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Construction of a Lifelong Education System in the New Era

—Taking Full-Time and Part-Time Teachers in the Railway System as the Research Direction

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Abstract

Against the dual background of the construction of a lifelong education system in the new era and the high-quality development of the railway industry, the full-time and part-time teaching staff, as the core support for railway continuing education, their construction quality is directly related to the training effectiveness and the supply of industry talents. Guided by the thought on socialism with Chinese characteristics for a new era on safe production and the development of artificial intelligence technology, this paper is based on the current situation of the construction of full-time and part-time teaching staff in the railway system, combined with data from 4 special surveys (covering 153 participating teachers) and empirical data from 52 students of the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot. It explores the construction path of a teaching staff suitable for the characteristics of the railway industry from the dimensions of teacher selection, training, management, and incentive, providing practical reference for improving the railway lifelong education system, strengthening safe production guarantees, and empowering industrial transformation and upgrading.

Keywords

New Era, Lifelong Education System, Railway System, Full-Time and Part-Time Teachers, View on Safe Production, Artificial Intelligence

1. Introduction

1.1. Research Background

The report to the 20th National Congress of the Communist Party of China clearly

proposes to "improve continuing education, accelerate the construction of a learning society, and vigorously improve the quality of the people", pointing out the direction for the construction of a lifelong education system. As an important infrastructure industry related to national economy and people's livelihood, the safe operation, technological upgrading, and high-quality development of the railway industry are inseparable from the support of a high-quality talent team, and the full-time and part-time teaching staff is the key link connecting industry needs and talent training.

The thought on socialism with Chinese characteristics for a new era about the important discussions on safe production provide the fundamental follow for railway education and training, emphasizing that "safety is the premise of development, and development is the guarantee of safety", requiring practitioners to have excellent professional skills and a sense of responsibility. At the same time, the in-depth application of artificial intelligence technology in the railway industry has promoted the transformation of training models from traditional theoretical teaching to "technology empowerment + practice orientation", putting forward higher requirements for the teaching ability and technical application ability of full-time and part-time teachers (Cao, 2025).

The current situation best reflects the problems. Starting from this, we will deeply explore the problems existing in the transformation process and promote higher vocational colleges to vigorously carry out continuing education (Wu, 2024). Survey data shows that the core needs of full-time and part-time teachers in the railway system for training focus on new technology application (88% - 90.91%), teaching ability improvement (62.07% - 80%), practical training (78.79% - 90.91%), etc. However, problems such as tight training schedules (40.91% - 79.31%) and outdated technical courses in existing training restrict the overall quality improvement of the teaching staff. Based on this, constructing a training system for full-time and part-time teachers in the railway system suitable for the requirements of the new era has become an urgent need for the implementation of the lifelong education system and the safe development of the industry.

1.2. Research Significance

1.2.1. Theoretical Significance

Enriching the practical connotation of lifelong education theory in the industrial field, combined with the Kirkpatrick Model, the dual-system theory of vocational education, and the Self-Directed Learning framework in adult learning theory, to construct an industry teacher training framework guided by "view on safe production + artificial intelligence". The specific connection logic between the three and the proposed training model in this study is clear, forming a complete closed loop of "theoretical guidance - practical implementation": first, the Self-Directed Learning framework in adult learning theory provides core support for the "personalized training mechanism" which is the core of the paper. This theory emphasizes that adult learning has the characteristics of "clear needs, self-driven, and practical orientation", which is in line with the characteristics of full-time and

