the satisfaction of first-year college students toward the case-based teaching method from four dimensions: case quality, teaching process, perceived ability improvement, and teaching support.

Literature Review

Case-Based Teaching Method (CBTM)

Case-Based Teaching Method (CBTM) originated at Harvard Law School and is defined as a

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student-centered pedagogical approach that uses real or highly simulated cases as its core instructional vehicle (Merseth, 1996). Its core theoretical connotation lies in guiding students to construct knowledge, cultivate practical skills, and develop critical thinking through structured case analysis, collaborative discussion, and situational practice—marking a fundamental departure from the traditional didactic "teacher-centered, passive learning" model. Within the specific context of college safety education, CBTM exhibits three distinct, conceptually defined characteristics that align with the goals of cultivating students' safety literacy:

1. Case Authenticity and Relevance: Cases are drawn from verifiable campus safety incidents or highly realistic simulated scenarios, with direct relevance to students' daily campus life. This characteristic ensures students can perceive the immediacy and tangibility of safety risks, laying the foundation for meaningful learning (Ulvik et al., 2020).

2. Student Subjectivity: Students serve as the primary participants in case analysis and group discussion, while teachers assume the roles of instructional guides and facilitators. Rather than providing pre-determined answers, teachers scaffold critical thinking, which stimulates students' independent reasoning and active engagement in the learning process (Levin, 1995).

3. Integration of Theory and Practice: CBTM facilitates the connection between abstract safety theory and concrete real-world scenarios during case analysis. Through practical drills and scenario simulations embedded in the teaching process, students transform declarative safety knowledge into procedural emergency response skills, addressing the theory-practice gap in traditional education (Shulman, 1992).

For this study, the CBTM implementation process is synthesized from the core theoretical frameworks and operational protocols proposed by Gallego et al. (2013), Xiao et al. (2020), and Chumak et al. (2022), with targeted adaptations to fit the pedagogical characteristics and learning objectives of college safety education. This study's adapted CBTM model consists of four sequential, conceptually distinct core steps, with clear alignment to the aforementioned CBTM characteristics and explicit definitions of teacher/student roles:

1. Case Design: This step involves selecting real campus safety cases (e.g., cyber fraud, dormitory fires, emergency first aid) that meet the explicit criteria of authenticity, relevance, and educational inspiration. Each case is systematically designed to include clear background information, a chronological event process, identified risk points, and specific safety competence cultivation objectives. Cases are presented in diverse multimedia formats (PPTs, short videos, text documents) to enhance accessibility and engagement.

2. Case Distribution & Question Setting: Case materials and targeted guiding questions are distributed to students via the university's digital teaching platform 3–5 days before class. Guiding questions (e.g., "What are the latent safety hazards in this case?" "What evidence-based

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emergency responses are appropriate for this scenario?") are intentionally framed to scaffold preliminary independent thinking and pre-class preparation, activating students' role as active learners.

3. Group Discussion: Students are organized into heterogeneous groups of 4–5 members for 40 minutes of in-class collaborative discussion. Under teacher facilitation, groups analyze case risks, explore evidence-based solutions, and share diverse perspectives. Teachers maintain the discussion's alignment with learning objectives but refrain from direct intervention in the discussion outcomes, preserving student autonomy in problem-solving.

4. Summary & Expansion: In this concluding step, teachers systematically synthesize the core safety knowledge and key skills embedded in the case, summarize critical insights from case analysis and problem-solving, and explicitly emphasize the practical significance of the learned content for real-world campus safety. Post-class practical tasks (e.g., designing dormitory safety checklists, writing targeted safety warning letters) are assigned to facilitate the transfer of knowledge and skills from the classroom to students' daily campus life, solidifying the theory-practice integration.

