Construction and Implementation of a Teaching System for Emergency Management Characteristic Experimental Class

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Abstract: This study addresses the insufficient alignment between the existing educational framework and the demand for high-quality, application-oriented talent in the field of emergency management. It focuses on systematically constructing and implementing a teaching system for an emergency management experimental class, aiming to explore a talent cultivation model that integrates interdisciplinary characteristics and industry development needs through a comprehensive theoretical and practical teaching structure. Utilizing methods such as systems analysis, empirical research, and interdisciplinary integration, the study establishes a dual-driven architecture comprising a "three-dimensional modular" theoretical teaching system (fundamental theories, core specialties, cutting-edge expansion) and a "stair-step layered" practical teaching system (experimental training, simulation, practical drills). It concurrently promotes the development of a "dual-teacher + international" teaching team and establishes a collaborative education platform between schools and enterprises to align curriculum content with professional standards and teaching processes with production practices. Additionally, it constructs a long-term internship mechanism centered on "project-oriented-task-driven-dynamic feedback," forming a closed-loop training system of "theory consolidation-skill enhancement-practical application." The findings indicate that this teaching system effectively enhances students' emergency decision-making, cross-team collaboration, and complex scenario adaptability by breaking down disciplinary barriers and strengthening industry-education integration, thereby significantly improving the alignment between talent cultivation and job demands in emergency management. The conclusions provide a replicable systematic solution for educational reform in emergency management disciplines and demonstrate the critical role of characteristic experimental classes in cultivating versatile emergency management professionals who possess theoretical knowledge, practical skills, and operational capabilities, offering both theoretical reference and practical guidance for the collaborative development of higher education and the emergency management industry.

Keywords: Emergency Management; Characteristic Experimental Class; Teaching System Construction; Dual-Teacher Teaching Team; Industry-Education Integration.

1. Introduction

1.1 Background and Problem Statement

The increasing frequency of global natural disasters and public safety incidents necessitates higher professional standards for emergency management personnel. According to the World Meteorological Organization, extreme weather events have increased at an annual rate of 15% over the past decade. In 2023, China's Ministry of Emergency Management reported over 23,000 disaster response cases, revealing significant capability gaps in risk assessment, interdepartmental coordination, and complex scenario management among emergency management professionals. The traditional higher education system faces challenges, including fragmented curricula, weak practical training, and disconnection from industry needs. Research from North China University of Science and Technology indicates that 78% of employers seek multidisciplinary talents in emergency management roles, yet only 43% of graduates meet practical competency standards. In this context, developing a specialized experimental class teaching system in emergency management is crucial to address the talent supply-demand gap and promote high-quality development in the field.

1.2 Research Objectives and Theoretical Significance

This study aims to design a systematic framework for a specialized teaching system that meets the demands of contemporary emergency management. Theoretically, it will construct an innovative model for emergency management education based on interdisciplinary integration and industry-education collaboration, addressing gaps in applied talent training theory. Practically, the study seeks to enhance the quality of talent cultivation through optimized course structures, strengthened practical training, and deeper school-enterprise cooperation. The findings will provide replicable reform solutions for higher education emergency management programs, supporting the modernization of national emergency management systems and capabilities.

1.3 Literature Review

Emergency management education has a long history abroad, with countries like the United States and Australia establishing mature teaching models. The U.S. Federal Emergency Management Agency (FEMA) has developed an integrated teaching system centered on "simulation-case study-practical exercises," covering all types of disaster management. Sydney University of Technology in Australia has integrated big data analytics and AI into emergency decision-making courses, significantly enhancing students' technical application skills. These practices demonstrate that foreign educational systems emphasize interdisciplinary integration, technology empowerment, and practical orientation.

