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Exploration of Product Design Innovation Practice Teaching Mode of Industry-Education Integration Combined with AI Technology

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Abstract: *This paper explores the feasibility and application effect of the innovative product design practice teaching mode combined with artificial intelligence (AI) technology in the context of industry-education integration. By analyzing the current status of the application of AI technology in education, this paper proposes an AI technology-driven product design practice teaching mode, which aims to enhance students' innovation ability and practical skills. The research focuses on the teaching of industry-integrated courses in modern industrial colleges. At the present stage of the policy background, the construction of modern industrial colleges in colleges and universities is gradually increasing, and the direction of teaching reform is also gradually biased towards the integration of industry and education, etc. in line with the development requirements of modern industrial colleges. This provides a lot of research guidance on the integration of industry and education for this study, but because each university has local development characteristics, the existing research results may not necessarily be adapted to the talent cultivation objectives of our modern industrial colleges. The model has been optimized in terms of teaching objectives, content, methods and process monitoring, with AI-enabled personalized learning, intelligent feedback and data analysis, to achieve the teaching effect of deep integration of industry and education. Through the implementation and effect analysis of specific cases, the positive effect of the model in enhancing students' learning effect and teaching efficiency is verified, and the application prospect of AI technology in the future teaching mode of industry-education integration is further explored.*

Keywords: *artificial intelligence, industry-teaching integration, product design, innovative teaching mode, practice teaching, personalized learning, teaching process monitoring, virtual simulation, data-driven teaching*

1. Introduction

With the rapid development of science and technology, artificial intelligence (AI) technology has gradually penetrated into the field of education, becoming an important force to promote educational innovation and optimize the teaching mode[1]. In the context of modern industrial colleges due to the addition of enterprise resources, the focus of teaching will be biased towards enterprise practice, so that most of the industrial college teaching reform projects in product design majors take the project practice design type courses as the main reform[2]. As one of the core of modern education reform, the integration of industry and education emphasizes the deep synergy between education and industry in order to cultivate innovative and practical talents that meet the needs of society[3]. In the field of product design education, the traditional teaching mode faces problems such as the disconnection between theory and practice, insufficient innovativeness, and difficulty in realizing personalized teaching, which urgently needs to be broken through and improved by technical means[4].

This study explores how the industry-teaching integration teaching mode combined with AI technology can introduce intelligent tools, data-driven decision support, personalized learning paths, and other innovative means in product design education to provide students with a richer practical experience and meet the industry's demand for innovative design talents[5]. At the same time, the research examines how the application of AI technology can realize real-time monitoring and feedback of the teaching process, improve the teaching effect through data analysis, and further promote the deepening of the integration of industry and education[6]. This study also aims to design a teaching framework for product design innovation that utilizes AI technology. It presents an optimized plan that integrates teaching goals,

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curriculum content, instructional methods, and process evaluation, and validates its effectiveness through detailed case studies. The proposed framework aims to provide both a theoretical foundation and actionable insights for advancing intelligent, industry-integrated teaching methodologies

2. Analysis of the current situation of AI technology and integration of industry and education

With the rapid development of artificial intelligence technology, the application of AI in the field of education has made significant progress[7]. This study also has to carry out the corresponding curriculum teaching reform from the development characteristics of our modern industrial college, and establish a teaching model adapted to the development of our industrial college[8]. Intelligent learning platforms and auxiliary tools are widely used in teaching, making personalized learning and precise teaching possible. Through natural language processing and computer vision, AI is able to automatically analyze students' learning behaviors and provide personalized recommendations and instant feedback, thus enhancing students' learning efficiency and experience[9]. The introduction of AI-related technologies such as virtual reality (VR) and augmented reality (AR) provides students with a more intuitive and immersive learning experience, breaking the time and space limitations of the traditional classroom[10]. Formula for the area of a circle:

$$A = \pi r^2 \tag{1}$$

The mode of industry-teaching integration is gradually being deeply promoted in various educational fields, especially in disciplines with strong practicality such as product design, which has attracted much attention. Through university-enterprise cooperation, construction of training bases, and joint development of curricula, industry-teaching integration provides students with real industrial environments and hands-on opportunities, helping them to accumulate industrial experience and enhance their practical abilities. This model not only helps to enhance the employment competitiveness of students, but also promotes the synergistic development of universities and enterprises in talent cultivation, scientific research and innovation. However, in practice, due to the allocation of resources, technical support and other issues, the implementation of the integration of industry and education is often difficult to meet expectations, and there is a status quo of in-depth cooperation that is difficult to realize.