Safety Capability

Safety capability refers to the comprehensive ability of first-year students to ensure their own and others' safety in campus scenarios (dormitories, classrooms, laboratories, cyberspace, etc.), which is an organic integration of safety knowledge, practical skills, and decision-making (Zhang et al., 2024). It is a key competence for freshmen to adapt to independent campus life, as they often face risks such as cyber fraud, dormitory fire hazards, and emergency incidents due to insufficient experience. According to the characteristics of campus safety risks and the needs of safety education, safety capability is divided into three core dimensions:

1. Safety Knowledge Reserve: The mastery of basic common sense and professional theories related to campus safety, including basic safety common sense (such as campus emergency help numbers, dormitory management regulations) and professional safety theories (such as the working principle of fire extinguishers, the causes of electrical fires).

2. Hazard Identification Ability: The ability to detect explicit and implicit safety hazards in the campus environment, including the detection of explicit hazards (such as aging power strips in dormitories, non-compliant storage of laboratory reagents) and the judgment of implicit hazards (such as phishing text messages, self-harm risks behind classmates' abnormal emotions).

3. Emergency Response Skills: The practical ability to respond to safety incidents independently or through collaboration with others, including individual emergency operations (such as using fire extinguishers to put out initial fires, providing first aid for hypoglycemia) and

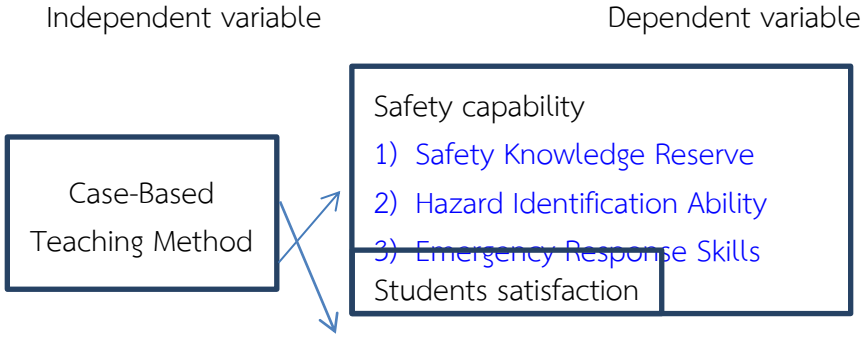
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collaborative emergency cooperation (such as assisting students with mobility impairments in evacuation, cooperating with peers to bandage injured classmates).

These three dimensions are interrelated and mutually supportive, forming a complete safety capability system. Safety knowledge reserve is the foundation, hazard identification ability is the key, and emergency response skills are the core embodiment of safety capability.

Conceptual Framework



Research Methodology

Population and Sample

Population: 200 full-time first-year undergraduate students of the 2025 cohort at Jilin Engineering Normal University, all of whom take the compulsory course "Safety Education for College Students".

Sample: 40 students selected via cluster random sampling. Taking "classes" as natural cluster units, the first two first-year classes were randomly selected from all classes offering the course, and all students in the selected classes were included in the study to ensure the representativeness of the sample and avoid sampling bias.

Experimental Design

This study adopted a one-group pretest-posttest quasi-experimental design to explore the effect of CBTM on students' safety capability and satisfaction. The design framework is shown in the following table:

Group	Pretest	Treatment	Posttest
Experimental	O_1	X	O_2

O_1: Measurement of students' safety capability before the experimental intervention (pretest), including safety knowledge reserve, hazard identification ability, and emergency response skills, to establish the baseline level of the dependent variable.

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X: experimental intervention, i.e., implementing the "Safety Education for College Students" course through the case-based teaching method, with a total of 32 class hours (16 theoretical teaching hours + 16 practical teaching hours), completed in 8 weeks.

O_2: Measurement of students' safety capability after the completion of the experimental intervention (posttest), using the same tools as the pretest to compare the changes in safety capability before and after the intervention.

Research Instruments

1. CBTM Implementation Plan: 4 lesson plans were designed, covering core modules such as network security, fire safety, emergency response, and comprehensive application. Each lesson plan corresponds to 8 class hours, and the teaching process strictly follows the four-step CBTM process. Expert evaluation confirmed that the lesson plans have very high appropriateness (M = 4.8, S.D. = 0.41), meeting the requirements of teaching implementation.

