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# Design of Modern Apprenticeship Teaching Mode for Students Majoring in Electrical Automation Technology

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**Abstract**

**Background and Aim:** Electrical automation has rapidly altered production, energy, and transportation. These areas are growing, requiring skilled electrical automation technicians. The college aims to ensure that its graduates are well-prepared to meet the challenges of the modern workforce. The objectives of this research are 1) to study employers' practical skills requirements for electrical automation technology graduates and 2) to design a modern apprenticeship teaching (MAT) model for students majoring in electrical automation technology at Guangxi Vocational and Technical College.

**Materials and Methods:** This study designs a modern apprenticeship teaching model for students majoring in electrical automation technology. The research combines qualitative and quantitative methods. There are 64 enterprises with employment of electrical automation technology in Guangxi Vocational and Technical College. Select 40 random companies as models. Qualitative data from 24 higher vocational teachers, enterprise engineers, human resources supervisors, school teaching managers, and vocational education experts. The process commences by examining the theoretical basis and establishing key concepts, such as modern apprenticeship and teaching models. This is followed by analyzing the data from questionnaires completed by human resources managers in enterprises. The aim is to identify the practical skills in electrical automation technology that are most in demand by these enterprises. The authors solicit specialists from pertinent disciplines to assess this pedagogical model and ascertain its appropriateness for implementation among students at Guangxi Vocational and Technical College.

**Results:** Research has shown that the modern apprenticeship teaching model for students majoring in electrical automation technology is an innovation that has been evaluated by experts. This study provides a theoretical and practical basis for developing and using modern apprenticeship systems in similar schools in Guangxi Province.

**Conclusion:** Capability requirements that employers expect from electrical automation technology graduates are. 9 aspects as follows; 1. identify and detect commonly used electronic components, 2. read and draw various types of Electrical principles and circuit diagrams, 3. use instruments and meters, 4. skilled in the use of electrical tools, 5. design and analyze low-voltage circuits, 6. install and debug the PLC control system, 7. troubleshoot PLC control system faults, 8. install and debug low-voltage circuits, and 9. Recognize and draw mechanical composition. The study provides a three-module teaching model the basic module, the improvement module, and the comprehensive module for students majoring in electrical automation technology.

**Keywords**: Modern apprenticeship system; Teaching mode; Electrical automation technology major

## Introduction

In recent years, with the development of Chinese society and the transformation and upgrading of economic structure, the Chinese government has clarified the goal of industrial transformation to intelligent manufacturing. Guangxi Province has also released policies that outline its development steps in the field of intelligent manufacturing. The upgrading of the intelligent manufacturing industry requires a lot of high-tech talents who have mastered rich practical skills. They need to bear related tasks such as programming, equipment operation, production line maintenance, machine debugging, and maintenance.

Guangxi Vocational and Technical College is a high-vocational school in Guangxi Province. The school's electrical automation technology majors shoulder the responsibility of providing high-tech talents for the development of Guangxi's intelligent manufacturing industry (Zhang & Phakdeephirot, 2023). The Electrical Automation Technology Major of Guangxi Vocational and Technical College was opened in 2002. After more than 20 years of construction and development, the major has achieved good results in



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talent training. However, in the context of the current intellectual manufacturing industry upgrade, new technologies and new industries are continuously iterated and upgraded. Enterprises' requirements for students' practical ability in electrical automation technology have continued to improve. At present, this major is struggling with the quality of talent training. It mainly includes three aspects: First, enterprises are updating their technology at a rapid pace, and the practical skills required of corporate personnel after graduating from higher vocational schools are becoming increasingly important. The large number of companies and a huge team of practitioners is a solid foundation for joint school-running and cooperative education (Zhu, 2014). Although the school's teaching content includes experimental lessons, Due to outdated training equipment and a teacher shortage, there is a gap between the content of experimental teaching and the technology used in enterprise production. These reasons cause students' professional practical ability to not meet the actual needs of the current enterprises; secondly, students also hope that in schools, they can master higher professional practical ability to be competent for higher and technological content to obtain a higher salary. Finally, the school hopes to shoulder more social responsibilities, send more talents to enterprises to master higher practical skills, and contribute to society's development.

