

Research on Talent Cultivation in Polymer Materials and Engineering under the Background of Industry-Education Integration

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Abstract: With the rapid development of the social economy, universities are placing increasing emphasis on cultivating highly skilled and competent professionals in polymer materials and engineering. To meet societal needs and enhance the core competitiveness of professionals, universities are focusing on integrating production and education, refining talent cultivation directions, and improving professional teaching systems. Leveraging the advantages of industry-education integration can enhance students' professional abilities, improve their adaptability to job roles, and significantly elevate the quality of talent training. This paper examines the cultivation of polymer materials and engineering professionals within the context of industry-education integration and offers corresponding insights on this topic.

Keywords: Industry-education integration; Polymer materials and engineering; Talent training; Research

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1. Introduction

In recent years, the Ministry of Education has issued Several Opinions on Deepening the Integration of Production and Education, explicitly advocating for schools to reform professional teaching in alignment with emerging technologies, industries, and models. The goal is to ensure the comprehensive development of professional talents through collaborative education and school-enterprise cooperation. Students majoring in polymer materials and engineering benefit from a wide range of employment opportunities, with a growing demand for professionals in this field during the country's current developmental stage. To address this, universities must thoroughly explore how professional teaching can be optimized under the framework of industry-education integration. This involves understanding the essence of integrating industry and education in talent cultivation while addressing the constraints present in existing teaching practices. Efforts should focus on improving the teaching system, enhancing faculty competencies, and innovating teaching methodologies to establish a robust professional teaching framework under the industry-education integration model ^[1].

2. Analysis of the connotation of industry-education integration

Industry-education integration refers to the collaboration between schools and enterprises during their development processes to effectively align school teaching with the actual production practices of enterprises. This creates a cohesive teaching process encompassing skill enhancement, integrated education, and social services. Specifically, “production” pertains to “industry,” while “teacher education” refers primarily to vocational education in this context. The relationship between industry and education is thus the connection between vocational education and industries outside of education. From the perspective of industry-education integration, enterprises are the primary stakeholders, with education serving the needs of enterprises. In vocational education, schools adopt employment-oriented approaches and implement teaching reforms centered on the comprehensive and diversified development of students. This ensures that the knowledge and skills students acquire align with society’s demand for frontline production technicians, thereby achieving mutually beneficial outcomes^[2]. Vocational education and industry are integral components of the societal reproduction chain, each fulfilling distinct responsibilities and functions while collaborating to foster coordinated and orderly social development. In some foreign countries, industry-education integration emphasizes the joint training of students by schools and enterprises through course projects and enterprise internships. This allows students to engage in real-world engineering projects, study practical production challenges in-depth, and develop solutions, ultimately enhancing their comprehensive abilities^[3].

3. Necessity of teaching reform for polymer materials and engineering majors in colleges and universities under industry-education integration

3.1. Enhancing the social relevance of professional teaching

Reforming professional teaching under the framework of industry-education integration enriches the teaching content and strengthens its social relevance. This integration involves multiple stakeholders, such as enterprise professionals and school instructors, working collaboratively to develop a new talent cultivation structure by exploring existing vocational education policies, measures, and characteristics. The integration of production and education is characterized by mechanisms that foster collaboration and development across various domains. Among these, the design of integrated mechanisms combines production practices, practical education, and training through the macro-level framework of industry-education integration^[4]. Guided by this new educational philosophy, schools focus on enhancing teachers’ instructional capabilities, equipping them with the latest teaching methodologies and concepts to ensure the seamless implementation of subsequent teaching activities. Professional instructors actively collaborate with enterprise personnel to incorporate cutting-edge practical teaching projects and innovative methods. This addresses existing issues such as students’ lack of engagement and limited improvement in their comprehensive abilities. Such efforts promote the development of students’ multifaceted skills. To further enhance the quality of talent cultivation, schools and enterprises jointly establish practical teaching bases under the industry-education integration model. These bases help improve students’ overall competency and job adaptability, bolstering their core competitiveness in the labor market and laying a strong foundation for their future careers.

3.2. Improving the quality of professional personnel training

Under the integration of industry and education, universities, based on their unique circumstances, implement talent cultivation initiatives for polymer materials and engineering majors in line with new strategies. This

approach aims to enhance training programs and deepen the reform of professional teaching. Simultaneously, the theoretical and practical collaboration between schools and enterprises serves as a guiding framework for teaching and a resource for educational tools. It encourages schools and educators to optimize talent training programs aligned with the integration of production and education, establish a scientific framework for talent cultivation, and refine the concepts and methodologies involved. These efforts aim to drive further optimization and reform of talent cultivation in polymer materials and engineering, leveraging advancements in the integration of industry and education. Furthermore, during the talent cultivation process, schools actively coordinate educational resources among themselves, enterprises, and educators to establish a “three-in-one education” model. Teachers are encouraged to collaborate with relevant enterprises to create a modern education system. This approach enhances the quality of talent cultivation, ensuring it meets the demands of social development and equips students with professional skills, an understanding of work processes, and strong professional qualities ^[5].