Domestic universities are actively exploring talent cultivation in emergency management. The Disaster Prevention Technology Institute's "Three Transformations and Three Systems" model strengthens practical coursework, raising the practical competence of students to 45% of total credits. Jiangsu University has developed an industry-education integrated training system, collaborating with businesses to create course modules that enable students to master risk assessment and emergency decision-making skills through real projects. However, these existing models still face challenges, such as insufficient systematization and scattered resource integration.

Existing research often focuses on isolated reforms rather than holistic teaching system construction. Some universities emphasize practical teaching but lack cohesion between theoretical courses and practical scenarios; cooperation with enterprises often stops at internship bases without deep collaborative curriculum development or faculty sharing. This study's innovation lies in integrating theoretical and practical teaching resources through a "three-dimensional modular" theoretical instruction and "tiered practical" teaching system; establishing a comprehensive collaboration model from curriculum development to hands-on internships.

2. Theoretical Foundations and Core Concepts of the Specialized Emergency Management Teaching System

2.1 Theoretical Foundations

Emergency management merges knowledge from management, engineering, and sociology. Interdisciplinary theory emphasizes breaking down disciplinary barriers to tackle complex issues. Research by Zhang Haibo and Tong Xing suggests that enhancing emergency management effectiveness relies on multidisciplinary collaboration, such as integrating meteorology and data science for disaster prediction, and combining management science and psychology for emergency decision-making. Thus, the specialized experimental class should establish a cross-disciplinary curriculum to cultivate students' ability to apply diverse knowledge to real-world problems.

Industry-education integration theory advocates for deep alignment between education and industry needs, achieving synergy between talent training and industry development. Given its highly practical nature, industry-education integration is critical in emergency management. Data from the Ministry of Education indicates that graduates from industry-education integrated programs enjoy employment rates 12 percentage points higher than average. The specialized experimental class should incorporate real projects and industry standards, ensuring that classroom teaching and practical experience align with industry demands.

2.2 Core Concepts and Objectives

The specialized experimental class focuses on "theory as foundation, practice as strength, and innovation as drive." Theoretically, it aims to solidify professional foundations through a

systematic multidisciplinary curriculum; practically, it seeks to enhance emergency response capabilities via a progressive practical teaching system; innovatively, it encourages student participation in emergency technology development and management model innovation to foster high-level problem-solving skills.

In response to the intelligent and diversified development trends in emergency management, the experimental class will establish a dynamic training mechanism. Regular industry demand surveys will incorporate new technologies (e.g., drone monitoring, blockchain traceability) and policies (e.g., revisions to the National Emergency Response Plan) into the curriculum, ensuring that training programs resonate with industry advancements.

3. Construction of the Theoretical Teaching System for the Specialized Emergency Management Experimental Class

3.1 "Three-Dimensional Modular" Curriculum Design

The foundational theory module integrates core courses from management, engineering, and sociology. Management courses include "Public Crisis Management" and "Emergency Decision Theory"; engineering courses cover "Disaster Prevention Techniques" and "Principles of Emergency Engineering"; sociology courses include "Social Risk Assessment" and "Community Emergency Management." This interdisciplinary course group will nurture students' system thinking and comprehensive analytical skills.

The core professional module focuses on technical methods and processes in emergency management, offering courses like "Risk Identification and Assessment," "Emergency Plan Development," and "Emergency Command and Dispatch." Course content includes real case studies, such as the Zhengzhou "7.20" heavy rain disaster response, enabling students to acquire essential skills in disaster warning, resource allocation, and public opinion management through case-based learning.

The advanced expansion module introduces emerging technologies and international experiences, including courses on "Big Data and Emergency Management" and "Applications of AI in Disaster Warning." Additionally, specialized comparative studies of international emergency management systems will enhance students' global perspective and ability to address global risks.

3.2 Dynamic Curriculum Content Update Mechanism

Establish a dynamic tracking mechanism for industry standards in collaboration with organizations like the China Association of Safety Production and the Emergency Management Society, annually releasing competency standards for emergency management positions. Curriculum outlines will be revised to integrate the latest industry technical specifications (e.g., "Emergency Communication Equipment Operation Standards") and regulatory policies (e.g., revisions to the "Production Safety Law").

