

Design of Electrical Vocational Education Instructional Based on Problem Orientation

Wu Yang, Wang Junjie, Li Weihua

Vocational-Technical Training Schools of Northmount Inc., Beijing, China

Email address:

wienerblut@163.com (Wu Yang), 48355611@qq.com (Wang Junjie), weihua8105@163.com (Li Weihua)

To cite this article:

Wu Yang, Wang Junjie, Li Weihua. Design of Electrical Vocational Education Instructional Based on Problem Orientation. *International Journal of Vocational Education and Training Research*. Vol. 9, No. 1, 2023, pp. 1-5. doi: 10.11648/j.ijvetr.20230901.11

Received: April 26, 2023; Accepted: May 26, 2023; Published: May 29, 2023

Abstract: Vocational education is different from general education in that it has a distinct "cross-border" characteristic of combining educational needs with industrial needs. The intelligent production mode has led to a major change in the demand for talents in the industry. The business community also emphasizes that enterprises do not deliberately pursue the high education of employees, but pay more attention to work experience, especially focusing on complex skills such as planning, judgment and decision-making, and analysis of complex systems. However, the traditional vocational education mode cannot effectively cultivate such ability. Research has shown that the knowledge required for work must be obtained in specific work contexts and holistic work processes, and classroom teaching in vocational education should be "situational oriented" and "scientific oriented". At present, research both domestically and internationally has paid less attention to the specific classroom design of vocational education. This article proposes a problem oriented instructional design method for the talent needs of intelligent enterprises, and applies it specifically to the instructional design of vocational education for primary electricians. The actual teaching design for one class hour is used as an example to demonstrate the specific application of this method. It has been proven that this method can effectively achieve the established vocational education goals, vividly mobilize learning enthusiasm, and have a solid grasp and memory of knowledge.

Keywords: Vocational Education, Electrician, Instructional Design

1. Introduction

Vocational education is different from general education in that it has a distinct "cross-border" characteristic of combining educational needs with industrial needs. Traditional vocational education aims to cultivate industrial workers and technical talents for traditional enterprises and under the background of the intelligent industrial revolution, the demand for talent in enterprises has also undergone profound changes [1]. Serving the needs of economic and social development and full employment, aligning with technological development trends and market demand, is the logical starting point for establishing China's deepening vocational education reform.

Literature suggests that traditional enterprises typically require three types of talents, namely engineering talents, technical talents, and skilled talents [2]. Engineering talents are engaged in product design, planning, and decision-making work, technical talents are engaged in

process design or equipment maintenance work on the front line of production, and skilled talents are directly engaged in equipment operation on the front line of production. The division of talent cultivation levels in traditional vocational education is precisely based on this talent classification theory. Reference points out that in an intelligent production system, enterprises need composite talents that integrate the three types mentioned above [3]. Foreign studies also believe that the intelligent production mode replaces the traditional fine job division with flexible, holistic, problem-solving oriented comprehensive tasks [4]. The business community also emphasizes that enterprises do not deliberately pursue the high education of employees, but pay more attention to work experience, especially focusing on complex skills such as arranging plans, judging decisions, and analyzing complex systems, while the traditional vocational education mode cannot effectively cultivate such capabilities [5].

Reference proposes a solution from the perspective of the education system [6]. A study has proposed that human

occupational cognition can only be carried out in a holistic form, and the knowledge required in work must be obtained in specific work contexts and holistic work processes, especially the subjective nature of "work process knowledge"[7]. Reference proposes that the development of vocational education curriculum should be based on the principle of "situational oriented and scientific oriented"[8]. References explore the curriculum design of vocational skills courses that combine specific scenarios. However, current research at home and abroad has paid less attention to the specific classroom design of vocational education [9, 10]. This article proposes a problem-based classroom design method for the talent needs of intelligent enterprises, and applies it specifically to the training of junior electricians. The actual teaching design for one class hour is used as an example to demonstrate the specific application of this method.

2. Analysis of Problem Oriented Classroom Design Process for Electrical Vocational Education

A problem-based vocational education classroom requires a teaching approach that focuses on solving typical practical problems. The basic principles, composition, operation and maintenance operations, as well as the main knowledge and skills of the teaching object are explained around typical practical problems and their solving processes.

2.1. Determine the Teaching Question Eye

The so-called teaching question eye is the starting point of teaching, and the typical problems raised at the beginning of teaching are analyzed and solved throughout the entire class [11]. As a typical problem in teaching, it should be a relatively serious problem that restricts the functionality of the equipment, creates a tense atmosphere at the beginning of the classroom, and firmly captures students' attention. It should also have representativeness, which should be a common problem on mainstream products of this type. Being able to solve this problem represents mastering the main knowledge of this type of equipment. It should also have authenticity, that is, it should not create a question for the purpose of imparting knowledge rigidly, or use an uncommon and unlikely problem.