Modern apprenticeship is a model of education promoted by enterprises and schools. This model's educational targets include both students and corporate employees. For them, enrollment means employment. They allocate a portion of their time to enterprises and another portion to studying at school. In internationally recognized vocational colleges, the modern apprenticeship system is already one of the leading models of education and teaching. Germany, the United Kingdom, Australia, and other manufacturing countries have generally promoted it, and it has proven to be very successful. Some majors in certain higher vocational schools in China have also implemented the modern apprenticeship system, achieving positive outcomes. However, there are no records of research on modern apprenticeship teaching models for students in electrical automation technology.

Therefore, researchers have conducted studies on modern apprenticeship teaching models specifically designed for students from Guangxi Vocational and Technical College. This study can effectively address the issue and enable students to adapt to the evolving needs of the intelligent manufacturing industry.

## Objectives

1. To study employers' practical skills requirements for electrical automation technology graduates.
2. To design a modern apprenticeship teaching (MAT) model for students majoring in electrical automation technology at Guangxi Vocational and Technical College.

## Literature Review

In the study of "Design of Modern Apprenticeship Teaching Mode for Students Majoring in Electrical Automation Technology", the researcher studied the documents concerning the following: Modern Apprenticeship System, Teaching Mode, and Related Research.

### A. Modern Apprenticeship System

In 1939, the World Labour Organization (ILO) defined "apprenticeship" as a "series of systems" in which employers hire and train young people, and young people serve the employer for a specified period. In 1962, the World Labor Organization once again defined apprenticeship as "long-term systematic training for a certain position within a company or under the guidance of independent craftsmen, based on written contracts and established standards.". Apprenticeship is seen as a form of long-term training that is based on specific job standards (Steedman, 2012).

Since the 21st century, different countries have implemented their apprenticeship reforms based on their actual situations, and traditional apprenticeship systems have been given new names. Examples include the "Registered Apprenticeship System" in the United States, the "Triple System" in Switzerland, and the "New Apprenticeship System" in Australia (Xiujin, 2009).



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In 2015, the International Centre for Technical and Vocational Education and Training (UNESCO-UNEVOC) defined modern apprenticeship as a unique form of vocational education that closely combines job-based learning with school-based learning through a workflow. Apprenticeship is governed by laws, standard social security programs, and written employment contracts. After a certain period, the apprentice can receive a formal evaluation and a recognized certificate (UNESCO-UNEVOC, 2015).

The definition of the modern apprenticeship system provided by Baidu Baike in China is "Modern apprenticeship system is a modern talent cultivation model that focuses on skill cultivation for students through deep cooperation between schools and enterprises, and joint teaching by teachers and masters. Modern apprenticeship system places more emphasis on the inheritance of skills and talent cultivation is jointly led by schools and enterprises, reflecting the deep integration of school-enterprise cooperation." This mainly strengthens the inheritance of skills and the deep cooperation between schools and enterprises (Hu & Zhen, 2022).

Although there is no unified definition domestically and internationally, all interpretations of "modern apprenticeship" include elements such as "apprenticeship", "labor remuneration", and "technological inheritance".

**B. Teaching Mode**

In the field of education, scholars generally believe that American scholars Bruce Joyce and Marsha Weil first proposed the concept of "teaching mode" in their book "Teaching Model". A model or plan to guide teaching activities. They believe that "teaching mode is a learning mode". They also believe that teachers help students acquire information, ideas, skills, values, thinking, and expression methods, and teach them how to learn (Joyce et al., 1986).

Joyce pointed out that "excellent teaching is composed of a series of teaching modes", "the classic definition of teaching is the design environment... a teaching mode is a learning environment, including the teaching behavior of using this mode", "We evaluate the quality of a teaching mode not only by whether it has achieved specific goals but also by whether it can improve learning ability, which is the main purpose".(Joyce et al., 2008). Li Bingde believed that the teaching model is a relatively stable, systematic, and theoretical teaching model of a relatively stable, systematic, and theoretical teaching model surrounding a theme in teaching activities (Li & Li, 1991). Xie Youru believes that the teaching model refers to the structure of the stable relationships between the elements and the activity process of the elements and the activity process of the elements and the activity process in a certain environment under the guidance of certain educational ideas, teaching theories, and learning theory. This definition highlights the three aspects of theory and thought, environment and resources, relationships, and structures (Gallagher, 1994).