2. Safety Capability Measurement Tools:

1) Comprehensive Test of Knowledge and Hazard Identification Ability: Includes 30 multiple-choice questions (safety knowledge reserve) and 7 scenario-based essay questions (hazard identification), with a full score of 70. The Index of Item-Objective Congruence (IOC) of each item is ≥ 0.5, and the reliability coefficient (KR-20) is 0.78, indicating good validity and reliability.

2) Emergency Response Skill Performance Evaluation Scale: An 8-item Likert scale (1-5 points) covering fire extinguisher operation, emergency evacuation, first aid for hypoglycemia, etc., with a full score of 40. The IOC of each item is ≥ 0.5, and the Cronbach's alpha coefficient is 0.76, meeting the measurement requirements.

3. Student Satisfaction Questionnaire: A 16-item Likert scale (1-5 points) covering four dimensions: case quality, teaching process, perceived ability improvement, and teaching support. The IOC of each item is ≥ 0.5, and the Cronbach's alpha coefficient is 0.97, indicating high reliability.

Data Collection

1. Pretest (O_1): In October 2025, before the start of the course, the comprehensive test of knowledge and hazard identification ability and the emergency response skill performance evaluation were conducted on 40 sample students. The test was conducted in a closed-book manner, and 2 invigilators were arranged to ensure the authenticity of the data.

2. Intervention (X): From October to December 2025, the "Safety Education for College Students" course was taught according to the standardized CBTM lesson plans, including theoretical teaching (case analysis, group discussion) and practical teaching (fire drills, first-aid training).

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3. Posttest (O_2): In December 2025, immediately after the end of the course, the same safety capability measurement tools as the pretest were used to re-measure the students' safety capability, ensuring the comparability of the data.

Data Analysis

Comparison of safety capability before and after intervention: Paired-samples t-test was used to compare the pretest and posttest scores of students' comprehensive safety capability and each dimension (safety knowledge reserve, hazard identification ability, emergency response skills). This test is selected because it is suitable for comparing the same group of subjects under two related measurement conditions, which can effectively reflect the changes in students' safety capability before and after the CBTM intervention.

Comparison of safety capability with 70% criterion: A one-sample t-test was used to compare the posttest scores of students' safety capability with the 70% criterion (77 points for the comprehensive score). The 70% criterion is set based on the university's course passing standard for safety education (specified in the 'Teaching Management Handbook (2024, p. 45)), which is a reasonable and authoritative threshold to evaluate whether students' safety capability meets the basic requirements after the intervention.

Analysis of student satisfaction: Descriptive statistics (arithmetic mean, standard deviation) were used to analyze the overall satisfaction and dimension satisfaction of students. The mean and standard deviation can reflect the central tendency and dispersion of the satisfaction scores, helping to intuitively understand the overall satisfaction level of students. Thematic analysis was used to sort out the suggestions in the open-ended questions, which can deeply tap into students' subjective opinions and practical needs, supplementing the limitations of quantitative analysis.

Research Results

1. Comparison of Safety Capability Before and After CBTM

Table 1 shows that students' posttest scores in all dimensions of safety capability were significantly higher than pretest scores, with a statistically significant level of .01 ($p < 0.01$). The comprehensive safety capability score increased from 42.53 (pretest) to 81.28 (posttest), indicating that CBTM has a significant promoting effect on improving students' safety capability.

Table 1 Comparison of Students' Safety Capability Before and After CBTM

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Group1	Full scores	n	Pretest scores		Post-test scores		*t*	*p*
			M	*SD*	*M*	*SD*		
Experimental group	110	40	42.53	8.68	81.28	7.37	45.617	.000

** p< 0.01.

2. Comparison of Safety Capability with 70% Criterion

Table 2 shows that students' posttest scores in all dimensions of safety capability were significantly higher than the 70% criterion, with a statistically significant level of .01 ($p < 0.01$). The safety capability score (81.28) was higher than the criterion of 77 points, indicating that after CBTM intervention, students' safety capability has met the preset passing standard.