2.2. Determine Teaching Ideas

The teaching approach adopts the classic three paragraph format of "what is", "why", and "how to do it". The three-stage approach can guide classroom design to form a rigorous logical loop [7, 12], but it should be noted that problem-based classroom design revolves around the analysis and resolution of typical problems, and should integrate basic concepts, main functions, mainstream

products, and classification knowledge into "what is"; Integrate knowledge of the internal composition and structure of the equipment, basic working principles, and the mechanisms of typical practical problems into the 'why'; Integrate knowledge on how to select products correctly, how to handle typical practical problems, and how to prevent them during operation and maintenance into the 'how to do' approach. In addition, during the design phase, attention should also be paid to the selection of knowledge points in each paragraph, and it should be logically extended to cover all the knowledge and skill points of the specified teaching content.

2.3. Enrich Methods and Techniques

After determining the main content of the teaching, it is also necessary to pay attention to the transition of each part of the content. Usually, questions can be set between paragraphs to complete the conversion between the teaching topics of each paragraph, and the teaching content can be directed towards depth through heuristic questions. The content within the paragraph should be combined with specific teaching scenarios, using VR virtual scene reproduction, multimedia teaching assistance, 3D model disassembly, video demonstration, computer model simulation and other means to reproduce and restore the internal structure, working principle, fault mechanism, etc. of the equipment. For key concepts that affect the quality and progress of teaching, as well as key deductions that connect the past and the future, group discussions and summaries, positive and negative viewpoints analysis, experiential operations, and even flipped classrooms should be set up to enable all students to think around the teaching content.

2.4. Make Good Connections and Summaries

After determining the main content of the teaching, it is also necessary to pay attention to the transition of each part of the content. Usually, questions can be set between paragraphs to complete the conversion between the teaching topics of each paragraph, and the teaching content can be directed towards depth through heuristic questions [13]. The content within the paragraph should be combined with specific teaching scenarios, using VR virtual scene reproduction, multimedia teaching assistance, 3D model disassembly, video demonstration, computer model simulation and other means to reproduce and restore the internal structure, working principle, fault mechanism, etc. of the equipment [14]. For key concepts that affect the quality and progress of teaching, as well as key deductions that connect the past and the future, group discussions and summaries, positive and negative viewpoints analysis, experiential operations, and even flipped classrooms should be set up to enable all students to think around the teaching content.

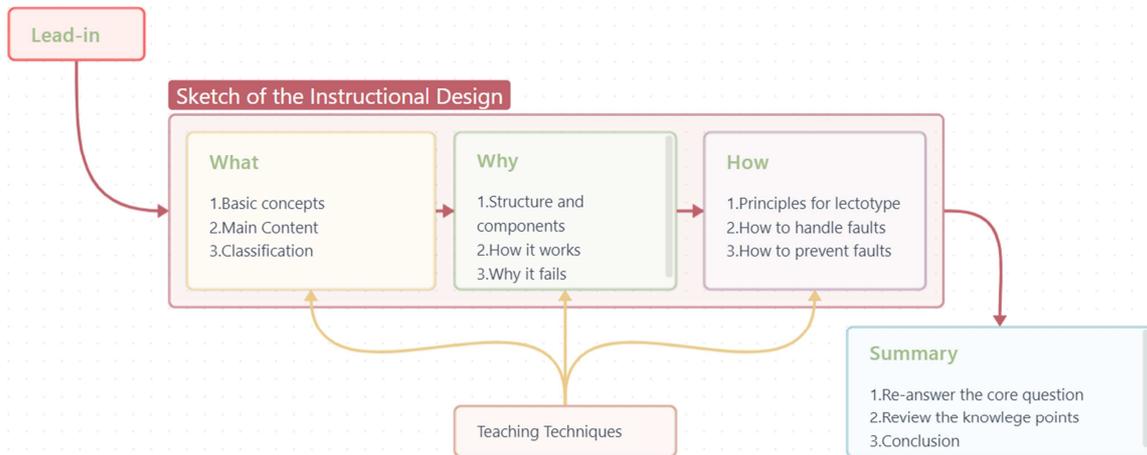


Figure 1. The procedures of the Problem oriented vocational education Instructional Design.

3. An Example of Problem Oriented Vocational Education Classroom Teaching

The following article takes teaching "low-voltage circuit breakers" knowledge and skills to junior electricians as an example to analyze problem-based classroom design.

Low voltage circuit breakers are an extremely important component in low-voltage distribution systems, with simple principles, complex structures, low costs, mature manufacturing technology, and mainly replacement maintenance in case of faults. The knowledge that junior electricians need to understand and master about low voltage circuit breakers can be completed within one class hour. Most common accidents and faults related to low-voltage circuit breakers at the grassroots level can be attributed to errors in model selection and configuration settings, and the selection of low-voltage circuit breakers often leads to power outages during use.