part-time teachers in the railway industry who "face prominent conflicts between work and study and have precise learning goals". Therefore, this study designs a "demand research - curriculum adaptation - dynamic optimization" mechanism, accurately grasps the ability shortcomings of teachers in different positions and years through pre-surveys, and builds a "basic compulsory + special elective" curriculum system to allow teachers to independently match learning content, effectively improving training adaptability; second, the dual-system theory of vocational education focuses on "collaborative education between enterprise practice and college teaching", directly guiding the construction of the "technology + teaching + safety" integrated training system and the "school-enterprise collaboration guarantee mechanism" in this study. Relying on railway enterprises to provide practical resources such as intelligent equipment operation and maintenance and on-site practical training, combined with the advantages of vocational colleges in teaching ability training, it achieves the dual improvement of "practical skills + teaching ability", in line with the "practice-oriented" training characteristics of the railway industry; third, the Kirkpatrick Model provides methodological support for the diversified evaluation system in the "precision + dynamic management mechanism". This model evaluates training effectiveness from four dimensions: reaction level (course feedback), learning level (practical test), behavior level (teaching achievements), and result level (post performance). Therefore, this study constructs an evaluation system of "practical test + teaching achievement display + student evaluation + long-term tracking" to comprehensively verify training effectiveness. By deeply binding specific educational theories with railway industry characteristics and training models, clarifying the application boundaries and adaptation paths of theories in practice, avoiding the disconnection between theory and practice, it provides more targeted theoretical reference for the construction of full-time and part-time teaching staff in similar industries.

1.2.2. Practical Significance

Targetedly solve the shortcomings of full-time and part-time teachers in the railway system in terms of teaching ability, technical application, and safety literacy, improve training quality and effectiveness; promote the skill upgrading of railway employees through the improvement of teachers' abilities, strengthen safe production guarantees, and provide talent support for the high-quality development of the railway industry.

1.3. Research Methods and Data Sources

1.3.1. Research Methods

Adopt literature research method, questionnaire survey method, statistical analysis method, and quasi-experimental research method. Sort out research results related to lifelong education, industry teacher training, and artificial intelligence-empowered training; conduct statistical analysis based on data from 4 special surveys and empirical data from the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, extract teachers' needs and existing problems;

verify the practical effect of the personalized training mechanism through quasi-experimental design (setting intervention group and control group); propose construction paths combined with the characteristics of the railway industry.

1.3.2. Data Sources

The survey covers 153 full-time and part-time teachers and vocational education management personnel from units such as China Railway Chengdu Bureau, Guangzhou Bureau, and Hohhot Bureau, including 66 vocational education management personnel from transportation stations and sections, 25 full-time and part-time teachers from Guangzhou Vocational Skills Training Base for Employees, 29 power supply system maintenance technical personnel, and 33 part-time teachers from transportation/passenger transport/freight transport systems. The survey content covers 15 core dimensions such as working years, training needs, teaching effects, and difficulty demands, with a data validity rate of 100%.

A quasi-experimental study was conducted with 52 students from the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot as the intervention group (adopting the "technology + teaching + safety" integrated training system proposed in this paper) and 66 students of the same type from Chengdu Bureau as the control group (adopting the traditional training model). The intervention cycle was 3 months, and the training effect was verified through pre-test and post-test comparison and questionnaire survey. The basic information of the intervention group students is as follows: the distribution of working years is 28.85% for less than 1 year, 25% for 1 - 3 years, 7.69% for 3 - 5 years, and 38.46% for more than 5 years; the overall training satisfaction rate is 80.77% (very satisfied) + 19.23% (relatively satisfied); the proportion of "very close" between course content and actual work needs is 63.46%, and "relatively close" is 34.62%.

2. Current Situation and Demand Characteristics of the Construction of Full-Time and Part-Time Teaching Staff in the Railway System

2.1. Current Situation of Team Structure

2.1.1. Unbalanced Distribution of Working Years

The proportion of new teachers is relatively high. Teachers with less than 1 year of working experience account for 36% - 78.79%, including 36% for full-time and part-time teachers of Guangzhou Bureau and 78.79% for part-time teachers of Hohhot Bureau's transportation system. In contrast, senior teachers with more than 5 years of working experience account for only 27.27% - 28%, and the team echelon construction needs to be improved. Among the students of the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, 38.46% have more than 5 years of work experience, and 28.85% are new teachers with less than 1 year of experience, showing the distribution characteristic of "high proportion of senior and new teachers, and weak middle echelon".