4. Current problems in the teaching of polymer materials and engineering in colleges and universities

Since entering the new era, the integration of industry and education has become a critical pathway for many colleges and universities to cultivate high-quality talent and advance professional teaching reform. Although many institutions have actively implemented reforms in teaching polymer materials and engineering, there are still significant challenges that hinder the achievement of established educational goals and the improvement of students’ comprehensive abilities. The primary issues are as follows ^[6]: (1) Incomplete professional teaching system: Many universities have an overly segmented approach to the major, leading to duplication of content across courses. The integration of industry and education often remains superficial, causing a mismatch between the professional teaching content and actual job market demands. Additionally, the failure to update professional teaching materials in a timely manner is a widespread issue. (2) Limited teaching methods: On the one hand, most educators rely heavily on traditional teaching methods, directly explaining knowledge based on course content and objectives, followed by practical exercises for students. This approach does not ensure a deep understanding of knowledge, hindering students’ comprehensive development. On the other hand, teaching activities are often confined to classroom instruction. Schools fail to actively collaborate with relevant enterprises to establish practical training bases, which adversely affects the smooth progression of subsequent teaching activities and reduces the effectiveness of talent cultivation. (3) Insufficient teaching competence of professional teachers: Many educators lack a thorough understanding of the integration of industry and education and fail to incorporate new educational concepts into their teaching practices. This limitation negatively impacts the quality of talent cultivation and prevents the effective application of innovative teaching models ^[7].

5. Training strategies for polymer materials and engineering professionals under the background of industry-education integration

5.1. Continuously improving the professional teaching system aligned with social needs

In the teaching of polymer materials and engineering in colleges and universities, a disconnect often exists between the teaching content and societal development needs. Therefore, schools should refine the

professional teaching system to align with social demands.

First, when establishing the polymer materials and engineering major, schools must fully consider the needs of society, industries, and enterprises as the guiding development direction, thereby improving the accuracy of talent cultivation^[8]. Additionally, schools should conduct in-depth studies on industry demands, enterprise needs, employment rates of graduates, and other relevant authoritative data. These findings should serve as a basis for timely updates to talent cultivation standards, ensuring that professional settings and training programs remain dynamic and adaptable.

Second, targeted and practical teaching projects should be introduced. Analysis reveals that the polymer materials and engineering major encompasses positions in areas such as scientific research and teaching, technology development, process and equipment design, technical transformation, and operation management related to material preparation, processing, and molding, as well as material structure and properties. Schools should deeply explore the demand for talent in these positions and incorporate classic and practical teaching projects into their curriculum. By aligning with enterprise production standards, schools can continuously optimize their teaching systems^[9]. Teachers should design course systems around typical enterprise work tasks, using workflows and task categories as a foundation. This approach fosters close collaboration between teaching activities and enterprise operations, enabling students to integrate their learning into real-world job tasks. As students engage in solving practical problems, they enhance their comprehensive abilities and professional quality.

Third, the design of the practical teaching system should be continually optimized. For instance, schools can establish courses like “Polymer Materials and Engineering Practice,” which integrate content from “Innovation and Entrepreneurship Education” and “Polymer Materials and Engineering Management.” To develop students’ comprehensive abilities, schools can guide students to participate in regular internships. Teachers, in collaboration with enterprise staff, can design practical training positions tailored to enterprise workflows, facilitating the holistic development of professional students.

5.2. Strengthening school-enterprise cooperation and innovating teaching modes

To fully leverage the value of industry-education integration, schools must enhance school-enterprise cooperation and innovate teaching models, breaking free from traditional teaching constraints^[10]. For example, colleges and universities can adopt advanced mechanisms and methods for integrating industry and education. They should clearly define the responsibilities and roles of colleges and enterprises under regulatory and legal frameworks, encouraging enterprises to actively participate in cooperative educational efforts. Additionally, government policies such as financial support and tax incentives can stimulate enterprise engagement in school-enterprise collaboration, embedding new educational concepts into every aspect of teaching.

Teachers specializing in polymer materials and engineering should actively innovate their teaching methods to avoid stagnation or misalignment with educational goals. By focusing on industry-education integration, professional teachers can incorporate case-based teaching methods to enhance student engagement. For example, through the introduction of real-world enterprise projects, teachers can cultivate students’ teamwork and innovation abilities while enhancing their problem-solving skills using acquired knowledge. This approach helps foster professional competencies and promotes holistic development.

