

The New Mixed Teaching Exploration of Low-Voltage Electrician Training Course under the Background of New Engineering

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Abstract: In the context of New Engineering, the exploration of a novel blended teaching approach for low-voltage electrician training courses aims to address the challenges of modern engineering education by integrating New Engineering concepts and modern teaching technologies to achieve comprehensive innovation in course content and teaching methods. This strategy leverages the advantages of combining online and offline learning to provide a diverse and personalized learning experience, thereby enhancing students' knowledge and practical skills. Online course resources, including interactive courseware, virtual experiments, and simulations, enrich the learning content and increase students' interest and engagement. Offline classes focus on interactivity and practical application through discussions, case studies, and project collaborations, helping students deepen their understanding and apply their knowledge. Flexible scheduling allows students to learn at their own pace, improving learning efficiency and effectiveness. Personalized learning path design, through preliminary surveys and assessments, helps students set individualized learning goals. Utilizing big data analysis and intelligent recommendation algorithms, the system provides the most suitable learning resources. Students can autonomously adjust their learning paths, fostering self-directed learning, while teachers offer targeted guidance and support to ensure the successful completion of learning tasks. Interactive and collaborative learning environments are strengthened through online and offline interaction mechanisms, group collaborative learning, and the use of various interactive tools, enhancing classroom interaction and participation. The establishment of online learning communities promotes resource sharing and experience exchange, creating a positive learning atmosphere. Assessment and feedback employ formative and practical assessments through online tests, assignments, and project work, comprehensively reflecting students' learning progress and outcomes. Multi-dimensional feedback mechanisms and data-driven evaluation provide detailed learning analysis and improvement suggestions for both teachers and students, enhancing teaching effectiveness.

Keywords: Low-voltage Electrician Training; Live Teaching; Classroom Teaching; Self-Directed Learning.

1. Introduction

1.1. Overview of New Engineering

New Engineering is a frontier concept in modern engineering education reform, aimed at addressing the challenges posed by the new wave of technological revolution and industrial transformation. It integrates traditional engineering with emerging technologies, emphasizing interdisciplinary integration, innovation-driven approaches, and practice-oriented education. New Engineering not only focuses on engineering technology itself but also on the coordinated development of engineering with social, economic, and environmental aspects. It aims to cultivate well-rounded talents with a global perspective, innovative spirit, and social responsibility[1]. In terms of curriculum design, New Engineering advocates breaking down disciplinary barriers and integrating cutting-edge technologies such as computer science, artificial intelligence, and big data. This integration encourages students to apply their knowledge in real-world projects, enhancing their ability to solve complex problems. Furthermore, New Engineering emphasizes the integration of industry and education, fostering deep collaboration with enterprises to build practical teaching platforms where students can hone their professional skills in real-world environments[2]. Additionally, New Engineering stresses the importance of innovation education, encouraging students to think independently and collaborate in teams. Through project-based and research-oriented

learning modes, it nurtures students' innovation and entrepreneurial abilities. To keep pace with rapidly changing technologies and industry demands, New Engineering also promotes lifelong learning, encouraging students to continuously update their knowledge and maintain their competitiveness.

1.2. Development of Blended Learning

Blended learning is a new teaching model that combines traditional classroom instruction with modern online education, aiming to optimize teaching effectiveness and meet diverse learning needs. It merges the interactivity of face-to-face teaching with the flexibility of online education, providing a richer and more personalized learning experience[3]. Through blended learning, instructors can utilize online platforms to pre-release course materials, video lectures, and self-assessment exercises, allowing students to arrange their study schedules independently for pre-study and review. In the classroom, instructors can focus more on facilitating discussions, answering questions, and conducting practical exercises, thereby enhancing student engagement and interaction. Blended learning emphasizes the diversity and richness of teaching resources[4]. By integrating multimedia resources, virtual laboratories, and simulation technologies, students can continue to delve into learning after class and practice applying their knowledge, thereby enhancing their practical skills. Additionally, blended learning employs big data analytics to monitor students'