2.1.2. Shortcomings in Ability Structure

Survey shows that teachers generally lack new technology application capabilities (demand ratio: 88% - 90.91%, this range represents the demand differences among the 4 survey units: 88% for Chengdu Bureau, 89.65% for Guangzhou Bureau, 90.91% for Hohhot Bureau, not statistical confidence intervals) and modern teaching capabilities (demand ratio: 62.07% - 80%, this range represents the demand differences among the 4 survey units: 62.07% for Chengdu Bureau, 73.33% for Guangzhou Bureau, 80% for Hohhot Bureau, not statistical confidence intervals). Some teachers have the problem of disconnection between theory and practice (6.9% - 24% reflect this difficulty, this range represents the demand differences among survey objects from different systems: 6.9% for transportation system, 24% for power supply system, not statistical confidence intervals), which is difficult to meet the needs of intelligent upgrading of railway equipment and practical training. Survey data from the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot shows that 84.62% of students hope to add "new technology application" courses in future training, and 73.08% pay attention to "emergency handling skills", confirming the urgent demand for new technology application and practical ability improvement.

2.2. Core Characteristics of Training Needs

2.2.1. Course Content Needs Focus on Practicality and Cutting-Edge

New technology application (86.21% - 90.91%), teaching ability improvement (62.07% - 80%), and emergency handling skills (48.28% - 76%) have become the three most concerned course modules. Among them, the demand for artificial intelligence-related technology application courses among power supply system teachers reaches 86.21%, reflecting the urgency of technology empowerment. In the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, 78.85% of students hope to add "case analysis teaching", which, together with new technology application and emergency handling skills, constitutes the three core needs, highlighting the distinct "practical orientation" of railway industry training.

2.2.2. Training Methods Prefer Practicality and Experience

Practical training (78.79% - 90.91%), on-site observation (68% - 81.82%), and theoretical teaching (54.55% - 84%) are considered the three most effective training methods. The demand for online learning accounts for only 6.9% - 16%, reflecting the "practice-oriented and application-focused" characteristics of railway industry training. Survey data from the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot further verifies this preference: 82.69% of students believe that "practical training" is the most effective, and 67.31% recognize "on-site observation", which, together with theoretical teaching (78.85%), become the three most popular training methods.

2.2.3. Support Service Needs Highlight Resources and Communication

100% of full-time and part-time teachers of Guangzhou Bureau and 96.55% of power supply system teachers pay attention to learning material sharing; 68% - 81.82% of teachers hope to build communication platforms; 44% - 63.64% need practical opportunities, reflecting teachers' strong demand for long-term learning support. In the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, 82.69% of students pay attention to "learning material sharing", 67.31% need "practical opportunities", and 63.46% hope to build "communication platforms", which is highly consistent with the overall survey trend.

2.3. Main Existing Problems

2.3.1. Mismatch between Training Supply and Demand

Some training courses are outdated compared to the development of industrial technology. 72.73% - 84% of teachers believe that the depth of course content is a key factor affecting training effect, while the supply of new technology application courses has not fully met the demand. In the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, 63.46% of students believe that "the depth of course content" is the core factor affecting training effect, which is consistent with the overall survey conclusion.

2.3.2. Obvious Time and Energy Constraints

40.91% - 79.31% of teachers reflect tight training schedules, especially 79.31% of power supply system teachers. The contradiction between work and study has become a major obstacle restricting training participation. In the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, 51.92% of students reflect "tight time arrangements", which is the main difficulty in the training process.

2.3.3. Imperfect Evaluation and Incentive Mechanisms

Existing evaluation methods mainly focus on course feedback (42.42% - 48.28%) and practical tests (68.18% - 89.66%), lacking long-term tracking and incentives for teachers' teaching achievements, making it difficult to form a driving force for continuous improvement. In the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, 78.85% of students believe that "practical tests" can truly reflect training effect, and 67.31% recognize "course feedback", confirming the limitations of existing evaluation methods.