The introduction of AI technology in the integration of industry and education has injected new vitality into this model. Through AI's data analysis and intelligent monitoring capabilities, educational institutions and enterprises are able to better track the learning process of students, and identify and solve learning problems in a timely manner. This not only improves the quality of teaching, but also provides strong support for teaching mode innovation. The AI-based virtual simulation training platform allows students to carry out experimental operations in a safe and low-cost environment, which effectively reduces the resource input of the traditional industry-teaching integration model and broadens the practical training space for students. Enterprises and industrial colleges jointly carry out research projects to share research results. Enterprises turn problems in practical applications into research topics and provide them to industrial colleges for research, while industrial colleges utilize their academic research and talent advantages to provide solutions for enterprises; enterprises send experts with rich practical experience and industry background to industrial colleges to serve as part-time teachers and provide students with practical guidance and cutting-edge industry dynamics; the hardware equipment and technology development costs required for the wide application of AI technology in the integration of education and industry are high, and for the students, the hardware equipment and technology development costs are high. The hardware equipment and technology development costs required for the widespread application of AI technology in the integration of education and industry are high, and it is difficult for many educational institutions and small and medium-sized enterprises (SMEs) to bear the related costs; the actual enhancement of the teaching effect of AI technology needs more empirical research and data support to ensure that it can truly meet the needs of education and industry， showed in Figure 1 :

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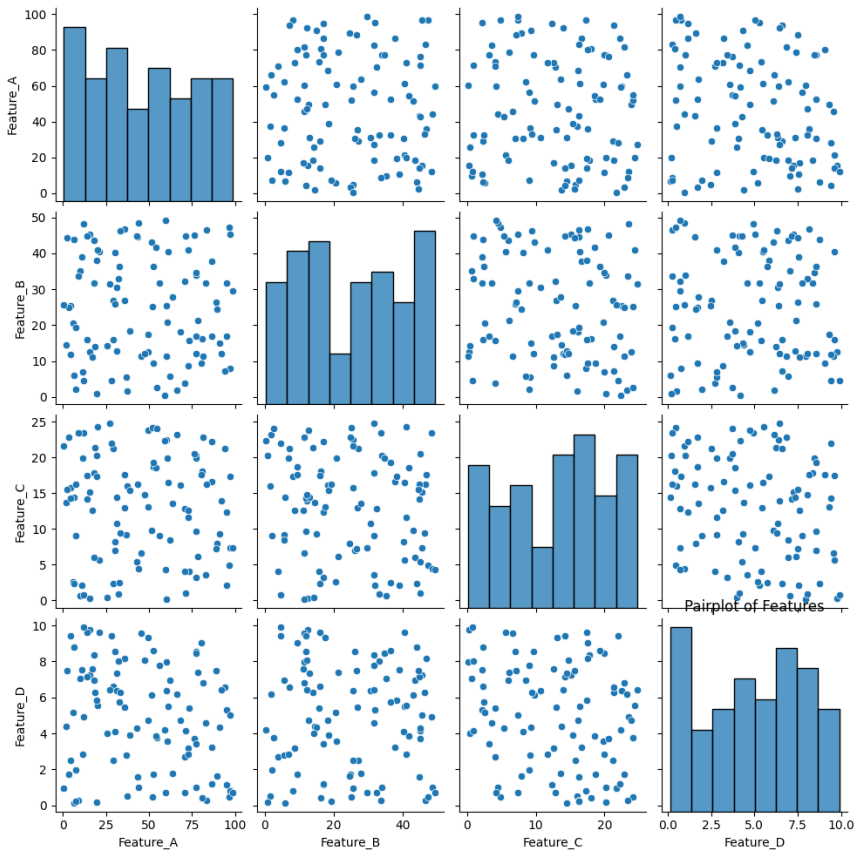

Figure 1: Pairplot of Features

3. Product design innovation practice teaching mode based on AI technology

The product design innovation practice teaching mode based on AI technology is centered on the optimization of teaching objectives, teaching content, and teaching methods, and makes the teaching process more flexible and efficient through AI-enabled personalized learning and intelligent feedback mechanisms. The model deeply integrates AI technology into all aspects of teaching, and strives to improve the practical skills of students while cultivating their innovation ability, and realizes the overall improvement of the precision of teaching objectives, the practicality of teaching content and the intelligence of teaching methods.