Therefore, based on the research results of the scholars above and the teaching characteristics of higher vocational education, the author believes that higher vocational education teaching models are a relatively stable teaching structure framework and implementation strategy. It is designed for the training of students under the guidance of teaching ideas and teaching theories.

**C. Related Research**

Tu (2018) explored the application of modern apprenticeship systems in the field of mechanical processing and manufacturing, proposing a symmetrical approach for the cultivation of highly skilled talents in the field of mechanical processing and manufacturing. Including: redefining the training objectives for skilled personnel in mechanical processing and manufacturing, selecting appropriate training content, implementing new management plans, course development plans, evaluation plans, etc. (Tu, 2018) Li (2017) conducted field research on the implementation of modern apprenticeship system in a vocational college in Chongqing, using a typical case study. Ultimately, it was found that only deep cooperation between schools and enterprises can truly achieve a win-win situation for all parties. Ultimately, the advantages of both enterprises and schools can be leveraged to cultivate more highly skilled talents (Li, 2017). Xie (2013) affirmed the advantages of the modern apprenticeship system in cultivating skilled talents, which can solve many problems in current vocational education in a targeted manner. He proposed that the implementation and development of a modern apprenticeship system require both good institutional



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guarantees and concrete work such as curriculum construction in practice (Xie, 2013). Fuller & Unwin (2003) researched the defects of modern apprentices implemented by the British government. He explored the rules, content, and measures of modern apprentices. He found that the most prominent problem was that the government hoped to expand the scale of modern apprentices, to provide opportunities for young people as much as possible. However, business owners lack demand and motivation. He believed that the government should take care of the interests of all parties in the process of promoting modern apprentices, rather than simply formulating a policy (Fuller, & Unwin, 2011).

Maguire (1998) conducted a study investigating 500 British employers operating modern apprenticeships. He found that 58% of the surveyed employers run small businesses, and 63% only recruit one apprentice. Employers are very satisfied with their ability to participate in apprenticeship training. He believed that the current economic environment and policies are conducive to the implementation of modern apprenticeship (Greig, 2019). Ryan et al (2013) made a comprehensive comparison between the modern apprenticeship programs in the UK and Germany. Although the government has provided a large amount of financial support and improved the skills of apprentices, there are gaps compared to Germany in terms of qualifications, completion rates, and the breadth and depth of training (Ryan et al., 2010)

## Conceptual Framework

This research uses structured surveys and semi-structured interviews with a representative sample of electrical automation employers. Quantitative survey data will be examined statistically to identify essential skill areas, while qualitative interview data will reveal employers' expectations and preferences. The educators, industry experts, and students collaborated to build a modern apprenticeship teaching (MAT) model for Guangxi Vocational and Technical College students. This framework assures that the MAT model is empirically anchored and practically relevant, creating a strong electronic automation technology education.

## Methodology

To find a modern apprenticeship teaching model suitable for students majoring in electrical automation technology, this study mainly adopts qualitative research and supplements it with quantitative research to solve different problems. We combine qualitative research with quantitative research methods to ensure qualitative research's reliability and validity. This study investigates the specific requirements of employers for practical skills of electrical automation technology students and establishes a modern apprenticeship teaching model to enhance their professional practical abilities. This study is divided into two stages.

Phase 1: Study the specific requirements of employers for practical skills of students majoring in electrical automation technology.

Phase 2: Study how to establish a modern apprenticeship teaching model suitable for students majoring in Electrical Automation Technology at Guangxi Vocational and Technical College.

To achieve the goals of the first phase, the following steps need to be completed. First, the researcher designed a questionnaire on the elements of practical ability of students majoring in electrical automation technology and handed the draft of the questionnaire to the consultant for review to ensure its correctness and completeness. Then, five experts conducted item-objective congruence testing on the questionnaire. The researcher requested permission for data collection from the company's human resources managers, and after receiving permission, the questionnaire was distributed to them. After collecting these questionnaires, perform data analysis on the questionnaires to clarify the specific needs of employment companies for the practical skills of students majoring in electrical automation technology, and sort these needs in order of importance.