3. Core Principles for the Construction of Full-Time and Part-Time Teaching Staff in the Railway System in the New Era

3.1. Principle Guided by the View on Safe Production

Integrate the thought on socialism with Chinese characteristics for a new era about the important discussions on safe production into the entire process of teacher training, strengthen the training of safety responsibility awareness and

emergency response capabilities, and ensure that teachers can convey safety concepts and standardize operating standards in teaching. Survey shows that the satisfaction rate of safety production-related courses among power supply system teachers reaches 79.31%, reflecting the importance of the safety-oriented approach. In the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, the average score of the course "The thought on socialism with Chinese characteristics for a new era about the Important Discussions and Instructions on Safe Production and Accident Case Education" reaches 9.44 points with an NPS value of 84.61%, fully demonstrating the high recognition of safety-related courses.

3.2. Principle of Artificial Intelligence Empowerment

Supported by artificial intelligence technology, promote the intellectualization of training content, digitalization of teaching methods, and precision of management modes. Focus on improving teachers' abilities in intelligent equipment operation, virtual simulation teaching, and big data analysis to adapt to the intelligent transformation needs of the railway industry. In the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, the average score of the course "Artificial Intelligence Assists Cadre Capacity Improvement—Application of epsee and Other Large Models in Office Work" reaches 9.46 points with an NPS value of 84.61%, and 82.69% of students recognize the course effect.

3.3. Principle of Adapting to Lifelong Learning

In line with the requirements of building a lifelong education system, construct a full-cycle training system of "pre-service training - on-the-job improvement - continuous further study", meet the personalized learning needs of teachers with different working years and positions, and realize the synchronization of teachers' abilities with industrial development.

3.4. Principle of Adapting to Industrial Characteristics

Based on the job characteristics of different systems such as railway transportation, power supply, passenger transport, and freight transport, design targeted training content and methods, highlighting practicality, professionalism, and emergency response, to ensure that teachers can accurately meet the needs of position teaching.

4. Construction Path of Full-Time and Part-Time Teaching Staff in the Railway System in the New Era

4.1. Constructing a "Three-Dimensional Integration" Selection Mechanism

4.1.1. Qualification Dimension

Clarify the professional qualification requirements for full-time and part-time

teachers. Full-time teachers should have a railway-related professional background and more than 5 years of industrial experience; part-time teachers should be front-line technical backbones or industry experts to ensure the professional authority of teachers.

4.1.2. Ability Dimension

Establish a three-dimensional assessment standard of "technical ability + teaching ability + safety literacy". Select candidates with both practical experience and teaching potential through practical tests, trial teaching evaluations, and safety knowledge assessments, referring to the practical test evaluation method recognized by 89.66% of teachers in the survey.

4.1.3. Literacy Dimension

Strengthen the assessment of political literacy and sense of responsibility. Take the practice of the view on safe production and professionalism as core indicators for selection, ensuring that teachers can play a value-leading role in teaching.

4.2. Building an Integrated Training System of "Technology + Teaching + Safety"

4.2.1. Modular Curriculum Setting

- Technology Empowerment Module: Offer courses such as Application of Artificial Intelligence in Railway, Intelligent Equipment Operation and Maintenance, and Big Data Analysis. Invite technical experts to teach to meet the new technology learning needs of 86.21% - 90.91% of teachers. To improve implementation effectiveness, a three-stage implementation path of "theoretical learning - virtual practical training - on-site application" can be constructed: the first stage involves learning theoretical knowledge such as basic principles of artificial intelligence and technical specifications of railway intelligent equipment through online courses; the second stage uses AI virtual simulation systems (specific technical parameters: scene reduction degree ≥95%, supporting simulation of 12 types of core scenes such as intelligent EMU dispatching and power supply system intelligent inspection, response delay ≤0.5 seconds, capable of recording operation trajectories and generating error analysis reports) relying on the national-level rail transit virtual simulation training base, simulating scenes such as intelligent EMU dispatching and power supply system intelligent inspection, allowing teachers to practice repeatedly in a safe and controllable environment; the third stage organizes teachers to go deep into front-line railway stations and sections to participate in the actual operation and maintenance of intelligent equipment (such as CR400BF EMU intelligent diagnosis terminals and catenary intelligent inspection robots), transforming technical knowledge into teaching ability. Practice in the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot shows that the average score of courses related to this module (such as artificial intelligence application and professional skill special teaching) reaches 9.39 points with an NPS value exceeding 80%, 48.08% of students believe that their

professional skills have been "significantly improved", and 51.92% believe that there has been "certain improvement".

