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Research on the Collaborative Education Model of Safety Engineering Major from the Perspective of New Quality Productivity

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Abstract: The development of new quality productivity has put forward new requirements for the talent training of the safety engineering major, promoting the transformation of the education model towards collaboration, intelligence, and competence orientation. Based on the connotation and characteristics of new quality productivity, this paper explores the construction path of the collaborative education model for the safety engineering major. By constructing a "four-party linkage" industry-education integration mechanism and a "four-dimensional integrated" talent training model, it promotes collaborative education among the government, enterprises, industries, and universities. Relying on the "intelligent ecology" inside and outside the classroom, it implements the four-dimensional integrated training of "learning, research, competition, and innovation". This paper clarifies the teaching reform methods centered on competence formation, aiming to provide theoretical reference and practical paths for the safety engineering major to adapt to the development of new quality productivity.

Keywords: New quality productivity; Safety engineering; Collaborative education; Education model

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1. Introduction

New quality productivity is a new form of productivity driven by scientific and technological innovation, with intelligence, greenization, and integration as its basic characteristics. Its in-depth application in fields such as industrial safety and risk prevention and control has put forward higher requirements for the training of safety engineering professionals: they not only need to have solid professional knowledge but also possess interdisciplinary integration capabilities, technological innovation capabilities, and engineering practice capabilities [1]. Currently, China is in a critical stage of industrial structure optimization and independent scientific and technological innovation. As a major that cultivates talents for maintaining the safe production of industrial and mining enterprises, social operation, and public safety, the quality of talent training in safety engineering is directly related to the construction of the national safe production system and the improvement of emergency management capabilities. Especially in emerging fields such as intelligent manufacturing, new energy, and aerospace, safety risks present diversified, dynamic, and systematic characteristics, and there is an urgent need for high-level safety engineering talents with multi-disciplinary knowledge integration capabilities, intelligent technology application capabilities, and on-site emergency disposal capabilities [2]. Against this background, it is necessary for university safety engineering majors to break out of the traditional disciplinary framework, eliminate the "island effect" in talent training, and build an open, collaborative, and intelligent new education system to meet the practical needs of the development of new quality productivity.

2. Requirements of new quality productivity for the talent training of safety engineering major

2.1. Requiring the transformation from knowledge-oriented to competence-oriented talent training

New quality productivity emphasizes technological integration and innovative application, and the field of safety engineering also shows an intelligent and systematic development trend. The traditional education model focuses on theoretical teaching, making it difficult to cultivate students' comprehensive capabilities to solve complex engineering problems. New quality productivity requires the education system to take competence formation as the core, focusing on practical teaching, project-driven learning, and innovation training, promoting students to transform from passive knowledge acceptance to active competence construction, so as to meet the industry's demand for high-quality safety engineers. Specifically, safety engineering talents should have risk identification and assessment capabilities, safety system design and optimization capabilities, intelligent monitoring and early warning capabilities, emergency decision-making and command capabilities, and cross-field collaboration capabilities. The cultivation of these capabilities cannot rely solely on classroom teaching, but must be achieved through multiple approaches such as real projects, simulation training, and enterprise practice [3].

2.2. Requiring the construction of a cross-subject collaborative education mechanism

The development of new quality productivity is a trend of interdisciplinary integration and multi-subject collaborative innovation. The training of safety engineers should also break the isolated training model of universities. The government, enterprises, associations, and universities should jointly formulate training programs, carry out practical training, and conduct scientific research and achievement transformation. The "four-party linkage" method of government, enterprises, associations, and universities can effectively integrate resources, complement each other's strengths, and improve the alignment between talent training and industrial development. The government acts as a policy guide and resource integrator, enterprises as a real scenario platform and technical supporter, and industry associations build bridges and standard systems [4]. For universities, they must assume the responsibilities of education management and knowledge creation. Only by establishing an educational cooperative relationship of "co-construction, supervision, sharing, and mutual benefit" can high-quality safety engineering talents adapting to industrial development be successfully cultivated.