To achieve the objectives of the second phase, the study was carried out according to the following steps. First, the researchers studied the factors that affect the practical skills of students majoring in electrical automation technology. In response to the above research, researchers, schoolteachers, and



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corporate human resources directors jointly designed an implementation plan for a modern apprenticeship teaching model for students majoring in electrical automation technology. Afterward, design a questionnaire for the above solution to confirm its appropriateness. Submit the draft of the questionnaire to the consultant for review to check the correctness and completeness of the questionnaire. Then, five experts conducted item-objective congruence testing on the questionnaire. Next, a conformity assessment form for the modern apprenticeship teaching model in the electrical automation major is designed. After obtaining permission to collect receipts, the suitability of the modern apprenticeship teaching model was collected from 5 experts and these collections were analyzed.

**Population Overall:** The population of this study includes two parts. The first stage of the research population is the human resources director of the enterprise. There are 64 enterprises with employment of electrical automation technology in Guangxi Vocational and Technical College. Randomly select 40 companies as models and issue questionnaires. To investigate the practical needs of enterprises for students of electrical automation technology. The second stage of the research population is 24 experts with different identities. They include higher vocational schoolteachers, school teaching managers, vocational education experts, corporate human resources supervisors, and enterprise engineers. Through the issuance questionnaire, let them evaluate the modern apprenticeship teaching model designed.

**Research Instruments:** The first stage of this study used a questionnaire as the research tool. To identify the practical needs of electrical automation technology students in manufacturing enterprises, a survey questionnaire was distributed to the human resources managers of the enterprise. The questionnaire consists of two parts: one is the basic information about the respondent's company (company size, industry, region), and the other is a list of practical abilities. Design a five-level scale for the practical abilities of students majoring in electrical automation technology and have respondents rate each of the listed abilities. 1 means very unimportant, 2 means unimportant, 3 means average, 4 means important, and 5 means very important. After collecting these questionnaires, conduct data analysis on the questionnaires to clarify the practical skills needs of enterprises for students majoring in electrical automation technology, and classify these needs in order of importance. The research tool for the second stage is also a questionnaire. Firstly, the researchers investigated the factors that affect the practical skills of students majoring in electrical automation technology. In response to the above research, researchers, schoolteachers, and enterprise human resources managers jointly designed an implementation plan for modern apprenticeship teaching mode for students majoring in electrical automation technology. Then, design a questionnaire for the above solution to confirm its suitability, namely the qualified assessment form for the modern apprenticeship teaching mode of electrical automation major. List the various contents of the teaching mode in the questionnaire and rate them using a five-level scale. 1 means fail, 2 means pass, 3 means average, 4 means good, 5 means excellent. After obtaining permission to collect receipts, suitability evaluation data for modern apprenticeship teaching models were collected from 24 experts and analyzed. Ultimately, this research phase will develop a modern apprenticeship teaching model for students majoring in electrical automation technology.

**Data Collection:** Data collection in the first research phase is mainly the human resources supervisor of the enterprise. Electric automation students in Guangxi Vocational and Technical College work in these enterprises. A total of 40 questionnaires were distributed and 40 questionnaires were retracted. Data collection in the second research stage mainly collects the adaptability of modern apprenticeship teaching models for electrical automation technology students. The identity of these experts is higher vocational teachers, enterprise engineers, human resources supervisors, school teaching managers, and vocational education experts. A total of 24 questionnaires were issued, and 24 questionnaires were retracted.

**Data Analysis:** After collecting the survey questionnaire, the reliability of the questionnaire is first tested. We then obtained important descriptive statistics like mean, maximum, minimum, and standard deviation through frequency analysis. Descriptive statistics are used to extract useful information by obtaining the distribution characteristics of variables (Lo et al., 2000).



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## Results

In the first stage, 40 documents were issued, and 40 valid questionnaires were collected. Analyze the basic information of the respondents in the questionnaire, as shown in Table 1.