In courses such as "Emergency Management Information Systems" and "Disaster Prediction and Warning," introduce big data analysis tools (e.g., Python, SPSS) and AI algorithms (e.g., machine learning models). Through project-based learning, students will apply technological tools to process emergency management data, transforming theoretical knowledge into practical application. For instance, in disaster prediction courses, students will use historical disaster data to build predictive models, enhancing the accuracy of risk assessment.

4. Construction of the practical teaching system for the emergency Management Characteristic Experimental Class

4.1 "Stepwise Stratification" practical teaching framework

The practical teaching at the basic level focuses on consolidating individual skills and aims to cultivate the basic capabilities of emergency management through standardized experimental and training courses. The curriculum covers basic modules such as emergency equipment operation, disaster data collection and analysis, and emergency plan document processing. It is equipped with dedicated laboratories such as emergency communication equipment laboratories and disaster information processing laboratories to ensure that students master the standardized operation of basic technical tools in the field of emergency management. In the teaching process, the "operation certification system" is introduced, requiring students to score above 90 points in 12 basic skills assessments such as the use of fire-fighting

equipment and first aid bandaging before they can proceed to the next practical stage. Practical data from a certain university shows that students who have completed the basic level training have improved their proficiency in operating emergency equipment by 65% compared with the traditional teaching mode, and the accuracy rate of data entry has increased from 72% to 91%[4].

The advanced level builds multi-disaster emergency response simulation scenarios based on virtual simulation technology, with a focus on cultivating students' cross-departmental collaboration and complex problem-solving abilities. Develop simulation systems covering 10 typical scenarios such as natural disasters (earthquakes, floods), accident disasters (chemical leaks, high-rise building fires), and public health events (infectious disease epidemics), and set up virtual positions such as emergency command centers, material dispatch centers, and public opinion monitoring centers. Students are required to complete the entire process handling from risk early warning, resource allocation to public opinion guidance in teams. During the drill, a "stress test mechanism" was introduced. Through variable Settings such as the superposition of sudden secondary disasters and resource scheduling conflicts, students were forced to optimize their decision-making plans in dynamic games. The operation data of the Emergency Management Simulation Laboratory of North China Institute of Science and Technology shows that the average emergency decision-making response time of student teams participating in cross-departmental drills is reduced by 40%, and the vulnerability rate of the plan is decreased by 55%[1].

The innovation layer focuses on the application of comprehensive capabilities in real-world scenarios, achieving capability advancement by participating in practical projects of government emergency management departments and building dynamic case libraries. In collaboration with local emergency management bureaus and fire rescue brigades, the "Grassroots Emergency Management Capacity Enhancement Program" was carried out. Students were organized to participate in real projects such as community disaster risk surveys, revision of enterprise emergency plans, and security guarantees for large-scale events. A total of 37 practical tasks were completed, and 29 effective solutions were formed. Simultaneously build a dynamic case library containing over 300 typical cases, classified by three dimensions: "disaster type-response level-handling effect". Among them, 70% of the cases come from major domestic emergencies in the past five years (such as the rainstorm disaster in Zhengzhou and the prevention and control of the COVID-19 pandemic). Thirty percent are international classic cases (such as the 3.11 earthquake in Japan and Hurricane Katrina in the United States). The case library adopts a "dual circulation update mechanism", with no less than 50 new cases added each year and 15% outdated cases eliminated to ensure the timeliness and typicality of the case resources [6].

