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INNOVATION AND PRACTICE IN PRODUCT DESIGN TEACHING DRIVEN BY INTELLIGENT TECHNOLOGY

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Abstract: With the rapid development of intelligent technology, its application in the field of education is becoming increasingly widespread. This article aims to explore the innovative application and practical effects of intelligent technology in product design teaching. The article first analyzes the impact of intelligent technology on educational models, then elaborates on the specific applications of intelligent technology in product design teaching, including the intelligent updating of teaching content, the innovation of teaching methods, and the improvement of teaching evaluation systems. It discusses how to introduce the concept of "Artificial Intelligence + Design" to build a cutting-edge teaching framework and adopt case-based teaching methods to enhance students' innovation and practical abilities. Through case analysis, this article demonstrates the effectiveness of intelligent technology in actual teaching and discusses the challenges it faces. Finally, the article proposes suggestions and prospects for the future application of intelligent technology in product design teaching.
Keywords: Intelligent technology; Product design; Teaching innovation; Practical application; Artificial intelligence

1 INTRODUCTION

With the rise of artificial intelligence, big data, cloud computing, and other intelligent technologies, the education industry is undergoing unprecedented changes. Especially in the field of product design, the application of these technologies has not only changed design tools and methods but also put forward new requirements for the training of designers. Traditional design education faces challenges in integrating new technologies, updating teaching content and methods. Therefore, studying how intelligent technology drives innovation and practice in product design teaching is of great significance for improving teaching quality and cultivating innovative talents.

This study aims to explore the current status and development trends of intelligent technology application in product design teaching, analyze its innovation points in teaching content, methods, and evaluation systems, propose a teaching model that combines the concept of "Artificial Intelligence + Design", and verify its effectiveness through practical cases. At the same time, this study will also explore problems encountered during implementation and solutions, providing references for future teaching reforms. This article uses a combination of literature review, case analysis, and empirical research methods. Firstly, it summarizes the application of intelligent technology in the field of education through literature review; secondly, it selects typical teaching cases for in-depth analysis; finally, based on empirical data, it evaluates the actual effects of intelligent technology in product design teaching and proposes corresponding suggestions.

2 CURRENT STATUS AND CHALLENGES OF PRODUCT DESIGN TEACHING

Traditional product design teaching mainly relies on a combination of teacher lectures and student practice, focusing on basic skill training. In this mode, the teaching content is relatively fixed, making it difficult to adapt to rapidly changing market demands and technological development. Currently, product design teaching faces issues such as outdated teaching content, limited practical opportunities, and insufficient cultivation of innovative abilities. These problems limit the enhancement of students' design thinking and practical operation capabilities.

The introduction of intelligent technology provides new ideas for solving the above problems. For example, virtual reality technology can simulate real design environments, enhancing students' practical experience; using big data analytics can help teachers better understand students' learning progress and needs, achieving personalized teaching. Currently, the application of intelligent technology in the field of education mainly focuses on intelligent teaching systems, virtual laboratories, online courses, etc. These applications not only enrich teaching methods but also provide students with more flexible and diverse learning methods. However, how to effectively integrate these technologies into traditional teaching systems remains a question worth exploring.

3 INNOVATION IN PRODUCT DESIGN TEACHING DRIVEN BY INTELLIGENT TECHNOLOGY

Intelligent technology refers to the use of multidisciplinary knowledge such as computer science and cognitive science to simulate human intelligence behavior. AI can provide design inspiration through data mining and pattern recognition, optimize design schemes, and even predict market trends. From early expert systems to deep learning today, intelligent technology has undergone multiple stages of development and has shown great potential in various fields. In the field of education, intelligent technology is used in personalized learning, intelligent tutoring, automated evaluation, etc.,

greatly improving teaching efficiency and quality.[1] To respond to the national strategy for artificial intelligence and the Ministry of Education's call for construction and development related to artificial intelligence, in 2018, Microsoft Research Asia collaborated with four top Chinese universities—Peking University, University of Science and Technology of China, Xi'an Jiaotong University, and Zhejiang University—to create a new generation of open scientific research and education platforms for artificial intelligence. This platform launched the country's first open-source platform solution in the field of deep learning developed jointly by multiple parties—Open Platform for AI (Open PAI), aiming to establish an independent intellectual property rights and innovative achievements foundation support platform for artificial intelligence.