**Table 1** Overview of Phase 1 Recycling and Collection

| Name | Options | Frequency | Percentage |
|---|---|---|---|
| Number of employees | Less than 200 | 21 | 52.50 |
| | 200-500 | 10 | 25.00 |
| | 500-1000 | 7 | 17.50 |
| | More than 1000 | 2 | 5.00 |
| Industry | agricultural products processing | 12 | 30.00 |
| | Aluminum processing industry | 5 | 12.50 |
| | Chemical industry | 2 | 5.00 |
| | Manufacturing | 9 | 22.50 |
| | Food industry | 3 | 7.50 |
| | Electronic industry | 9 | 22.50 |
| Region | Guangxi Province | 24 | 60.00 |
| | Pearl River Delta region | 7 | 17.50 |
| | Yangtze River Delta region | 3 | 7.50 |
| | Other regions | 6 | 15.00 |
| **Total** | | **40** | **100.0** |

Through Table 1 we can find that 40 companies are participating in the survey. Among them, 24 companies that belong to the province of Guangxi accounted for 60%of the total, and 7 and 3 companies belonging to the Pearl River Delta and the Yangtze River Delta, accounting for 17.5%and 7.5%. There are 6 companies in other regions, accounting for 15%. This result is in line with the actual situation. Most of the graduates of the Electrical Automation Technology of Guangxi Vocational and Technical College are employed in Guangxi Province, followed by the Pearl River Delta region adjacent to Guangxi Province. We can also find that the three industries with the most concentrated employment of students are the agricultural product processing industry, manufacturing, and electronics industries. The reason is that the main industries in Guangxi Province are the agricultural processing industry, followed by the manufacturing and electronics industries. The main industries in the Pearl River Delta region are also manufacturing and electronics industries.

In the Cronbach reliability analysis, the trust coefficient value is 0.978, which is greater than 0.9, so it shows that the research data is very high. It can be used for further analysis.

**Table 2** The result of the questionnaire from employers in overview(N-40)

| Capability requirements | μ | δ | Interpretation | Ranking Within All Factors |
|---|---|---|---|---|
| Able to read and draw various electrical principles and circuit diagrams | 4.78 | 0.70 | High | 2 |
| Able to process parts | 3.43 | 1.50 | | 32 |
| Able to assemble and debug electronic circuits | 4.38 | 1.15 | | 10 |
| Able to recognize and draw mechanical structure diagrams | 4.55 | 0.85 | High | 9 |
| Able to identify and detect commonly used electronic components | 4.80 | 0.69 | High | 1 |



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| Capability requirements | μ | δ | Interpretation | Ranking Within All Factors |
|---|---|---|---|---|
| Able to operate CNC machine tools | 3.28 | 1.68 | | 33 |
| Proficient in using commonly used instruments and meters | 4.70 | 0.76 | High | 3 |
| Proficient in using commonly used electrical tools | 4.70 | 0.82 | High | 4 |
| Able to design and analyze low-voltage electrical circuits | 4.70 | 0.85 | High | 5 |
| Able to install and debug low-voltage electrical circuits | 4.65 | 0.77 | High | 8 |
| Able to design C language programs | 3.98 | 1.07 | | 16 |
| Able to program microcontrollers | 3.90 | 1.03 | | 17 |
| Able to write PLC programs | 4.08 | 1.07 | | 11 |
| Selection and driving capability of three-phase asynchronous motors | 4.08 | 1.00 | | 12 |
| Selection and driving ability of stepper motors | 4.00 | 1.01 | | 15 |
| Able to select and debug servo motors | 4.05 | 1.01 | | 13 |
| Can maintain the power supply and distribution system of the factory building | 3.68 | 1.27 | | 24 |
| Able to install and adjust automated production lines | 3.75 | 1.28 | | 22 |
| Can maintain industrial robots | 3.55 | 1.45 | | 27 |
| Able to simulate robot workstations | 3.23 | 1.62 | | 36 |
| Able to install and debug PLC control systems | 4.70 | 0.82 | High | 6 |
| Able to troubleshoot PLC control system faults | 4.68 | 0.86 | High | 7 |
| Proficient in operating equipment | 4.05 | 1.11 | | 14 |
| Able to manage equipment | 3.88 | 1.07 | | 18 |
| Able to design 3D drawings | 3.58 | 1.32 | | 25 |
| Able to operate industrial robots | 3.58 | 1.34 | | 26 |
| Able to use office software | 3.78 | 1.23 | | 21 |
| Able to operate CNC lathes | 3.28 | 1.52 | | 34 |
| Able to debug industrial networks | 3.45 | 1.47 | | 31 |
| Able to apply machine vision | 3.50 | 1.43 | | 29 |
| Able to install and debug pneumatic components | 3.80 | 1.26 | | 19 |
| Able to install and debug hydraulic components | 3.80 | 1.24 | | 20 |
| Able to perform 3D reverse design | 3.25 | 1.56 | | 35 |
| Proficient in using English | 3.50 | 1.26 | | 30 |
| Able to organize technical data according to specifications | 3.53 | 1.38 | | 28 |
| Able to learn new technologies | 3.73 | 1.24 | | 23 |
| Total Average | 3.95 | 1.16 | | |