4.2 Integration of Practical Teaching Resources and Platform Construction

The on-campus experimental teaching center has been systematically renovated in accordance with the standards of "full coverage of all disaster types and full-process simulation", and a comprehensive training base with a total area of 2,000 square meters has been built, which includes eight functional units such as the disaster monitoring and early warning laboratory, the emergency command simulation laboratory, and the psychological crisis intervention laboratory. Among them, the disaster monitoring and early warning laboratory is equipped with a Doppler weather radar simulation system and a unmanned aerial vehicle remote sensing data processing platform, which can access the monitoring data of departments such as the meteorological bureau and the earthquake bureau in real time. The emergency command simulation laboratory builds a multi-screen interactive command system, supporting 1:1 reproduction of real emergency command scenarios. In the past three years, a total of 12 million yuan has been invested in equipment purchase and platform development. The opening rate of experimental courses has reached 100%, and the equipment utilization rate has increased by three times compared with traditional laboratories [5].

Off-campus practice bases are classified into three categories based on the principle of "complementary functions and deep collaboration" : Government-type bases (such as the provincial emergency management department and the municipal fire and rescue detachment) focus on policy implementation and

on-site command capability cultivation. Enterprise-type bases (such as emergency equipment manufacturing enterprises and safety production technology service companies) concentrate on technology application and industrial practice. Research-oriented bases (such as the Institute of Disaster Prevention and Control and the Key Laboratory of Public safety) are dedicated to the research and development of cutting-edge technologies and the cultivation of innovation capabilities. Formulate the "Construction Standards for Off-Campus Practice Bases", clearly stipulating that government-type bases should provide no less than 20 practical positions each year, enterprise-type bases should undertake 10% of the co-construction tasks of professional courses, and research-oriented bases should absorb students to participate in at least 5 provincial or ministerial-level or above scientific research projects. At present, 42 various types of practice bases have been signed, among which leading enterprises in the industry account for 35%, and there are 12 national-level scientific research platform cooperation bases [7].

5. The path to Building a "Dual-Qualified + Internationalized" Teaching Team

5.1 Optimization of Diversified Teaching Staff Structure

Establish the "Three-dimensional Capacity Enhancement Plan" to strengthen the practical abilities of teachers within the school: First, the "Industry Rotation System", which requires professional teachers to accumulate no less than six months of rotation in emergency management departments and the front lines of enterprises every five years, participating in the handling of real projects. Currently, 23 teachers have completed their rotation training and have led or participated in the formulation of 17 local emergency plans. The second is the "technical certification system", which encourages teachers to obtain professional qualifications such as registered safety engineers and emergency management professionals, with the proportion of certified teachers reaching 68%. The third is the "interdisciplinary Research and training mechanism". Every year, 10% to 15% of teachers are selected to conduct interdisciplinary studies at domestic and foreign universities. In the past three years, a total of 45 teachers have been sent, and 28 new interdisciplinary research achievements have been added [4].

Build a "dual-track parallel" model for introducing off-campus teachers: At the industry expert level, 32 senior practitioners with rich practical experience have been appointed as part-time professors from units such as the Ministry of Emergency Management and the China Academy of Safety Science and Technology. They undertake 30% of the practical course teaching tasks and offer the "Frontier Lecture Hall of Emergency Management" series of lectures, with an average annual teaching duration of over 400 class hours. At the international scholar level, long-term cooperation has been established with institutions such as Texas A&M University in the United States and Kyoto University in Japan. Every year, 5 to 8 renowned international experts are invited to conduct all-English courses, workshops, and joint research. In the past five years, a total of 12 overseas intellectual projects have been introduced, and 19 Sino-foreign collaborative papers have been published [2][3].

5.2 Innovation in Collaborative Teaching Mode

Each student is assigned a "1+1" dual mentor system: The theoretical mentor is a teacher with the title of associate professor or above within the school, responsible for academic planning and the construction of the theoretical knowledge system. The practical mentors are selected from senior experts in the industry, focusing on guiding the improvement of practical skills and career development planning. The dual mentors hold regular joint guidance meetings to jointly formulate personalized training programs. In the guidance of graduation theses, a "double-blind review system" is implemented, requiring that practical topics account for no less than 70% and must undergo practical feasibility studies by industry mentors. The tracking data of a certain experimental class shows that under the dual-track guidance system, the quality of students' completion of practical projects has increased by 41% compared with the single-mentor model, and the clarity of career goals has improved by 58%[1].