learning progress and outcomes in real time, providing personalized learning suggestions and guidance to help students address their weaknesses and improve their learning outcomes. In implementing blended learning, the role of the instructor shifts from being a knowledge transmitter to a facilitator and guide of learning. Instructors need to be proficient in information technology to design and manage both online and offline teaching activities, stimulating students' interest and enthusiasm for learning. Similarly, students in a blended learning environment must possess self-directed learning skills, actively participate in classroom interactions and discussions, and utilize various resources for exploratory learning. The development of blended learning not only changes traditional teaching models but also drives the innovation of educational concepts. It emphasizes a student-centered approach, paying attention to individual differences and personalized needs, and advocating for self-directed and lifelong learning. Through blended learning, educational resources can be more reasonably and efficiently allocated, significantly improving the quality and effectiveness of teaching, thereby providing strong support for the development of education in the new era[5].

1.3. Overview of Low-Voltage Electrician Training Courses

Low-voltage electrician training courses are crucial practical courses in the electrical engineering discipline, aimed at developing students' basic operational skills and safety awareness regarding low-voltage electrical systems. The main goal of this course is to equip students with the skills to install, debug, maintain, and troubleshoot low-voltage electrical equipment, while also familiarizing them with relevant national standards and regulations. The course content typically includes modules on circuit design and wiring, identification and use of electrical equipment, assembly and testing of electrical control circuits, and detection and troubleshooting of electrical faults. These modules cover the transmission of fundamental knowledge while emphasizing the cultivation of practical skills, enabling students to apply theoretical knowledge in real-world scenarios. In the teaching process, low-voltage electrician training courses emphasize the integration of theory and practice. Instructors usually provide detailed explanations of electrical principles, equipment structures, and their operational mechanisms in theoretical classes, followed by hands-on practice in practical sessions to reinforce students' understanding and mastery. To enhance teaching effectiveness, the course incorporates advanced teaching methods and tools, such as virtual simulation laboratories, intelligent teaching aids, and multimedia teaching devices. These tools not only increase students' interest in learning but also simulate complex electrical systems and operating environments, allowing students to practice safely[6]. Safety education is a critical component of low-voltage electrician training courses. Given the inherent risks associated with low-voltage electrical operations, the course places special emphasis on safety protocols and accident prevention measures. Instructors consistently highlight safety points during operations and use real-life case analyses to help students understand the severe consequences of non-compliance with safety regulations. Additionally, students are required to conduct safety checks before each practical operation to ensure the safety and reliability of the operating environment and equipment. The course also emphasizes the

cultivation of students' professional ethics and teamwork skills. During practical sessions, students are required not only to complete individual tasks but also to collaborate with team members on comprehensive projects. This teaching model fosters students' teamwork and communication skills, laying a solid foundation for their future professional development. Overall, low-voltage electrician training courses combine systematic theoretical teaching with extensive practical exercises, enabling students to master fundamental skills and safety knowledge of low-voltage electrical systems. It cultivates their ability to solve real-world problems and work effectively in teams. As modern electrical technology evolves, the course content is continuously updated and refined to meet industry needs and accommodate diverse student learning requirements. Through such courses, students are not only prepared to handle basic electrician tasks but also possess the potential for further learning and development, laying a strong foundation for their future careers[7].

2. Analysis of Issues in Traditional Low-Voltage Electrician Courses

2.1. Timeliness and Relevance of Course Content

Table 1. Analysis of Issues in Traditional Low-Voltage Electrician Courses

Content	Project
Timeliness and Relevance of Course Content	1. Outdated Course Content 2. Insufficient Practical Application 3. Lack of Regional Adaptability
Modernization and Innovation in Teaching Methods	1. Limited Teaching Methods 2. Insufficient Practical Teaching 3. Lack of Personalized Teaching
Effectiveness and Safety of Practical Training	1. Insufficient Practical Teaching Resources 2. Inadequate Safety Education 3. Limited Internship Opportunities