The overall teaching approach in the classroom revolves around the analysis of accident causes and countermeasures, and three levels of problems are introduced through accident cases to deepen the knowledge and skills of the concept, principle, and selection of low-voltage circuit breakers.

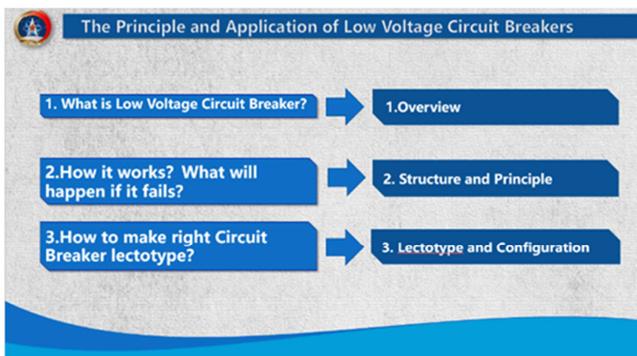


Figure 2. The analysis of cases leads to three teaching contents.

The first paragraph of the lecture mainly focuses on the introduction of accident cases, and elicits the true reasons for the accident cases through inductive questioning. Multiple rounds of discussion and analysis lead to three levels of problems that need to be solved in learning low-voltage circuit breakers. Subsequently, the concept, function, and classification of low-voltage circuit breakers were introduced.

The second paragraph of the lecture mainly analyzes the composition, structure, basic principles, and working characteristics of low-voltage circuit breakers. The use of anatomical circuit breakers to demonstrate the internal structure, 3D animation simulation of the action process, and practical operation experience on stage are used to explain and experience, making the knowledge explanation interesting. The working process of using coordinate system dynamic drawing to assist in explaining the matching of upper and lower circuit breaker characteristics to achieve fault and power outage selectivity in low-voltage distribution systems.

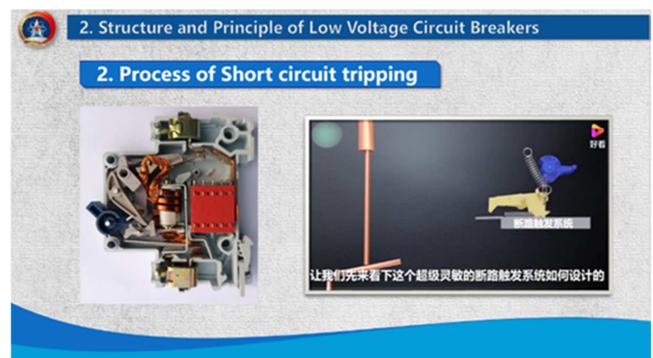


Figure 3. The combination of on-site physical objects and simulated animations showcases the structure and principles.

On the basis of analyzing the causes of accident cases, the third paragraph of this class combines the research and collection of the most confusing problems of circuit breakers in the daily work of junior electricians, such as incorrect

selection and matching. The precautions for circuit breaker selection in work are summarized into three aspects, and explained with a large number of practical examples.

The figure consists of three vertically stacked slides, each with a blue header and a white body. Each slide features a small circular logo in the top-left corner.

- Slide 1:** Header: "3. Lectotype and Configuration of Low Voltage Circuit Breakers". Sub-header: "1. According to installation conditions". Text: "Referring to designer's decision". Images: A photograph of a large industrial electrical cabinet on the left and a schematic diagram of a circuit breaker installation on the right.
- Slide 2:** Header: "3. Lectotype and Configuration of Low Voltage Circuit Breakers". Sub-header: "2. According to user's needs". Image: A photograph of various circuit breaker models on the left. Three callout boxes on the right, each with a red 'X' and a grey arrow pointing right, contain the text: "Greater the current, the better", "More expensive, the better", and "More functions, the better".
- Slide 3:** Header: "3. Lectotype and Configuration of Low Voltage Circuit Breakers". Sub-header: "3. According to parameters". Three numbered callout boxes on the left: "1 Recheck parameters", "2 Make sure parameters suit for the condition", and "3 Make sure parameters suit for the webs". Image: A schematic diagram of a circuit breaker installation on the right, with labels in Chinese: "检修工作" (Maintenance work) and "热水部 人员生活" (Hot water department, staff life).

Figure 4. The summary of troubleshooting.

In the course summary stage, a brief review of the main content of this class was conducted, and the key points were summarized as a pithy phrase, as shown in the figure. And corresponding review and preview questions were left.