Break down the barriers between institutions and disciplines, and form an interdisciplinary teaching team composed of teachers from 5 universities and 8 disciplines (management, engineering, sociology, computer science, etc.)

to jointly develop cross-disciplinary courses such as "Big Data Analysis for Emergency Management" and "Sociology of Disasters". The team adopts a "rotating host system", with each course taught collaboratively by 2 to 3 teachers from different disciplines. Knowledge integration is promoted through case studies, interdisciplinary workshops and other forms. In the past three years, a total of 7 interdisciplinary courses have been developed, and 3 interdisciplinary textbooks on emergency management have been published. The related teaching achievements have won 2 provincial teaching achievement awards [6].

6. Construction of a Long-Term Mechanism for School-Enterprise Cooperation and on-the-Job Internships

6.1 Construction of a School-Enterprise Collaborative Education Platform

Establish an "Emergency Management Industry-Education Integration Community" jointly participated by universities, industry associations, enterprises and government departments, and implement a project responsibility system under the leadership of the council. The council is composed of representatives from 15 units and holds two joint meetings each year to review major matters such as the talent cultivation plan, the joint construction of curriculum standards, and the establishment of practical bases. It has three specialized committees under it: curriculum development, practical training base, and innovation and entrepreneurship. These committees are respectively responsible for connecting with industry demands, coordinating practical resources, and incubating emergency technology projects. Since the operation of the community, 46 school-enterprise cooperation projects have been facilitated, among which 12 achievements have been transformed into practical emergency management solutions, generating direct economic benefits of over 8 million yuan [5].

A dynamic mapping model of "job competency-curriculum system" was established. Through the investigation of job requirements of 50 enterprises related to emergency management, 12 core competency indicators such as risk assessment, emergency command, and public opinion management were extracted, and 23 professional courses were developed accordingly. The course content is revised every two years. Technical backbones from enterprises are invited to participate in the formulation of the teaching syllabus to ensure that the match between the course content and job requirements is no less than 90%. For instance, in response to the emerging demand for "smart emergency response" positions in recent years, courses such as "Blockchain Application in Emergency Management" and "Unmanned Aerial Vehicle Emergency Monitoring Technology" were promptly added. The student satisfaction rate of these related courses reached 92%[7].

6.2 "Project-oriented-Task-driven" On-the-Job Internship System

The on-the-job internship tasks are divided into three levels according to the principle of "progressive difficulty and compound ability" : The primary tasks (such as emergency material ledger management and basic data statistics) account for 30%, mainly targeting lower-grade students; Intermediate tasks (such as the formulation of small-scale emergency plans and local risk assessment) account for 50% and are applicable to senior students. Advanced tasks (such as the design of security plans for large-scale events and cross-regional emergency response drills) account for 20% and are undertaken by teams of outstanding students. Each task sets clear ability assessment points. For example, intermediate tasks require the mastery of six skills such as ArcGIS spatial analysis technology and risk matrix assessment methods, while advanced tasks require the possession of four core capabilities such as cross-departmental coordination and dynamic decision-making adjustment [1].

Build a "three-dimensional" internship monitoring system: In terms of process management, students are required to submit internship logs every week, and enterprise mentors conduct progress evaluations every month; In terms of ability assessment, a comprehensive scoring criterion of "task completion degree (60%) + teamwork collaboration (20%) + innovation contribution (20%)" is adopted; In terms of feedback and improvement, a dual reporting system for internship summaries was established (reporting simultaneously to the school's mentor group and the enterprise's management). Over the past three years, a total of 187 improvement suggestions have been collected, and based on this, 29 internship task designs have been

optimized. Data shows that the retention rate of internship units for students participating in this system has reached 45%, an increase of 27 percentage points compared with the traditional internship model [4].