The launch of the Open PAI platform marks an important step in China's education and research work in the field of artificial intelligence. Leveraging its open, open-source, compatible characteristics, combined with Microsoft's powerful computing capabilities and resources, the platform provides strong technical support for cooperating universities. Through this platform, universities can enjoy advanced artificial intelligence management and scheduling services while also exploring innovation and educational services in the field of artificial intelligence. Open PAI not only provides an integrated development environment for the entire lifecycle—Tools For AI, but also integrates Microsoft's open-source tools in core technology areas such as speech, vision, language, as well as high-quality open-source tools from universities in their respective fields. Such an integrated development environment significantly reduces the cost of learning and research, allowing teachers and students to more flexibly apply core technologies to solve key industry problems, thereby enhancing the value and influence of scientific research achievements.

Over the past seven years, Zhixin Platform has provided Chinese universities with four core resources and services, including computing platforms, algorithms and tools, data, and courses. These resources and services not only support the development of joint scientific research projects but also promote various forms of cooperation such as curriculum co-construction, faculty training, internships, and international exchanges. The construction and operation of Zhixin Platform have established an open, open-source system for collaboration in artificial intelligence technology innovation and education in China, providing strong support for the country's new generation of AI research achievements. Additionally, the successful operation of Zhixin Platform has introduced a new model for cultivating high-end technological talents in China. Through the platform's resource sharing and cooperation mechanisms, it not only accelerates the transformation of research outcomes but also offers students more opportunities for practice and innovation. This establishment of a science and education ecosystem helps create a virtuous cycle, promoting the continuous development and innovation of China's AI field.

3.1 Intelligent Updates to Teaching Content

Smart technologies allow teaching content to be updated in real-time according to the latest industry trends, ensuring that students learn knowledge and skills that are up-to-date. By incorporating artificial intelligence technology, teaching content can be dynamically adjusted based on students' real-time learning situations. For example, intelligent systems can analyze students' learning progress and understanding, automatically recommending suitable learning resources and exercises to enhance the personalization and effectiveness of teaching. Moreover, by introducing online resource libraries and open courses, students can independently choose their learning materials, meeting diverse learning needs.

3.1.1 Incorporation of latest technology trends

The introduction of intelligent auxiliary teaching systems enables teachers to more precisely analyze students' learning situations, achieving personalized teaching; while the application of virtual reality and augmented reality technologies allows students to explore knowledge in immersive environments, significantly enhancing their interest and efficiency in learning. Additionally, blockchain technology demonstrates unique value in educational assessments, ensuring fairness and transparency in evaluation processes. The integration of these cutting-edge technologies not only enriches educational resources but also promotes educational equity, allowing every student to access high-quality educational resources and laying a solid foundation for nurturing more talents with innovative abilities and practical skills for the future society.[2]

3.1.2 Integration of interdisciplinary knowledge

The integration of interdisciplinary knowledge has become key to driving innovation and solving complex problems. The intertwining of knowledge and skills from different fields provides us with broader perspectives and richer solutions. For instance, the combination of artificial intelligence and biotechnology is opening new chapters in the healthcare sector; principles of physics are applied in economics to help analyze market dynamics; and the fusion of art and technology has given rise to emerging industries like digital media. Such cross-disciplinary collaboration not only promotes the development of various disciplines but also brings unprecedented changes to society. Therefore, cultivating interdisciplinary thinking is crucial for both individuals and society.

3.1.3 Focus on practical skill training

In today's rapidly changing social environment, possessing solid practical skills means stronger competitiveness and adaptability. Therefore, educational institutions should emphasize and innovate practical teaching methods, such as laboratory operations, case analysis, simulation drills, etc., allowing students to learn in real or near-real situations. Additionally, encouraging students to participate in scientific research projects, internships, and community service activities broadens their horizons and increases experience. Moreover, establishing university-enterprise cooperation mechanisms is an effective way to enhance students' practical skills. Enterprises can provide internship positions for students, while schools can adjust course settings according to enterprise demands, jointly cultivating high-quality

talents that meet market needs.