2.3. Requiring the construction of a new educational ecology relying on intelligent technology

Information technology is an important part of new quality productivity. Technologies such as artificial intelligence, big data, the Internet of Things, and virtual reality can solve many problems in educational innovation. Therefore, a "smart ecology" based on intelligent systems should be built in the curriculum system of the safety engineering major. Intelligent technologies are used for blended teaching, personalized learning, and real-time evaluation, thereby improving teaching efficiency and student participation, and realizing the transformation of teaching from a traditional model to an intelligent, interactive, and open model. For example, VR/AR technology can be used to simulate fire, explosion, or leakage accident scenes to support the design of emergency evacuation plans and emergency drills; big data analysis can be used to further analyze learning behaviors to achieve precise educational guidance; in addition, intelligent sensors can be used to obtain experimental data, improving the authenticity and scientificity of practical teaching.

2.4. Requiring the strengthening of innovation, entrepreneurship, and scientific research capability cultivation

Facing new technologies and new industrial models, students majoring in safety engineering should have high innovation and entrepreneurship capabilities as well as scientific research capabilities. Universities can cultivate students' innovation capabilities through multiple channels, and encourage them to actively participate in various scientific research projects, competitions, and entrepreneurship activities, so as to improve their comprehensive capabilities such as technology integration capabilities, risk analysis capabilities, and system design capabilities [5]. They should be guided to participate in the development of applied scientific research projects such as intelligent ventilation, intelligent fire prevention and extinguishing, and emergency rescue robots, and complete the process of scientific research achievement transformation, forming a virtuous cycle of "learning through research, creating through competition, and teaching through creation".

3. Construction strategies of the collaborative education model for safety engineering major from the perspective of new quality productivity

3.1. Establish a "Four-Party Linkage" industry-education integration collaborative education mechanism

On the basis of the university-oriented talent training subject, efforts should be made to cultivate safety engineer talents needed by enterprises, thereby promoting the formation of a "four-party collaborative education mechanism" among the government, enterprises, industries, and universities (see **Figure 1**). The four parties divide labor and cooperate to achieve collaborative education [6]. For example, the government undertakes policy guidance and standard formulation, and increases investment in the research and development and application of artificial intelligence technology; industry associations act as bridges and standard systems between schools and enterprises; universities have advantages in knowledge transmission and skill training, and can cooperate closely with enterprises through models such as "double-qualified teacher system" and "order-based training", highlighting the main role of new enterprises, mobilizing their enthusiasm, allowing students to receive corporate guidance in schools, jointly declare scientific research projects, carry out collaborative technological innovation and achievement transformation, improve the university's scientific research capabilities and enterprise's innovation capabilities, and provide more practical opportunities for students; enterprises can share instruments and equipment, provide real scenes and mentor guidance for students, while universities adjust teaching content arrangements according to enterprise needs. Through the joint efforts of schools and enterprises, various resources are integrated into forces promoting educational and technological development, forming a "spiral upward" effect [7]. To this end, a “Safety Engineering Industry-Education Integration Collaborative Education Committee” can be established, bringing together experts from various fields, entrepreneurs, and university teachers under the leadership of the government. They will regularly discuss issues such as improving talent training programs, curriculum settings, experimental content, and assessment standards; enterprises can establish “Safety Engineering Practice Bases”, inviting university teachers to participate in enterprise technological transformation activities, and allowing college students to carry out internships or graduation designs as appropriate. Third, industry associations can carry out activities such as “Safety Engineering Innovation Competitions” and “Industry Technology Lectures” to strengthen academic research and talent training.