7. Evaluation of the Implementation Effect of the Teaching System and Optimization Strategies

7.1 Construction of a Diversified Evaluation Index System

Establish a three-dimensional evaluation system including knowledge reserves, skill levels and professional qualities: Knowledge reserves are measured by quantitative indicators such as professional course grades and awards in subject competitions. In the past three years, the average grade point of students in the experimental class has been 0.8 higher than that of the ordinary class, and the winning rate in the National Emergency Management College Students' Competition has reached 73%. The skill level adopts dynamic indicators such as emergency response simulation assessment and the completion quality of practical projects. Among them, the pass rate of emergency decision-making plans (reviewed by enterprise experts) reaches 89%, an increase of 36% compared with the traditional assessment method. Professional qualities were evaluated through qualitative indicators such as the assessment of internship units and the performance of team collaboration projects. 92% of the enterprises reported that the students in the experimental class had significantly better stress resistance and sense of responsibility than ordinary graduates [6].

The "input-process-output" full-chain evaluation model is adopted: The input dimension is used to examine the school-running conditions such as the structure of teaching staff and practical resources. Currently, the proportion of dual-qualified teachers reaches 85%, and the off-campus practice bases cover 80% of the major emergency management industry clusters across the country. The process dimension monitors teaching process data such as course satisfaction (average 91.2 points) and the frequency of interaction between teachers and students (an average of 28 times per student per year); The output dimension tracks the long-term achievements such as the employment rate of graduates (95.6%), the rate of professional matching (82%), and the career development speed (the management promotion rate three years after graduation is 37%). The relevant assessment data are collected in real time through the teaching management system to form the annual teaching quality analysis report [7].

7.2 Continuous Improvement Mechanism

Establish an "Industry Demand radar system", and capture the development trends of the industry in real time through regular participation in the National Emergency Management Work Conference, tracking the "Annual Report on Emergency Management in China", and other means. In the past five years, in accordance with the reform direction of "all disaster types and large-scale emergency response", courses such as "Nuclear Accident Emergency Management" and "Public Health Emergency Response" have been successively added, and the ratio of traditional technologies to emerging technologies in the course content has been adjusted to 4:6. Meanwhile, in response to the intelligent transformation of emergency management positions, compulsory contents such as Python programming and basic machine learning have been added to the training program to ensure that the technical adaptation period for graduates is shortened to within three months [2].

Establish a closed-loop improvement mechanism of "student evaluation of teaching-teacher reflection-team discussion-plan revision": Students conduct real-time evaluations of the courses through the online system. In the past three years, 1,278 valid evaluation data of teaching have been collected, and the adoption rate of improvement suggestions for issues such as "update speed of practical cases" has reached 89%. The teaching team holds teaching reflection meetings every month, forms a "List of Classroom Teaching Problems", and has cumulatively optimized 17 teaching methods. At the end of each semester, a revision meeting of the training program involving representatives from schools and enterprises is held. In the past three years, a total of 11 courses have been adjusted and more than 200 teaching cases have been updated [5].

8. Conclusions

The teaching system of the emergency management characteristic experimental class constructed in this study has achieved the organic unity of interdisciplinary integration and

in-depth collaboration between industry and education through the dual-wheel drive of "three-dimensional modular" theoretical teaching and "stepwise stratification" practical teaching. Research shows that this system significantly enhances students' emergency decision-making ability (up 42% compared to the traditional model), cross-team collaboration ability (up 55%), and adaptability to complex scenarios (up 63%). The rate of graduates' major matching reaches 82%, which is 35 percentage points higher than the average level of similar majors [1][4]. The innovation points are mainly reflected in the following aspects: First, break through the limitations of the single-link reform and establish a full-element teaching system covering training objectives, curriculum framework, practical platforms, and faculty construction; Second, create a dynamic adaptation mechanism and achieve cultivation through the alignment of industry standards and the embedding of technical tools

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