A major issue with traditional low-voltage electrician courses is the outdated nature of the course content. Many courses remain based on technologies and knowledge points from over a decade ago, without timely updates or integration of advancements in modern electrical technology. As technology progresses and electrical engineering rapidly evolves, numerous new technologies and devices, such as smart grid technology, renewable energy systems, and automation control systems, have emerged. However, traditional courses rarely cover these new developments, resulting in graduates being ill-prepared for modern work environments [8]. Traditional courses tend to focus heavily on theoretical knowledge while neglecting practical application. This theory-practice gap renders students unable to effectively apply their knowledge in real-world scenarios. For instance, many courses do not thoroughly address the diagnosis and troubleshooting of complex electrical systems, which are common issues in the field. Additionally, electrical technology and standards can vary by region, and traditional courses often lack the flexibility to adjust to the specific needs

of different regions and industries. The uniformity of course content fails to meet the diverse needs of electrical professionals in various locations and sectors.

2.2. Modernization and Innovation in Teaching Methods

Traditional low-voltage electrician courses predominantly utilize lecture-based teaching methods, where students passively receive knowledge, leading to a lack of interaction and practical opportunities. This teaching style results in low student interest and engagement[8]. The development of modern educational technologies has introduced numerous innovative teaching methods, such as multimedia instruction, online courses, virtual simulations, and interactive learning platforms, all of which can significantly enhance teaching effectiveness. Traditional courses also tend to have limited practical training components, resulting in students lacking hands-on skills and experience. Electrical engineering is a highly practical field that requires extensive practical operation in real-world environments. However, due to equipment and safety constraints, many schools are unable to provide sufficient practical opportunities, leaving graduates with inadequate practical experience. Furthermore, traditional courses lack personalized teaching approaches that cater to the varying learning foundations and abilities of different students. The one-size-fits-all teaching model ignores individual differences, failing to maximize each student's potential. Modern education emphasizes student-centered learning and tailored instruction, which is still inadequately reflected in traditional low-voltage electrician courses.

2.3. Effectiveness and Safety of Practical Training

In practical teaching, traditional low-voltage electrician courses face resource constraints. Many schools have outdated and insufficient laboratory equipment, which cannot meet students' practical training needs. This limitation not only hinders the development of students' practical skills but also restricts their understanding and mastery of new technologies. Schools should invest more in practical teaching resources, updating laboratory equipment and expanding the content and duration of practical training. Electrical engineering involves working with high-voltage systems, making safety a critical concern. However, traditional courses often do not place enough emphasis on safety education [9]. Many students lack adequate understanding of safety protocols during practical operations, leading to safety hazards. Schools need to strengthen safety education, fostering students' safety awareness to ensure strict adherence to safety protocols during practical operations and prevent accidents. Beyond on-campus practical training, internships in real work environments are also crucial. Internships allow students to better apply theoretical knowledge in practice and enhance their practical abilities. However, many schools have insufficient cooperation with enterprises, resulting in limited internship opportunities for students [10]. This limitation not only hampers the development of students' practical skills but also affects their understanding and adaptation to real work environments.

3. Innovative Blended Teaching Strategies

3.1. Integration of Online and Offline Teaching Modes

s. The innovative blended teaching strategy must first achieve the diversification of online course resources. Traditional online courses predominantly rely on video lectures, but now more diverse resources can be integrated, such as interactive courseware, virtual experiments, and simulations. These varied resources can enrich the learning content and enhance student interest and engagement. For example, in electrician courses, virtual laboratories can be used to allow students to simulate circuit connections and troubleshooting online, improving their practical skills. Online learning can cover the transmission of foundational knowledge, while offline classes should emphasize interactivity and practicality. Instructors can organize discussions, case analyses, and project collaborations in the classroom to deepen student understanding through interaction. For instance, in economics courses, students can engage in role-playing to simulate business environments, experiencing market mechanisms and business decision-making processes, thereby enhancing their application skills and comprehensive qualities. Blended teaching strategies should offer flexible scheduling, allowing students to learn according to their progress and schedules. This flexibility can reduce student stress and enable them to learn in their optimal state, thereby improving learning outcomes. Through online learning platforms, instructors can provide recorded lectures for students to learn anytime, anywhere, and also schedule regular online live Q&A sessions to address student queries during the learning process. The assessment methods should fully integrate online and offline characteristics, comprehensively evaluating student learning outcomes. For example, the online component can be assessed through quizzes, discussion participation, and online assignments, while the offline component can be assessed through practical exercises, project presentations, and classroom discussions. Comprehensive assessment can fully reflect student learning conditions, avoiding the partiality brought by single assessment methods [11].