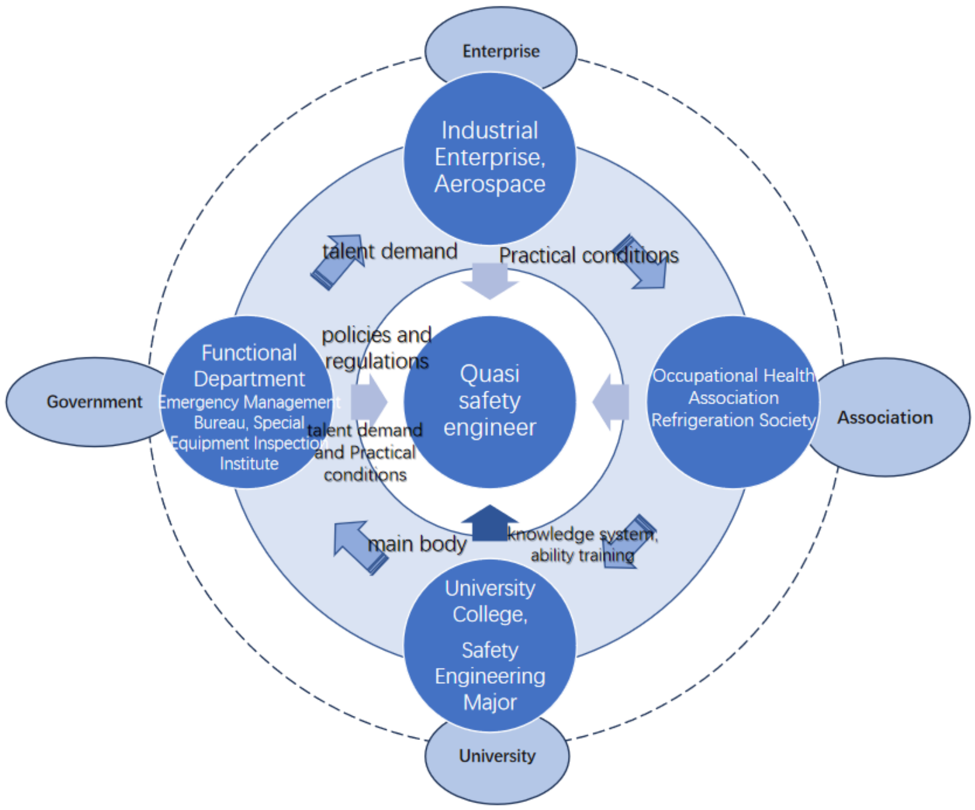

Figure 1. “Four-Party Linkage” Collaborative Education Mechanism.

3.2. Construct a “Four-Dimensional Integrated” new talent training model under the “intelligent ecology” inside and outside the classroom

In the process of building the “four-party linkage” education model, the fundamental goal should be to improve students’ comprehensive quality. We should “promote teaching through construction”, build an “intelligent ecological circle” inside and outside the classroom, incorporate the four dimensions of “learning, research, competition, and innovation” into it, form a new mechanism for talent training, and transform from traditional teaching to comprehensive competence cultivation. Teachers should focus on students’ competence and growth, put forward the goal of “innovation +”, and implement the OBE concept throughout. Develop online and offline intelligent teaching assistance systems based on artificial intelligence technology to provide personalized resources, and attach importance to links such as “process evaluation” and “question answering and guidance” to improve students’ ability to apply theories to solve engineering problems. Actively give play to the role of the school-enterprise industry-university-research link, encourage teachers to introduce the latest scientific research achievements and cases into the classroom, and encourage students to participate in the research and development of scientific research projects by teachers or enterprises to better cultivate their scientific research capabilities; fourth, use competitions as a bridge between teachers and students' activities, and actively create a progressive atmosphere. Based on various levels of competition projects, such as the "Internet +" Competition, build various discipline competition systems, including "disciplinary expertise + innovation and entrepreneurship", guiding students to apply intelligent technology to professional designs, such as industrial ventilation and fire and explosion prevention, and reflecting intelligent risk prevention and control functions in their works. At the same time, create a positive competition atmosphere where seniors guide juniors. In addition, take innovation as the fundamental point to create an "innovation pool" for cultivating students [8]. Teachers should strive to drive students to give play to their innovative capabilities through innovation and entrepreneurship activities, and promote the in-depth integration of intelligent technology and the industry through the introduction of the school-enterprise "double-qualified teacher" system, realizing the integration of the talent supply side and the demand side. For example, from the "learning" dimension, a "Safety Engineering Intelligent Learning Platform" can be built to provide services such as micro-courseware, virtual simulation laboratories, online exams, and learning data analysis; from the "research" dimension, a "Safety Science Student Maker Space" can be established to carry out special scientific research projects around actual enterprise safety problems. On the one hand, in the "competition" link, activities such as "Safety System Design Competition" and "Emergency Drill Simulation Competition" can be set up; on the other hand, in the "innovation" link, a "Safety Technology Innovation and Entrepreneurship Incubation Fund" can be established to support students in carrying out safety product innovation and research and development and entrepreneurship activities (**Figure 2**).