It can be seen from Table 2 that in the 36 capabilities options given, the needs of enterprises' professional practical ability of students are mainly concentrated in the following 9 aspects: can identify and detect commonly used electronic components, read and draw various types of Electrical principles and circuit diagrams, with commonly used instruments and instruments, skilled in common electrical tools, can design and analyze low -voltage circuits, can install and debug the PLC control system, can be eliminated by faults of the PLC control system failure, can be installed and debugged by installation and debugging Low -voltage circuits can identify and draw mechanical composition.



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The μ value of the above items is between 4.55-4.80 and the σ value is between 0.69-0.86. This shows that although the scale and location of the enterprises participating in the questionnaire survey are different, they have the same demand for the practical skills of the above nine electrical automation technology majors. At this stage, the core of studying apprentices should pay attention to the core.

Researchers analyze the needs of 9 professional practical abilities of electrical automation technology. The results are shown in figure 1

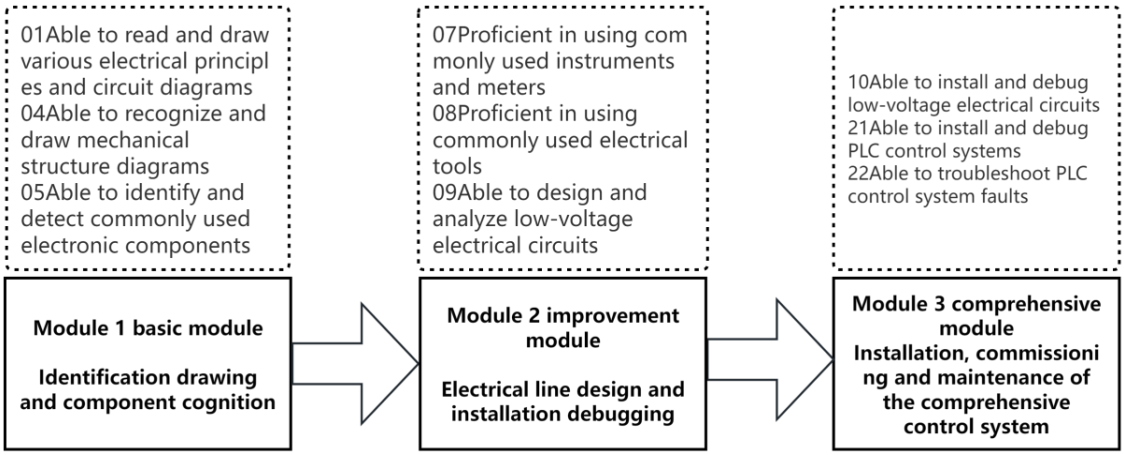


**Figure 1** Classification diagram of students' practical ability in electrical automation technology

Picture 1 illustrates the researchers' categorization of the 9 competencies of enterprises into 3 distinct modules: the basic modules (recognition drawing and component cognition), the improving modules - electrical line design and installation debugging, comprehensive module - Installation, commissioning, and maintenance of the comprehensive control system. Training students through basic modules can help them master the readings and drawings of part diagrams, diagrams and drawings of circuit diagrams, and the understanding and measurement of basic electronic components. By improving the module's training, students can learn how to use electrical tools, operate basic electrical equipment and instruments, and design and analyze low-voltage electrical lines. Through training, students of comprehensive modules can master comprehensive skills such as installation and debugging of common low-voltage electrical lines, installation, commissioning, and maintenance of the PLC control system. From the perspective of students' learning and cognition, these modules represent a progressive relationship. After students learn and master the abilities of the previous module, they can begin studying subsequent module courses.