Table 2 Comparison of Students' Safety Capability with 70% Criterion

Group	n	criterion score	*M*	*SD*	*t*	*p*
Experimental group	40	77	81.28	7.37	3.671	.001

** p < 0.01

3. Students' Satisfaction Toward CBTM

Table 3 shows that students' overall satisfaction with CBTM was at a very high level (M = 4.70, SD = 0.48). Among the four dimensions, case quality (M = 4.73) and teaching process (M = 4.73) had the highest satisfaction, followed by perceived ability improvement (M = 4.71) and teaching support (M = 4.62). All items in each dimension had a mean score above 4.5, indicating that students highly recognized the application of CBTM in safety education courses.

Table 3 Students' Satisfaction Toward CBTM (n = 40)

Dimension	M	SD	Satisfaction Level
Case Quality	4.73	0.48	Very High
Teaching Process	4.73	0.44	Very High
Perceived Ability Improvement	4.71	0.46	Very High
Teaching Support	4.62	0.53	Very High
Overall Satisfaction	4.70	0.48	Very High

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Conclusion

This study explores the effect of the case-based teaching method on the safety capability of first-year college students through a quasi-experimental design. The research results show that: 1) After the CBTM intervention, students' comprehensive safety capability and scores in all three dimensions (safety knowledge reserve, hazard identification ability, emergency response skills) were significantly improved, and the difference was statistically significant. 2) Students' post-intervention safety capability exceeded the preset 70% criterion, indicating that CBTM can effectively help students meet the basic safety capability requirements. 3) Students' overall satisfaction with CBTM was at a high level, and they highly recognized the case quality, teaching process, ability improvement effect, and teaching support of CBTM.

In conclusion, the case-based teaching method is an effective teaching method for college safety education. It can not only improve students' multi-dimensional safety capability but also enhance students' learning participation and satisfaction, providing a feasible path for solving the problems of traditional safety education, such as a rigid teaching mode and a weak practical transformation effect.

Discussion

Factors Contributing to the Improvement of Safety Capability

The significant improvement of students' safety capability after CBTM intervention is closely related to the characteristics and implementation process of CBTM:

1. Authentic and Relevant Cases: The cases selected in this study are all derived from real campus safety incidents, such as cyber fraud, dormitory fires, and emergency response, which are highly relevant to students' campus life. This authenticity and relevance enable students to deeply perceive the proximity of safety risks, arouse their learning interest and attention, and lay a foundation for the effective absorption of knowledge and skills (Ulvik et al., 2020). At the same time, each case is closely linked to the three dimensions of safety capability, with clear risk points and competence cultivation objectives, making students' learning more targeted.

2. Student-Centered Group Discussions: The group discussion link in CBTM fully mobilizes students' active participation. In the discussion process, students share their perspectives, analyze problems collaboratively, and explore solutions, which not only deepens their understanding of safety knowledge but also cultivates their hazard identification and decision-making abilities (Levin, 1995). Teachers only play the role of guides, avoiding direct provision of answers, which encourages students to think independently and improves their problem-solving ability.

3. Integration of Theory and Practice: CBTM combines theoretical teaching (case analysis, knowledge explanation) with practical teaching (fire drills, first-aid training), enabling students to

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transform the theoretical knowledge learned from cases into practical operation skills. For example, after analyzing the dormitory fire case, students conduct fire extinguisher operation drills and evacuation simulations, which effectively bridge the gap between theory and practice and improve the practical transformation effect of knowledge (Shulman, 1992).