3.1. Design of Teaching Objectives

In the product design innovation practice teaching based on AI technology, the design of teaching objectives needs to be centered on the enhancement of students' innovation ability and practical skills. Through the introduction of AI auxiliary tools, teaching can help students master the industry's cutting-edge intelligent design methods, thus enhancing their creativity and ability to solve practical problems in the design process.AI technology provides a new perspective, prompting students to boldly try out innovative ideas in the design process, and gradually cultivating their sense of innovation. Formula for the quadratic equation:

$$c = \sqrt{\{a^2 + b^2\}} \tag{2}$$

The model emphasizes the achievement of students' personalized growth goals. by analyzing students' learning data, the AI system is able to identify each student's strengths and weaknesses so that targeted learning goals can be set. Compared with traditional teaching, AI technology enables differentiated instruction in the design of teaching goals, ensuring that students at different levels can grow and improve accordingly in the learning process. Personalized teaching goal design can enable students to overcome their shortcomings in a more targeted manner, effectively improving learning results.

The design of teaching objectives should also focus on the cultivation of students' collaboration and

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communication skills. Product design innovation typically requires teamwork, and AI technology can enhance communication and information sharing on collaborative platforms. However, students often lack practical experience in applying their professional knowledge. Traditional product design courses are largely limited to classroom-based theories and hypothetical project exercises, which do not provide students with opportunities to engage in real-world projects. As a result, students' ability to absorb and apply professional knowledge remains restricted. Collaborative learning allows students to learn from one another, strengthening both their communication skills and their understanding of the subject matter. At the same time, AI can also track the dynamics of teamwork in real time, helping teachers to accurately understand the performance of students in collaboration, in order to better guide and motivate students.

AI technology provides technical support for real-time feedback and dynamic adjustment, making the design of teaching objectives more flexible and iterative. By analyzing students' learning progress through AI, teachers can adjust teaching objectives in a timely manner to match the actual situation of students and help them better achieve the established learning objectives. This dynamically adjusted design of teaching objectives not only adapts to students' individualized development needs, but also ensures the maximization of the overall teaching effect.

3.2. Optimization of teaching content

The product design innovation practice teaching mode based on AI technology focuses on the intelligent integration and updating of resources in the optimization of teaching content. First of all, AI technology can update the teaching content in real time according to the industry trends and design frontier dynamics, provide students with the most cutting-edge learning resources, and help them master the latest design concepts and technical means. Educational resources and teaching objectives are disconnected, teaching cognitive limitations, product design involves a wide range of industries, the course teaching content for the various industries involved in the ability to high requirements in the material process molding and other technical aspects of the content has a strong requirement, the teaching conditions of on-campus practice is insufficient, students lack hands-on practical ability. Through AI data analysis and industry big data to obtain the market demand, the teaching content can be closer to the actual industry, so that students in the learning process is always in line with market demand,showed in Figure 2 :

