



# Research on the Construction of Photovoltaic Professional Curriculum System from the Perspective of Industry Education Integration

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**Abstract.** Against the backdrop of the rapid development of the photovoltaic industry and the integration of industry and education, this article proposes ideas and strategies for the construction of the photovoltaic professional curriculum system from the perspective of industrial education integration, in response to the problems of vague course system objectives, unclear course positioning, untimely course content updates, and lack of evaluation and monitoring mechanisms in the construction of photovoltaic professional courses in some vocational colleges. Specific professional curriculum system design plans are also provided to meet the needs of the rapid growth of China's photovoltaic industry.

**Keywords:** Integration of industry and education; Curriculum system construction; Photovoltaic industry;

## 1 Introduction

In September 2020, China explicitly proposed the "dual carbon" goals of peaking carbon emissions and achieving carbon neutrality. In this context, the new energy industry has shown unprecedented vitality. As an important component of the new energy industry, the photovoltaic industry will face opportunities but also challenges, and talent is the key for enterprises to cope with future challenges. Therefore, the talent cultivation of photovoltaic majors must adapt to the pace of the industry, actively adjust and optimize. As one of the important strategies of vocational education, the integration of industry and education essentially refers to the resource sharing, mutual learning, and collaborative innovation between vocational colleges and enterprises, achieving a two-way integration of collaborative education, technology research and development, and achievement transformation. However, the current cooperation between universities and enterprises is still superficial, and the results of talent cultivation cannot be well matched with industry demands. The fundamental reason is that the construction of the professional curriculum system has not been resolved, which is also the problem that this article aims to solve [1] [2].

## 2 Common Problems in Curriculum System Construction

If the integration of industry and education needs to be truly implemented, the first problem to be solved is the low participation enthusiasm of enterprises, which is mainly due to the lack of effective and feasible cooperation mechanisms and laws and regulations. The basic needs of enterprises and universities differ greatly, and establishing a good cooperation mechanism and laws and regulations is the foundation for ensuring the rights and obligations of all parties. In addition, there are often several issues in the construction of the curriculum system, including:

- 1) There is a phenomenon of piecing together the curriculum system structure;
- 2) The course teaching content does not match the industry demand;
- 3) The teaching staff is weak, such as the singularity of the teaching staff and the lack of "dual teacher" teachers;
- 4) Lack of supervision mechanisms such as evaluation and monitoring.

## 3 Construction of Photovoltaic Professional Curriculum System

### 3.1 Government led role

To fully leverage the leading role of the government, specific policies, regulations, and cooperation mechanisms should be introduced to clarify the rights and responsibilities of all parties involved. At the same time, incentive mechanisms should be established to fully mobilize the subjective initiative of all parties, and some regions should be selected for pilot projects to form a positive operating model, which can be gradually promoted.

### 3.2 The role of comprehensive participation of enterprises

Enterprises should integrate their needs, new technologies, processes, and products in projects, as well as actual work scenarios and platforms, into the entire talent training system based on industry development needs. This system includes professional settings, training programs, team building, resource conditions, training processes, course standards, and quality evaluations, to achieve effective alignment between enterprise employment standards and university talent training standards [3] [4].

### 3.3 The main role of schools

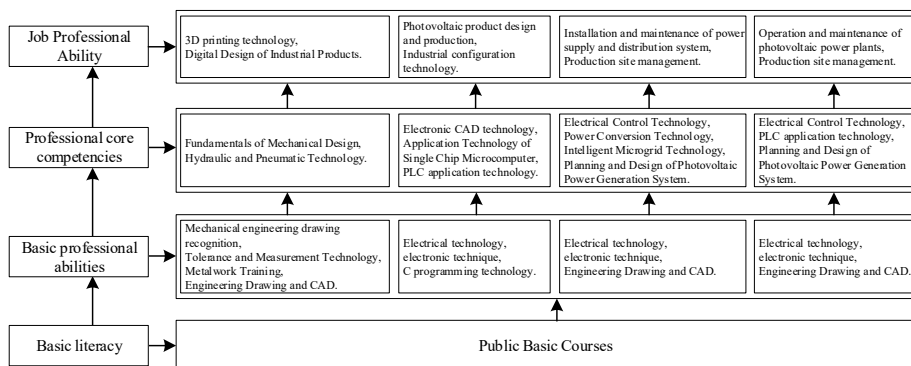
1) Conduct sufficient market research on photovoltaic industry related enterprises, determine industry demand, align professional settings with industry demand, and clarify the main job groups to provide reliable industry basis for curriculum system construction. Secondly, guided by the vocational education professional standards revised by the Ministry of Education in 2022, provide reliable theoretical basis for curriculum system construction. The final determination of the main job groups for the photovoltaic profession is shown in Table 1.