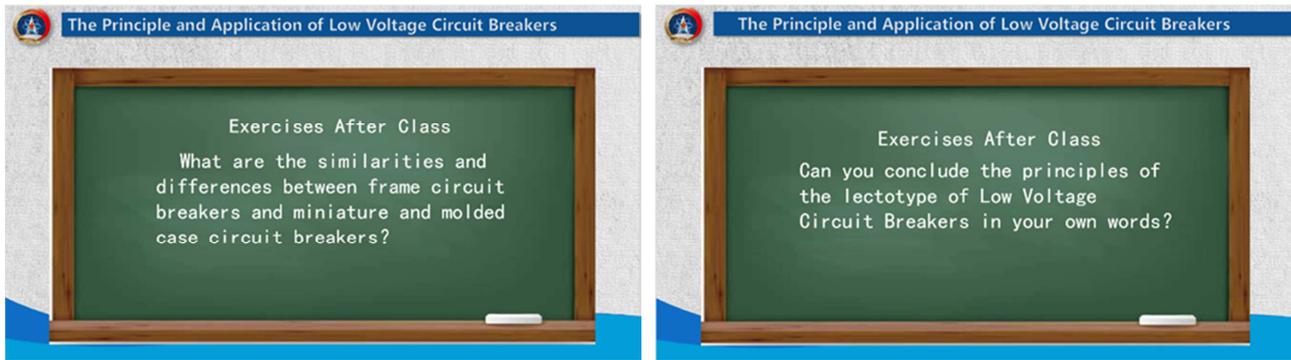


Figure 5. Summary and Review.

4. Conclusion

Above, this article takes the 1-hour "Circuit Breaker" teaching content as an example to analyze the specific practice of problem-based classroom design for primary electrical vocational education. Through our teaching practice in recent years, it has been proven that this method can effectively achieve the established vocational education goals [15], vividly mobilize learning enthusiasm, and have a solid grasp and memory of knowledge.

Of course, there are also issues with this method, such as insufficient applicability to classroom teaching content mainly focused on non-equipment and components. The author is also continuously exploring, improving, and perfecting it. Readers are welcome to actively explore with us.

References

- [1] Y. Tang, "1+X certificate system: the innovation of vocational education system design in the new era," *Chinese Vocational and Technical Education*, Beijing, vol. 16, 2019, pp. 5-11.
- [2] X. Xue, *Theory and Practice of Higher Vocational and Technical Education*. Shanghai: Fudan University Press, 2000, pp. 7-8.
- [3] G. Xu, "Fundamental Transformation of Vocational Education Talent Training Mode in the Intelligent Era," *Education Research*, Beijing, vol. 37, 2016, pp. 72-78.
- [4] J. P. Womack, D. T. Jones, *The Machine that Changed the World*. MIT: Rawson Associates, 1990, pp. 15-16.
- [5] J. Yang, *Research on Vocational Education and the Development of China's Manufacturing Industry*. Beijing: Higher Education Press, 2009, pp. 06-12.
- [6] S. Wang, "Training of Technical and Skilled Talents for Education 4.0: Demands and Changes," *Continuing Education Research*, vol. 5, 2023, pp. 40-46.
- [7] N. C. Boreham, R. Samurcay, M. Fischer, *Work Process Knowledge*, London: Routledge, 2002, pp. 10-11.
- [8] D. Jiang, "On the Action System and Its Characteristics: Reflections on the Curriculum System of Vocational Education," *Research on Education Development*, vol. 12, 2002, pp. 70-75.
- [9] D. Liu, "Research on Curriculum Reform of 'Industrial Robot Operation and Application' Based on Vocational Skills Competition," *Southern Agricultural Machinery*, vol. 54, 2023, pp. 190-192.
- [10] W. Wu, Y. Su, Y. Zhang, "Analysis of Vocational Education Teaching Reform Based on Skills Competition - Taking the Architectural Information Model Competition as an Example," *Vocational Journal*, 2023, vol. 05, pp. 26-28.
- [11] S. Sun, "Some opinions on 1+X Certificate System," *Chinese Vocational and Technical Education*, 2019, vol. 16, pp. 5-11.
- [12] X. Zhu, "Dilemma and Strategies on the Cultivation of High Skilled Talents Under the Background of Industrial Transformation and Upgrading," *Modern Education Management*, 2014, vol. 09, pp. 104-107.
- [13] X. Zhu, "Reflection on Professional Quality Educational Practice in Higher Vocational Colleges," *Journal of Zhejiang Normal University*, 2010, vol. 06, pp. 121-124.
- [14] J. Li, "Modernizing Governance of Modern Vocational Education System," *China Higher Education Research*, 2010, vol. 11, pp. 19-24.
- [15] W. Zhang, "On Construction Path of Double-professional Teachers in Higher Vocational Colleges from Perspective of Coordination Innovation," *Journal of Higher Education*, 2014, vol. 35, pp. 56-59.