After the 9 capabilities of corporate needs are clarified, and after dividing it into 3 modules, researchers jointly design experts and educational experts to design a modern apprenticeship teaching model for electrical automation technology. First, deconstruct the 9 capabilities as the main points of knowledge, and then determine 9 modern apprenticeship courses based on these knowledge points. After that, enter the curriculum standard writing link, according to the specific ability requirements, the production conditions of the enterprise, and the school's teaching process, the standard curriculum standards of the above nine courses were written. Curriculum standards include curriculum positioning and goals, content requirements, teaching organizations, and evaluation standards, which explain the connotation of various contents and provide a basis for the implementation of curriculum teaching of modern apprentices in both schools and enterprises. At the same time, the course content of the course was further refined according to the curriculum standards, and the teaching tasks of each course were determined.

To ensure the standardization of modern apprentice teaching models, the implementation plan was



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formulated. Including 3 aspects: Teacher team construction plan, curriculum resource construction plan, and training base construction plan.

To determine whether the modern apprenticeship teaching mode of the opposite side of electrical automation technology is feasible, 24 people from different fields have been invited to evaluate this teaching model.

**Table 3** Common data of the respondents in overall

| Name | Options | Frequency | Percentage |
|---|---|---|---|
| Occupation | Enterprise Engineer | 5 | 20.83 |
| | Vocational schoolteachers | 6 | 25 |
| | Enterprise HR | 5 | 20.83 |
| | Vocational education experts | 4 | 16.67 |
| | Teaching management personnel in vocational | 4 | 16.67 |
| Professional title | Primary Title | 1 | 4.17 |
| | Middle Title | 8 | 33.33 |
| | Vice-senior Title | 10 | 41.67 |
| | Senior Title | 5 | 20.83 |
| Age | Below 30 | 2 | 8.33 |
| | 30-40 | 9 | 37.5 |
| | 40-50 | 9 | 37.5 |
| | Over 50 | 4 | 16.67 |
| Total | | 24 | 100 |

Table 3 shows that a total of 24 models participated in the questionnaire. They are from 5 different fields in terms of occupation. There are at least 4 people in the number of people at least 6 people, and the number is roughly comparable. The collected data can provide a comprehensive reflection of people's attitudes toward apprentice teaching models in various fields. From the perspective of the type of title, there are 10 deputy senior titles, and 5 people with senior titles, and the sum of the two accounts for 62.5%. The attitude of senior professional titles is more convincing. From the perspective of the aging structure of the respondents, there are 22 people over 30 years old, accounting for 91.67%of the proportion. The older the ages, the greater the experience of the interviewees. Therefore, from the perspective of professional characteristics, titles, and age structures, the collected data are very representative and can reflect the real situation.

**Table 4** Overview of the Results of the Apprenticeship Teaching Model Suitability Questionnaire(N-24)

| Option | μ | δ |
|---|---|---|
| Job analysis | 4.875 | 0.448 |
| Job ability requirements | 4.365 | 0.637 |
| Analysis of typical work tasks | 4.708 | 0.550 |
| Knowledge Point Organization | 4.708 | 0.550 |
| Curriculum system construction | 4.625 | 0.770 |
| Design of assessment methods | 4.625 | 0.711 |
| Curriculum Standards for Pre-job Safety Production Training | 4.792 | 0.509 |
| Curriculum Standards for Factory Power Distribution and Maintenance | 4.708 | 0.550 |
| Curriculum Standards for Management of Mechanical and Electrical Equipment for Sugar Production | 4.917 | 0.282 |
| Curriculum Standards for Intelligent Manufacturing Production Line Maintenance | 4.750 | 0.532 |
| Curriculum Standards for Installation and Maintenance of Vertical | 4.833 | 0.381 |