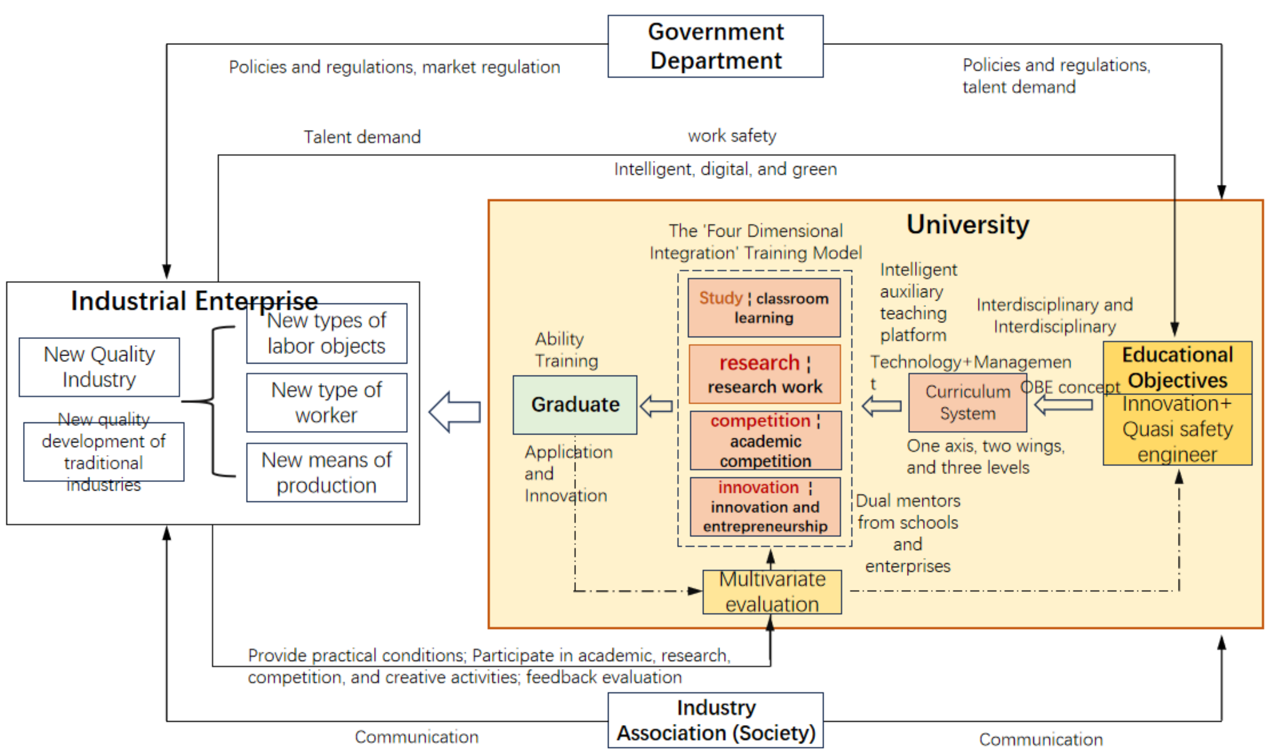

Figure 2. "Four-Dimensional Integrated" Talent Training Model.