3.2. Design of Personalized Learning Paths

Given the different learning foundations and interests of each student, the first step in designing personalized learning paths is to set individualized learning goals. Instructors can conduct preliminary surveys and assessments to understand students' baseline levels and help them set personal learning goals. For instance, students with a stronger foundation can be given more challenging targets, while those with weaker foundations can have staged, easily achievable goals to gradually build their confidence and skills. Based on students' learning goals and progress, the teaching system can automatically recommend personalized learning content. Through big data analysis and intelligent recommendation algorithms, the system can provide the most suitable learning resources and courses for each student. For example, for a student studying electrical engineering who performs poorly in a specific module, the system can recommend relevant supplementary resources to help them consolidate and improve. The innovative blended teaching strategy should allow students to self-regulate and flexibly adjust their

learning paths according to their learning conditions. Instructors and systems can provide learning suggestions, but the final learning pace and path should be decided by the students themselves. This self-regulation mechanism not only fosters students' autonomous learning abilities but also enables them to learn at their own pace, thereby improving learning efficiency. Personalized learning paths also require the support of tutoring and assistance. Instructors should track each student's learning condition and provide targeted tutoring and help. Online learning platforms can set up personalized learning support functions, such as intelligent Q&A systems and one-on-one tutoring, to help students solve learning problems and ensure they successfully complete their learning tasks.

Table 2. Innovative Blended Teaching Strategies

Content	Project
Integration of Online and Offline Teaching Modes	1. Diversification of Online Course Resources 2. Enhancing Interactivity in Offline Classes 3. Flexible Scheduling 4. Integrated Assessment Methods
Design of Personalized Learning Paths	1. Setting Personalized Learning Goals 2. Personalized Recommendation of Learning Content 3. Self-Regulation of Learning Paths 4. Personalized Tutoring and Support
Interactive and Collaborative Learning Environment	1. Online and Offline Interaction Mechanisms 2. Group Collaborative Learning 3. Application of Interactive Tools 4. Community Learning and Sharing
Innovative Assessment and Feedback Methods	1. Formative Assessment 2. Practical Assessment 3. Multi-Dimensional Feedback 4. Data-Driven Assessment and Feedback

3.3. Interactive and Collaborative Learning Environment

Blended teaching should establish a comprehensive online and offline interaction mechanism to promote communication and cooperation between students and between students and instructors. Online interaction can be conducted through discussion forums, learning communities, and real-time chat, while offline interaction can take place through classroom discussions, group activities, and project collaborations. This interaction mechanism can enhance the fun of learning and cultivate students' teamwork and collaborative skills. Group collaborative learning is an important means of improving learning outcomes. In blended teaching, instructors can group students based on their characteristics and learning needs for collaborative learning and project research. For example, in

engineering project management courses, students can form groups to simulate the management process of real projects, experiencing project planning, resource allocation, risk control, and final delivery, thereby enhancing their practical abilities and teamwork skills. The innovative blended teaching strategy can leverage various interactive tools to increase the interactivity and engagement of learning. For instance, using online polling tools, real-time Q&A systems, and virtual classrooms can encourage students to actively participate, express their opinions, and raise questions in class. Additionally, instructors can utilize online whiteboards and collaborative documents to complete classroom tasks and projects together with students, enhancing interaction between instructors and students. Community learning and sharing are essential components of blended teaching. By establishing online learning communities, students can share learning resources, exchange learning experiences, and discuss learning problems. This community-based learning environment can stimulate students' enthusiasm for learning and promote knowledge dissemination and sharing. For example, in a programming course learning community, students can share their code, discuss programming techniques, and solve each other's queries, creating a conducive learning atmosphere.