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| Option | μ | δ |
|---|---|---|
| Warehouse | | |
| Curriculum Standards for Installation and commissioning of non-standard electromechanical products | 4.750 | 0.676 |
| Curriculum Standards for Motor Drive Technology | 4.792 | 0.588 |
| Curriculum Standards for Industrial Networking and Data Collection | 4.708 | 0.624 |
| Curriculum Standards for Productive Training | 4.592 | 0.415 |
| Teacher Team Building Plan | 4.875 | 0.338 |
| Curriculum resource construction plan | 4.875 | 0.338 |
| Training Environment Construction Plan | 4.708 | 0.624 |

From the above table, the average score of the 18 items to be evaluated through the five-level scale is between 4.365 and 4.917, and the standard deviation is between 0.282 and 0.770. After evaluation by 24 experts, the design of the modern apprenticeship teaching mode for electrical automation technology majors is reasonable.

## Conclusion

This research has designed a modern apprenticeship teaching model for students majoring in electrical automation technology at Guangxi Vocational and Technical College. Based on investigating the needs of enterprises to transfer to the professional practical ability of students, they extract their main points about their needs for practical ability. The requirements for students' professional practical skills in firms are mostly focused on the following nine aspects: I can recognize and detect frequently utilized electronic elements, as well as interpret and create representations of different varieties. Proficient in electrical principles and circuit diagrams, adept at using commonly utilized instruments and tools, capable of designing and analyzing low-voltage circuits, skilled in installing and troubleshooting PLC control systems, capable of identifying and resolving faults in the PLC control system, experienced in installation and debugging processes. Low-voltage circuits can detect and represent mechanical structures. Modern apprenticeship is a model of education promoted by enterprises and schools. This model's educational targets include both students and corporate employees. The experts have a high degree of recognition of the apprenticeship plan and a reasonable design. Guangxi's high vocational colleges can also promote the design of a modern apprenticeship plan for electrical automation technology majors.

## Discussion

The research results highlight nine critical capability requirements that employers expect from electrical automation technology graduates. These capabilities are 1) the ability to identify and detect commonly used electronic components, 2) proficiency in reading and drawing various electrical principles and circuit diagrams, 3) adeptness in using instruments and meters, 4) skill in utilizing electrical tools, 5) competence in designing and analyzing low-voltage circuits, 6) capability to install and debug PLC control systems, 7) proficiency in troubleshooting PLC control system faults, 8) experience in installing and debugging low-voltage circuits, and 9) the ability to recognize and draw mechanical compositions. Addressing these requirements, the study proposes a structured three-module teaching model to be implemented at Guangxi Vocational and Technical College. This model includes the Basic Module, which covers identification drawing and component cognitive skills; the Improvement Module, which focuses on electrical line design and installation debugging; and the Comprehensive Module, which encompasses the installation, commissioning, and maintenance of comprehensive control systems (Ubert, 2023). Furthermore, the automation for teachers in higher education institutions, teachers should understand the latest education teaching trends, and improve their education teaching ability (Liu et al., 2016). This modular approach ensures a systematic and progressive development of skills, aligning educational outcomes with industry demands and enhancing the employability of graduates.



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**Suggestions**

Based on the research findings, it is suggested that the design of a modern apprenticeship teaching model for students majoring in Electrical Automation Technology should be structured into three distinct modules. The first module, the Basic Module, should focus on identification drawing and component cognitive skills, ensuring students develop a strong foundational understanding of electrical components and their functions. The second module is the Improvement Module, which should emphasize electrical line design and installation debugging, allowing students to refine their practical skills and problem-solving abilities in real-world scenarios. Finally, the Comprehensive Module should cover the installation, commissioning, and maintenance of comprehensive control systems, providing students with holistic, hands-on experience in managing complex automation systems. Implementing this structured approach will ensure a progressive learning path, equipping students with the necessary competencies to meet industry standards and expectations effectively. This modular framework not only aligns with employers' practical skills requirements but also enhances the overall efficacy of the apprenticeship program by fostering a comprehensive skill set among graduates.

In our further research, we will apply the modern apprenticeship teaching model of electrical automation technology and conduct a more in-depth test in this teaching mode, using pre-posttest and comparison tests.

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