**Table 1.** Main Job Groups in Photovoltaic Engineering Technology

| Professional category                   | Corresponding industries | Main job groups                                                                                                                                                                                                                                          |
|-----------------------------------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| New energy power generation engineering | New energy industry      | Planning and design of photovoltaic power generation systems;<br>Electrical installation and commissioning of photovoltaic power stations;<br>Operation and maintenance of photovoltaic power plants;<br>Design and production of photovoltaic products; |

2) The construction of the curriculum system is guided by market demand, with the cultivation of core competencies for job groups as the main line and projects as the carrier. The curriculum structure is aligned with the advancement of abilities, following the principle of hierarchical progression, to construct the entire curriculum system. The teaching content is aligned with technological development, introducing new technologies and processes into classroom teaching. The teaching process is linked to the production process, transforming specific work tasks in the production process into the knowledge, skills, and professional qualities required in the teaching process. At the same time, integrating resources from various aspects of enterprises and schools, including teaching staff, teaching resources, and training bases, seeking the maximum point of convergence between both parties, forming a professional curriculum system with its own characteristics, and jointly completing the formulation of photovoltaic professional curriculum standards and teaching content [5].

The photovoltaic professional curriculum system constructed based on this is shown in Figure 1.

**Fig. 1.** Construction ideas of photovoltaic professional curriculum system

3) In Figure 1, the construction of the photovoltaic professional curriculum system revolves around basic literacy, professional basic abilities, professional core abilities, and job professional abilities. Basic literacy refers to public basic courses, including advanced mathematics, English, ideological and moral education, and the rule of law. The basic professional abilities, core professional abilities, and job professional abilities are gradually improved based on the abilities required by the main job groups, such as 3D printing technology and digital design of industrial products, which are the

main lines of our school's "Mechanical Design and Manufacturing" professional group and have their own characteristics; The direction of photovoltaic product design and production, as well as industrial configuration technology, is the main line of the "Photovoltaic Product Design and Production" job group. Its introductory courses include electronic CAD technology, microcontroller application technology, and PLC application technology, among others. There are also three introductory courses before it, which conform to the objective law of gradual teaching progression; The direction of installation and maintenance of power supply and distribution systems, as well as production site management, is the main line of the "Electrical Installation and Debugging of Photovoltaic Power Stations" job group. Its leading courses include electrical control technology, power conversion technology, intelligent microgrid technology, and photovoltaic power generation system planning and design, with three leading courses before it; The direction of operation and maintenance of photovoltaic power plants, as well as production site management, is the main line of the "Photovoltaic Power Plant Operation and Maintenance" job group. Its leading courses include electrical control technology, PLC application technology, and photovoltaic power generation system planning and design. There are also three leading courses before it. The overall curriculum system construction idea is called the "four lines, three guides, and three progressions" talent training mode.

4) Smooth two-way talent flow mechanism. Hire enterprise technical experts and experts to serve as part-time teachers in colleges and universities, and open up channels for the promotion of enterprise faculty; Dispatch college teachers to enterprises for on-the-job training, participate in enterprise project research and development, and open up promotion channels for college engineers.

### **3.4 Quality assessment mechanism with joint participation**

The government, industry, enterprises, vocational colleges and other parties need to establish a vocational education quality evaluation system, fully play its evaluation and supervision role, conduct reasonable evaluations of various aspects, and propose adjustment and optimization suggestions based on the evaluation results. Establish a multi-level and multi-dimensional monitoring system, with all parties jointly controlling the quality of talent cultivation. Establish a quality supervision and tracking system involving enterprises, employees, universities, teachers, students, employers, and relevant institutions.

## **4 Conclusion**

This article proposes the construction ideas and strategies for the curriculum system of photovoltaic majors in vocational colleges. Firstly, clarify the main working groups in the photovoltaic industry. Secondly, under the guidance of the photovoltaic professional standards issued by the Ministry of Education, and based on the existing resources and conditions of universities and enterprises, a professional curriculum system with certain characteristics was formed, and a specific plan for the photovoltaic

professional curriculum system was proposed, providing a certain reference basis for the reform of the photovoltaic professional curriculum system under the background of industry education integration.

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