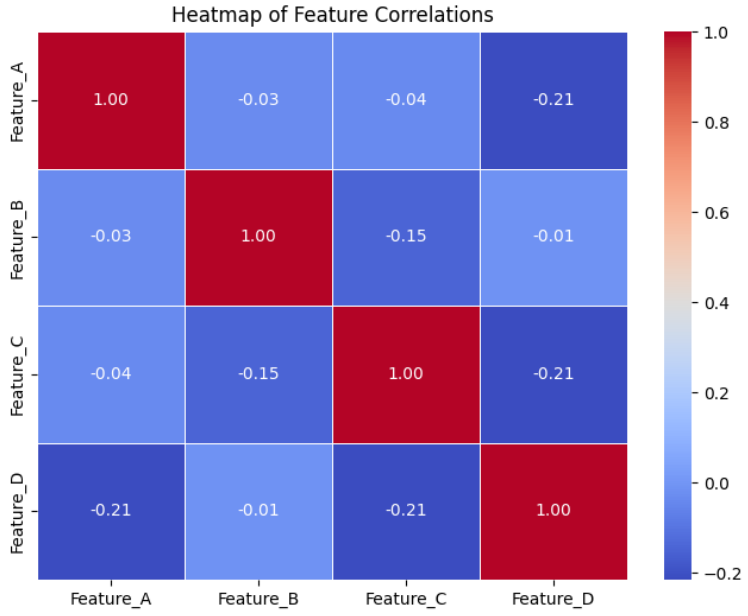

Figure 2: Heatmap of Feature Correlations

Teaching content optimization focuses on the construction of personalized learning modules. the AI system is able to identify students' knowledge weaknesses and personal interests based on their learning data, so as to push corresponding learning resources and practical projects. Through such personalized resource recommendation, each student can have access to the content that suits his/her learning progress

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and ability level, which ensures that the teaching of product design is tailored to the needs of the students, and that the students can master the core knowledge and skills more efficiently.

AI technology empowers the diversity and interactivity of teaching content. In the teaching of product design innovation, AI-driven virtual reality (VR) and augmented reality (AR) technologies can provide students with an immersive hands-on experience. Through these technologies, in the knowledge objectives, students are trained to have solid theoretical knowledge of product design research courses, master the product design process and methods, understand the enterprise operation process, need to understand the market demand, competitors and the industry in market research, understand the importance of product design research in the enterprise, and cultivate the students' market sensitivity and understanding of the user's needs. In terms of skill objectives, students should effectively master and apply various research methods in design practice. They should also acquire a comprehensive set of professional skills, enabling them to conduct experiments and tests for design projects in virtual environments. This hands-on experience allows students to observe design outcomes firsthand, providing a more intuitive understanding of design principles. The interactive content not only increases the interest of teaching, but also significantly improves the learning effect and participation of students.

Teaching content optimization also includes the construction of an intelligent assessment and feedback system.The AI system can analyze students' performance in the learning process in real time and provide targeted feedback and assessment information. For example, by analyzing students' design results through AI, it can provide timely feedback on improvement suggestions, thus helping students understand and master design points. Such an intelligent assessment system can ensure students' timely absorption and consolidation of what they have learned, and provide data support for the continuous optimization of teaching content.

3.3. Innovations in teaching methods

In the product design innovation practice teaching based on AI technology, the core of the teaching method innovation is to realize personalized teaching. The AI system can automatically generate a learning path suitable for each student according to the student's learning behavior data and progress, making the teaching method more flexible and diverse. For example, AI can recommend relevant learning resources, practice questions and case studies in real time to help students get timely support when they encounter difficulties, thus realizing the precision and personalization of teaching and effectively improving students' learning efficiency.

The introduction of AI technology makes the feedback mechanism in the teaching process more intelligent. While traditional teaching feedback often relies on teachers' classroom observation and homework assessment, AI systems are able to monitor and analyze students' performance in real time during the learning process, quickly identify problems in learning, and provide immediate feedback. Through this instant feedback mechanism, students can adjust their own strategies and methods at any time in the learning process, and teachers can also keep abreast of the learning status of students in the teaching process and provide more targeted counseling.

AI technology has driven the development of virtual tutors and adaptive learning systems to provide students with 24/7 learning support. The virtual tutor system can answer students' questions, guide the direction of learning, and even provide technical advice in designing projects, while the adaptive learning system dynamically adjusts the difficulty according to the student's progress, ensuring that the student steadily improves at an appropriate learning pace. This continuous, personalized support greatly expands the time and space constraints of traditional classroom teaching, allowing students to take control of their learning process.

Teaching method innovation is also reflected in the intelligent support for collaborative learning. ai technology can help assign tasks, track progress, and automatically generate team learning reports in team collaboration, helping students to effectively divide up the work and stay in sync during collaboration. Through these intelligent collaboration tools, students are able to better coordinate the roles and responsibilities in the project. Students analyze and summarize the collected data, and then sort out the market, users, enterprise needs and cultural elements in combination with the technical conditions of the enterprise. In the process of practice, teachers and enterprise mentors participate in the discussion and provide guidance, so that the students can understand the design positioning from a more comprehensive and in-depth perspective, thus ensuring the scientific and practicality of the design scheme to complete the design positioning to improve the efficiency of the team, but also enhance their cooperation and communication skills in product design. This intelligent collaborative approach injects

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new vitality into innovative practical teaching and makes team learning more efficient and organized.