Moreover, teachers can construct immersive teaching environments that replicate real-world working conditions. For example, situational teaching activities can be organized around trending topics such as “functional polymer materials.” Students, working in groups, can explore and discuss questions with their

teachers. This method not only deepens students' understanding of workflows but also helps them master proper practice standards, ultimately enhancing their job adaptability.

5.3. Building a professional training base based on industry-education integration

Establishing a professional training base is a crucial step to fully implement the integration of industry and education. Schools should deepen their cooperation with local enterprises, combine resources from both institutions, and jointly develop high-quality training bases that simulate real workplace environments to foster students' comprehensive development.

First, schools should build a platform integrating online teaching, student simulations, practical training, and virtual simulation practice^[11]. This platform should categorize information from enterprises and schools according to standardized criteria and undergo regular maintenance to meet the needs of students' internships and enterprises' recruitment requirements. The platform should also include simulation practice functions where students can engage in virtual learning experiences. Additionally, this module should support teacher-student and peer communication, enabling teachers to promptly address learning challenges and students to seek guidance. Teachers can collaborate with enterprise engineers to refine teaching plans and methods effectively.

Second, in constructing specific training bases, attention should be given to enhancing teaching, production, research and development, and social service functionalities. Efforts should focus on updating management mechanisms, scientific planning, sustainable development, improving teacher capabilities, and prioritizing students' holistic development. This approach will effectively integrate educational resources and foster a resource-sharing mechanism for the modern era, ultimately advancing professional teaching standards^[12].

Third, with government leadership and participation from schools and enterprises, offline practical training bases should be developed, including facilities such as new energy vehicle engine laboratories and virtual reality laboratories. These facilities will enable teachers to conduct targeted teaching activities. During practical training, enterprises can sign agreements with students, facilitating direct employment opportunities post-graduation. This strategy ensures a steady supply of high-quality, skilled talent for enterprises, achieving a win-win scenario for schools and businesses.

5.4. Building a double-qualified teaching team

The teaching abilities of educators significantly impact the quality of talent cultivation. Within the framework of industry-education integration, schools must prioritize the enhancement of teaching capabilities and the development of double-qualified teaching teams suited for the modern era.

First, schools should prioritize building dual-teacher teams, emphasizing the formation and growth of these teams based on talent training needs. The integration of industry and education places higher demands on teachers' innovation, educational expertise, and operational abilities. To help teachers master the principles of industry-education integration and acquire advanced teaching methods, schools can invite professional experts to provide regular guidance and organize opportunities for teachers lacking practical experience to work on the frontlines. This approach enhances teachers' innovation and teaching management capabilities.

Second, schools should conduct in-house training. Regular education and research activities can be organized to analyze employer requirements and key areas for student development, aligning with the latest education reform directions to ensure quality talent training^[13]. For preschool education teachers facing high workloads, implementing a reward mechanism can encourage active participation in training programs.

Third, schools must continuously optimize the teaching staff structure during their development. Following a principle of “letting go and bringing in,” schools should encourage teachers to visit partner enterprises to learn about the latest practical projects and employment standards. Professionals and managers from partner enterprises can be invited to participate in student education and implement a modern apprenticeship system ^[14]. Furthermore, schools should actively collect feedback from teachers to identify challenges in professional teaching within the industry-education integration framework. This feedback will inform the development of effective teaching reform strategies, allowing modern educational concepts to become the institution’s hallmark.

5.5. Building a comprehensive teaching evaluation system based on industry-education integration

First, the teaching methodology should align with the theme of industry-education integration and extend beyond the classroom. This involves incorporating second-classroom education ^[15], such as enterprise internships, practical training assessments, and project completions, to reflect the synergy between industry and teaching rather than focusing solely on traditional instruction. The completion of specific tasks serves as a tangible representation of students’ learning objectives and acts as a motivator. Second, professional competency evaluations and case analyses should be included in the assessment criteria. These additions encourage students to develop comprehensive abilities while aiding schools in achieving their goal of fostering talent with strong moral and professional qualities. Furthermore, after conducting teaching evaluations, teachers should refine the teaching content and methodologies. This adjustment ensures a deeper integration of the industry-education concept with professional instruction, effectively advancing the reform of professional teaching and ultimately enhancing the quality of talent cultivation.

6. Conclusion

To sum up, integrating industry and education into the teaching of polymer materials and engineering in colleges and universities can significantly improve the quality of talent training and support the holistic development of students. In the new era, colleges and professional educators must deeply analyze the essence of industry-education integration and recognize its necessity in professional teaching. By addressing existing challenges in current teaching practices, it is essential to construct a modern professional teaching model. This includes optimizing the teaching system, innovating instructional methods, and building a new team of educators, ultimately cultivating more high-quality talents for the future.

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