- Teaching Ability Module: Cover content such as case teaching method, practical teaching organization, and application of information-based teaching tools. Adopt the "7-minute practical teaching + comment and guidance" mode (with a satisfaction rate of 100% in power supply system training) to improve teachers' practical teaching ability. In the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, the average score of the course "Structured Expression in Team Management—Railway Foreman Communication Efficiency Improvement Course" reaches 9.65 points with an NPS value of 90.39%, and 82.69% of students recognize the teachers' interactivity and guiding ability.
- Safety Literacy Module: Interpret important discussions on safe production, analyze railway safety accident cases, and carry out emergency response drills to strengthen teachers' safety teaching ability and adapt to the requirements of industrial safety development.

4.2.2. Diversified Training Methods

Adopt a combined mode of "practical training + on-site observation + group discussion". Conduct on-site teaching relying on railway industry-education integration training bases (with a demand ratio of 81.82% among transportation system teachers), and use virtual simulation technology to create a safe and risk-free practical environment to solve the contradictions between work and study and practical risks. Survey data from the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot shows that 82.69% of students believe that "practical training" is the most effective, and 67.31% recognize "on-site observation", which is highly consistent with the design logic of the combined mode (Xu, Ma, Liu, & Wang, 2025).

4.2.3. Long-term Learning Support

Build an integrated online-offline learning and communication platform to realize 100% sharing of learning materials. Establish a regular Q&A guidance mechanism (demanded by 44% - 60.61% of teachers) and organize inter-unit teacher exchange activities to promote the sharing of high-quality teaching experience. In the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, 82.69% of students pay attention to "learning material sharing", 51.92% need "regular Q&A guidance", and 63.46% hope to build "communication platforms", providing empirical basis for the long-term learning support mechanism.

4.3. Establishing a "Precision + Dynamic" Management Mechanism

4.3.1. Classified Management

Formulate differentiated management plans according to the characteristics of full-time and part-time teachers, teachers from different systems, and teachers

with different working years. For example, focus on basic ability training for new teachers and technical update and innovative teaching ability improvement for senior teachers (Shao, Kong, & Liang, 2025).

4.3.2. Dynamic Evaluation

Construct a diversified evaluation system of "practical tests + teaching achievement display + student evaluation + long-term tracking", refer to the evaluation methods recognized by 68.18% - 89.66% of teachers, regularly collect teaching effect data, and form personalized improvement reports.

4.3.3. Technology-Empowered Management

Establish a personalized training mechanism of "demand research - curriculum adaptation - dynamic optimization" to improve management efficiency and precision. Specifically, accurately grasp the ability shortcomings of teachers in different positions and with different working years through pre-training questionnaires. Combine the technical development of the railway industry and safety training requirements to build a curriculum system of "basic compulsory courses + special elective courses": basic compulsory courses cover common content such as interpretation of safe production discussions and core teaching methods; special elective courses are set for personalized needs such as new technology application and emergency teaching organization. At the same time, regularly collect training feedback data, dynamically adjust course content and matching plans, and form a closed-loop management. Quasi-experimental research verification shows (52 people in the intervention group and 66 people in the control group), after the implementation of this mechanism, the average score of training courses for students in the intervention group reaches 89.6 points, an increase of 12.3 points compared with the control group (77.3 points), and the overall satisfaction rate of students in the intervention group with the training (100% satisfied, including 80.77% very satisfied) is significantly higher than that of the control group (82.14% satisfied), fully verifying the practical value of the personalized training mechanism.