3.3. Promoting curriculum teaching reform with process assessment of competence formation as the starting point

Guide teachers to learn advanced educational and teaching concepts and change their understanding of education; focus on students' competence cultivation, reform teaching methods and approaches with the process of competence formation as the evaluation method; develop on-campus and off-campus intelligent learning platforms with the help of artificial intelligence technology, adopt student-centered, online and offline blended inquiry teaching methods, encourage students to actively participate in various activities, and advocate teachers to use emerging information technology means such as artificial intelligence and the Internet in classroom teaching to improve classroom interaction, openness, and student participation, realizing the transformation from passive acceptance to active learning. Use online platforms such as Xuexitong and YUKETANG to carry out test questions and homework to evaluate students' level and development; identify key and difficult points from exams and exercises and provide targeted tutoring and help; enable students to deepen their understanding of knowledge points and form professional skills to solve practical problems: at the same time, cultivate their spirit of independent work and solidarity and cooperation [9]. In addition, the assessment of students' course scores should not be limited to paper-based exams, but can be in the form of project defense, virtual simulation operation, on-site question answering, and group mutual evaluation, focusing on examining students' ability to solve real or simulated problems, scheme design ability, and organizational command ability. For example, the course "Factory Ventilation and Dust Removal" can require students to design an intelligent ventilation system for the production workshop of a certain company and conduct simulation operation and evaluation; the course "Safety Management" can require students to complete a project of hazard identification and prevention countermeasure design for a chemical park in teams.

3.4. Strengthening the integration of school-enterprise resources and the construction of innovation platforms

Universities should actively co-build training bases, laboratories, and innovative R&D platforms with industrial enterprises, provide students with real engineering practice environments in terms of shared equipment utilization rate and teaching staff, and transform various resources into school-running advantages through cooperative project development and technical collaborative research; industrial enterprises can optimize curriculum settings according to their own needs. Universities using enterprise platforms for practical learning and innovative research is a demand-supply matching and coordinated development education model. For example, they can co-build an "Aerospace Safety Engineering Experiment Center" with aerospace research institutes and enterprises; in addition, they can co-build a "Chemical Process Safety Training Base" with chemical enterprises. Or cooperate with high-tech enterprise teams to establish a "Safety Intelligent Detection R&D Platform", etc. When designing such platforms, attention should be paid to their functional diversity, transparent management, and variable projects to make them an important way for students to learn skills; at the same time, teachers and enterprise engineers should be encouraged to jointly compile textbooks, produce teaching courseware, and formulate training topics, to ensure that the update of course content can keep up with industry standards and technological development. Universities can hire professional and technical personnel from enterprises as part-time professors or practical instructors, and enterprises can also select employees to study in schools or participate in teaching seminars, so as to realize the two-way flow of personnel and the two-way transmission of knowledge [10].

4. Conclusion

The development of new quality productivity has brought opportunities and challenges to the education of the safety engineering major. By constructing a "four-party linkage" collaborative education mechanism and a "four-dimensional integrated" training model, promoting the construction of an intelligent ecology inside and outside the classroom and curriculum teaching reform, the comprehensive capabilities and innovative qualities of students can be effectively improved, and the efficient connection between talent training and industrial needs can be realized. In the future, safety engineering majors should continue to deepen industry-education integration and strengthen technological empowerment to provide solid talent support for the construction of safety engineering in the new era. Looking forward, the collaborative education of safety engineering still needs to be continuously deepened in the following aspects: first, further improve the institutionalized and regular operation of the "four-party linkage" mechanism, forming a sustainable policy support and resource guarantee system; second, strengthen the standardized construction and data security guarantee of intelligent education platforms, improving their teaching support capabilities and scope of application; third, promote the cross-integration of safety engineering major with emerging majors such as artificial intelligence, big data, and the Internet of Things, cultivating more compound safety science and technology talents; fourth, strengthen international exchanges and cooperation, introducing advanced foreign safety engineering education concepts and curriculum systems, and improving the international competitiveness of talent training. Only by continuously iterating the education model and innovating educational methods can the safety engineering major better serve the national safe production strategy and provide reliable safety guarantees and talent support for the development of new quality productivity.

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Disclosure statement

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