Reasons for High Student Satisfaction

Students' high satisfaction with CBTM mainly stems from the following aspects:

1. High-Quality Cases Meet Learning Needs: Students gave high scores to the authenticity and relevance of cases (M = 4.85), believing that real campus cases can better help them understand safety risks and improve their ability to cope with practical problems. The appropriate difficulty of cases also ensures that students can actively participate in case analysis and discussion, avoiding the sense of frustration caused by overly complex cases.

2. Scientific Teaching Process Enhances Learning Experience: The reasonable grouping method (4-5 students per group), sufficient discussion time, and timely teacher guidance make the teaching process orderly and efficient. The scientific arrangement of practical links, such as fire drills and first-aid training, allows students to personally experience the emergency response process, enhancing their sense of learning gain and participation.

3. Obvious Ability Improvement Enhances Learning Confidence: Students generally believe that CBTM has significantly improved their safety knowledge reserve, hazard identification ability, and emergency response skills (M = 4.80 for both hazard identification ability and emergency response skills). The obvious improvement in ability makes students recognize the effectiveness of CBTM, thereby enhancing their learning confidence and satisfaction.

4. Comprehensive Teaching Support Guarantees Teaching Effect: Complete case materials, sufficient teaching venues and equipment, and teachers' professional guidance and timely feedback provide a solid guarantee for the smooth implementation of CBTM. Students' high satisfaction with teaching support (M = 4.62) also reflects the importance of sufficient teaching resources for improving teaching quality.

5.

Recommendation

Implications for Practice

1. Optimize Case Library Construction: Establish a dynamic case update mechanism, supplement new campus safety cases (such as new types of cyber fraud, shared electric vehicle safety) every year according to the latest safety incidents, and ensure the timeliness and pertinence of cases. At the same time, design major-specific cases according to the professional characteristics of students, such as adding laboratory safety cases for engineering students and job-hunting fraud cases for liberal arts students.

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2. Teaching Process Design: Extend the pre-class case preview time to 5 days, and design differentiated preview tasks for students with different learning levels. For students with weak foundations, provide case analysis frameworks to help them conduct preliminary thinking; for students with strong abilities, assign extended questions to stimulate in-depth exploration. Introduce role-playing and scenario simulation into classroom teaching to make the teaching process more vivid and interesting, and enhance students' immersive experience.

3. Strengthen Teacher Training: Regularly carry out CBTM training for teachers, focusing on improving their case design, classroom guidance, and practical teaching organization abilities. Encourage teachers to cooperate with the school's safety management department to collect and sort out real campus safety cases, ensuring the authenticity and typicality of cases. At the same time, establish a teaching exchange mechanism to promote teachers to share CBTM experience and continuously improve teaching quality.

4. Perfect Evaluation System: Further increase the weight of process evaluation (accounting for no less than 40%), including students' participation in group discussions, performance in practical drills, and completion of after-class tasks, in the course score. Introduce a student mutual evaluation mechanism, allowing students to evaluate each other's case analysis reports and practical operation performance, and deepen their understanding of safety knowledge and skills in the evaluation process.

Recommendations for Further Research

1. Expand Research Objects: Conduct research on students of different majors, genders, and grades to explore the differences in the effect of CBTM on the safety capability of different groups of students, and provide a basis for personalized safety education.

2. Extend Research Cycle: Track the long-term safety behavior of students after receiving CBTM intervention, such as investigating the incidence of safety incidents among students within one year after the course, to verify the sustainability of the teaching effect.

3. Innovate Teaching Combination Modes: Explore the combination of CBTM with blended teaching, flipped classroom, and other teaching modes, such as using online platforms to carry out after-class case discussions and knowledge reviews, and using offline classrooms for practical drills and scenario simulations, to expand learning time and space and improve teaching effectiveness.

4. Enrich Research Content: Expand the safety capability evaluation system to include psychological crisis response, off-campus internship safety, and other dimensions, and explore the effect of CBTM on improving students' comprehensive safety capability. At the same time, conduct in-depth research on the influence mechanism of CBTM on students' safety capability, and provide more in-depth theoretical support for the application of CBTM in safety education.

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