4.4. Improving the "Incentive + Guarantee" Long-Term Mechanism

4.4.1. Diversified Incentives

Establish a system of "material incentives + spiritual incentives + career development incentives". Commend and reward teachers with excellent teaching effects, link training achievements with professional title evaluation and post promotion, and stimulate teachers' enthusiasm for continuous improvement.

4.4.2. Resource Guarantee

Increase investment in training facilities, build intelligent training bases and virtual simulation teaching platforms, and ensure sufficient training funds; reasonably arrange training time, alleviate the time pressure reflected by 72.73% of teachers, and improve training participation. In response to the "tight time arrangements" reflected by 51.92% of students in the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, a "flexible learn-

ing + centralized practical training" mode can be adopted, using fragmented time to complete online theoretical learning, and conducting centralized offline practical training and on-site teaching to effectively alleviate the contradiction between work and study.

4.4.3. School-Enterprise Collaboration Guarantee

Construct a "railway enterprise + vocational college + industry association" collaborative guarantee mechanism. Enterprises provide practical positions and technical support; vocational colleges are responsible for teaching ability training; industry associations build communication platforms to form a joint training force.

5. Conclusions and Prospects

5.1. Conclusions

The construction of full-time and part-time teaching staff in the railway system in the new era is a key support for the implementation of the lifelong education system and the high-quality development of the industry. Based on survey data and empirical data from the training course at China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, the teaching staff has problems such as unbalanced structure, insufficient technical application ability, and prominent contradictions between work and study. Their core needs focus on new technology application, practical training, and long-term learning support. By constructing a "three-dimensional integration" selection mechanism, an integrated training system of "technology + teaching + safety", a "precision + dynamic" management mechanism, and an "incentive + guarantee" long-term mechanism, the overall quality of the teaching staff can be effectively improved, realizing the training goal of "safety shaping soul, technology empowering, and teaching quality improvement", and providing core support for the construction of the railway lifelong education system.

5.2. Prospects

In the future, the integrated application of artificial intelligence technology can be further deepened to develop personalized intelligent training platforms and realize the digital management of the entire process of teacher training; strengthen the exchange and cooperation of teachers between different railway bureaus and industries to share high-quality resources and successful experiences; establish a feedback mechanism for teacher training quality evaluation, continuously optimize training plans, and promote the in-depth adaptation of teacher team construction to the intelligent, safe, and high-quality development of the railway industry, providing a more solid guarantee for the comprehensive implementation of the lifelong education system in the industrial field.

5.3. Research Limitations

This study has the following limitations: the representativeness and coverage of the sample are limited. On the one hand, the total sample size of the survey is only

153, while the scale of employees in various railway bureaus of China's railway system is huge (for example, China Railway Chengdu Bureau Group Co., Ltd. has more than 100,000 employees). The limited sample size is difficult to fully reflect the overall situation of full-time and part-time teachers in the national railway system, which may affect the wide applicability of the research conclusions; on the other hand, the sample coverage is concentrated in some units of Chengdu Bureau, Guangzhou Bureau, Hohhot Bureau, and China Railway Special Cargo Guangzhou Mechanical Insulated Vehicle Depot, not covering key regions such as Shenyang Bureau and Shanghai Bureau, nor involving important systems such as railway freight transport and engineering construction, resulting in certain restrictions on the universality of the research results. Future research can expand the sample coverage, increase research objects from different regions and systems, and carry out long-term longitudinal tracking research to further verify the long-term effectiveness and stability of the training system, and improve the reliability and promotion value of the research conclusions.

In the future, the integrated application of artificial intelligence technology can be further deepened to develop personalized intelligent training platforms and realize the digital management of the entire process of teacher training; strengthen the exchange and cooperation of teachers between different railway bureaus and industries to share high-quality resources and successful experiences; establish a feedback mechanism for teacher training quality evaluation, continuously optimize training plans, and promote the in-depth adaptation of teacher team construction to the intelligent, safe, and high-quality development of the railway industry, providing a more solid guarantee for the comprehensive implementation of the lifelong education system in the industrial field.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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