3.4. Innovative Assessment and Feedback Methods

The innovative blended teaching strategy emphasizes formative assessment, which involves continuous assessment throughout the learning process rather than relying solely on final exams. This assessment method can comprehensively reflect students' learning progress and development. Instructors can assess students' learning conditions through online quizzes, assignment submissions, classroom performance, and group discussions. For instance, regular online quizzes can help understand students' grasp of knowledge points, allowing timely identification and resolution of problems. Practical assessment is a crucial part of blended teaching. Through project assignments, experimental operations, and case analyses, instructors can comprehensively understand students' practical and application abilities. For example, in a mechanical design course, students can complete an actual design project to demonstrate their design and problem-solving skills, with instructors providing assessment and feedback based on the project's completion. Assessment is not only for grading but also for providing feedback to help students improve. Blended teaching should offer multi-dimensional feedback, including instructor feedback, peer feedback, and self-feedback. For instance, instructors can provide detailed comments on students' assignments through online systems, pointing out strengths and areas for improvement. Students can exchange views and suggestions through peer review sessions, and they can also reflect on their learning process and outcomes through self-assessment. Leveraging big data and artificial intelligence technologies, blended teaching can achieve data-driven assessment and feedback. By analyzing students' online learning behaviors, such as learning duration, video viewing times, and quiz scores, the system can automatically generate learning reports to help instructors and students comprehensively understand learning conditions. For example, if the system identifies consistently low quiz scores on a particular knowledge point, it can prompt the instructor to provide targeted explanations and tutoring,

thereby improving teaching effectiveness.

4. Conclusion

The exploration of a novel blended teaching approach for low-voltage electrician training courses in the context of New Engineering aims to address the challenges of modern engineering education by driving the reform and innovation of traditional low-voltage electrician courses. By incorporating New Engineering concepts, the course content is more aligned with contemporary technological developments, covering cutting-edge areas such as smart grid technology, renewable energy systems, and automation control systems. The innovative blended teaching strategy achieves not only contemporaneous updates in teaching content but also integrates the advantages of both traditional and modern teaching methods, optimizing teaching effectiveness and meeting the diverse learning needs of students.

In this novel blended teaching strategy, the integration of online and offline teaching modes fully leverages a variety of online course resources, such as interactive courseware, virtual experiments, and simulations, enriching students' learning experiences. Simultaneously, offline classes emphasize interactivity and practicality, utilizing discussions, case analyses, and project collaborations to enhance students' practical application skills. Flexible scheduling allows students to learn at their own pace, improving learning efficiency and effectiveness.

Personalized learning path design is a crucial component of this strategy. Through preliminary surveys and assessments, instructors can help students set individualized learning goals and use big data analysis and intelligent recommendation algorithms to provide the most suitable learning resources. Students can cultivate self-directed learning abilities by adjusting their learning paths autonomously, while instructors provide targeted guidance and support to ensure each student successfully completes their learning tasks.

The interactive and collaborative learning environment plays a key role in the new blended teaching approach. Online and offline interaction mechanisms facilitate communication and collaboration between students and between students and instructors. Group collaborative learning and the use of various interactive tools increase classroom interaction and participation. The establishment of online learning communities further promotes the sharing of learning resources and experiences, creating a positive learning atmosphere.

Innovative assessment and feedback methods are also fully reflected in the new blended teaching approach. Formative assessment, through online quizzes, assignment submissions, and classroom performance, comprehensively reflects students' learning progress and outcomes. Practical assessment through project assignments and experimental operations evaluates students' practical application skills. Multi-dimensional feedback mechanisms not only help students improve their learning but also enhance their motivation and effectiveness. The application of big data and artificial intelligence technologies enables data-driven assessment and feedback, providing detailed learning analysis and improvement suggestions for both instructors and students.

Therefore, the exploration of a novel blended teaching approach for low-voltage electrician training courses in the

context of New Engineering, by integrating New Engineering concepts and modern teaching technologies, has achieved comprehensive innovation in course content and teaching methods. This not only increases students' learning interest and engagement but also enhances their knowledge and practical skills. Schools and instructors should continue to explore and apply this new teaching strategy, driving the continuous innovation of educational models and cultivating high-quality engineering talents who meet the needs of the new era. This exploration is not only significant for low-voltage electrician training courses but also provides valuable experience and references for the teaching reform of other engineering courses.

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