4. Implementation case and effect analysis of AI-based industry-teaching integration teaching model

The AI-based industry-teaching integration teaching model has been successfully implemented in the product design program of a university. The program cooperated with a number of well-known enterprises to establish an industry-teaching integration training base, which provides students with a real project practice environment through the introduction of AI technology. In the teaching process, teachers use the AI system to analyze the needs of enterprises, develop corresponding project tasks, and allow students to design products in the context of real problems in enterprises. This practical teaching mode, which is closely related to market demand, not only stimulates students' enthusiasm for learning, but also effectively improves their practical ability.

During the implementation process, the application of AI technology provides students with a personalized learning experience. Through learning behavior analysis, the AI system is able to monitor the learning progress of each student in real time and push appropriate learning resources and suggestions based on their characteristics. Certain students, who excelled in the operation of design software, make full use of the resources shared by enterprises on industrial college topics, enterprise teachers, equipment technology, and other resources for course design. These students are guided to engage in targeted practical training and practice, comprehensively integrating the characteristics and advantages of industrial colleges to adapt to the teaching reforms necessary for the development of industrial colleges in the present time. Other students, who may have a greater aptitude for creative conceptualization, benefit as the AI system tailors learning paths to their individual strengths and needs. This enables each student to grow at a pace that best suits him or her.

In terms of effect analysis, through a comparative study of the implemented classes and traditional teaching classes, it was found that the AI-based industry-teaching integration teaching mode significantly improved students' design innovation ability and practical skills. The survey data showed that the ratings of the classes implementing the model were higher than those of the traditional classes in terms of the innovativeness, practicality and market adaptability of the project design. Feedback from participating companies also showed that students demonstrated stronger independent problem-solving ability and teamwork spirit during the internship, further enhancing their employment competitiveness. The AI-based industry-teaching integration teaching model not only improves students' professional ability, but also promotes the deep cooperation between universities and enterprises. Enterprises gave positive feedback on the performance of students, believing that this new teaching mode can better meet the needs of the industry and cultivate high-quality talents who can adapt to market changes. The partnership between colleges and enterprises has become closer as a result, providing successful practice cases and valuable experience for future exploration of the integration of industry and education.

5. Conclusion

The industry-teaching integration teaching mode based on AI technology provides new ideas and methods for educational innovation in the field of product design. Through in-depth analysis of teaching objectives, optimization of teaching content and innovation of teaching methods, the model effectively realizes personalized and precise teaching, and promotes the comprehensive improvement of students' innovation ability and practical skills. Teaching evaluation introduces the external mechanism of enterprise evaluation for comprehensive assessment, mainly based on the comprehensive evaluation of professional teachers and enterprise teachers, from the reasonableness of the selection of research methods; the accuracy of the design positioning; the completeness of the research report; the innovativeness of the product design, the enthusiasm of classroom performance, etc., which can help to improve the quality of teaching, and cultivate more high-caliber talents in line with the needs of the enterprises. In the implementation of actual cases, the application of AI technology not only enhances the learning experience of students, but also lays a good foundation for the in-depth cooperation between colleges and enterprises, and promotes the effective docking between talent cultivation and industrial demand.

In the future, with the continuous development and maturity of artificial intelligence technology, the AI-based industry-teaching integration teaching mode will usher in a broader application prospect. Colleges and universities should continue to explore and improve this teaching mode, combining the

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development dynamics of the industry and the needs of education reform, further optimizing the curriculum and teaching methods, and ensuring the cultivation of high-quality talents that meet the needs of society. At the same time, enterprises should also actively participate in the education process, provide students with practice opportunities and feedback, and jointly promote the synergistic development of education and industry. Through such sustained efforts, the integration of industry and education will not only enhance the quality of education, but also inject a constant flow of innovative impetus into the development of the economy and society.

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