3.1.4 Continuous learning resource recommendations

Leveraging big data analytics and machine learning algorithms, open educational resources (OER) can offer students continuous learning resource recommendations. These recommendations are based on students' learning history, interests, and goals, helping them to continue deep learning outside of class hours and maintain the coherence and depth of knowledge. Online learning platforms like Coursera and edX provide a wealth of course resources covering multiple academic fields. These platforms are interactive, allowing students to learn through videos, assignments, and quizzes, participate in project practices, obtain certification certificates, and enhance their professional competitiveness. It is recommended that students attend relevant offline lectures and online platforms like TED Talks to broaden their knowledge base and stimulate innovative thinking, thereby improving their overall quality.[3]

Construction of Resource Sharing Platform:

3.2 Intelligent Innovation in Teaching Methods

The application of smart technologies has promoted the diversification of teaching methods. For example, the flipped classroom model encourages students to autonomously learn theoretical knowledge through online platforms before class, focusing on discussions and practical operations during class time, enhancing classroom interaction and learning efficiency.

3.2.1 Flipped classroom model

The flipped classroom model is an innovative teaching method that reallocates the time distribution inside and outside the classroom, transferring the decision-making power of learning from teachers to students. By reversing the traditional teaching process, students autonomously learn new knowledge before class through videos, reading materials, etc., while classroom time is used for discussions, problem-solving, and deepening understanding. Under this model, students are no longer passive recipients of knowledge but active participants in learning, which not only improves their self-learning ability but also cultivates their critical thinking and problem-solving skills. For teachers, the flipped classroom signifies a role shift from knowledge transmitters to learning guides and facilitators. Teachers design courses according to teaching objectives, ensuring students master core knowledge points before class and deepen understanding through activities during class. Course content is modularized and specialized, constructing a complete and logical knowledge system to avoid fragmented presentation of knowledge. Teachers need to design high-quality teaching videos and other digital resources to support students' autonomous learning and conduct effective interactions and guidance in class. The flipped classroom model plays a significant role in improving teaching quality and student learning outcomes, encouraging proactive learning, making the teaching process more personalized and efficient.

3.2.2 Project-Based learning (PBL)

PBL is a student-centered teaching method that enhances students' practical abilities and problem-solving skills by involving them in the design and implementation of real projects. Teachers, based on curriculum standards and students' learning needs, identify core knowledge points for the project and design challenging tasks to stimulate students' interest in learning and encourage them to apply their knowledge through exploration and practice. Under teachers' guidance, students develop project plans, assign tasks, and solve problems through practical activities. After completing the project, students reflect on their learning experiences and evaluate the project outcomes. PBL emphasizes student-centered learning through real or simulated project tasks, allowing students to construct knowledge and experience in the process of completing projects. It encourages active participation in learning, promoting innovative thinking and problem-solving skills through practice, exploration, and collaboration.

PBL is contextual, meaning knowledge is not learned in isolation but within specific, real-life situations. The benefits of PBL include its emphasis on interdisciplinary knowledge integration, enabling students to apply knowledge from different subjects to solve real problems through comprehensive project designs. PBL also focuses on teamwork, enhancing understanding and application of knowledge through personalized and collaborative learning environments, which also improve problem-solving skills, foster innovative and critical thinking, and lay a solid foundation for future studies and careers.[4]

3.2.3 Collaborative learning strategies

Collaborative learning strategies emphasize teamwork and mutual assistance, promoting knowledge sharing among students, improving problem-solving abilities, and enhancing team spirit. To implement this strategy, teachers first design reasonable group allocation schemes to ensure every member can leverage their strengths. They then clarify task objectives and division of labor, ensuring each participant knows their responsibilities. Additionally, encouraging open discussions creates a safe and inclusive learning environment where everyone feels confident expressing their ideas without fear of criticism. Regular reflection meetings are organized to share what was learned during cooperation, challenges encountered, and how they were overcome. This deepens understanding of knowledge points and cultivates good communication skills and social responsibility.

3.2.4 Gamification in education

Gamification in education involves incorporating game elements into the teaching process to make learning more engaging and interactive. This approach typically includes point systems, level advancement, task challenges, and virtual rewards, making the learning process more lively and fun. Teachers design various game activities for students to master knowledge points while completing tasks. Examples include puzzle games and role-playing simulations. These activities not only spark curiosity but also develop teamwork and problem-solving skills. Gamification provides

instant feedback, helping students understand their progress and identify issues promptly. Through competition and collaboration, students learn from each other in a relaxed and enjoyable atmosphere. Gamification is becoming an increasingly popular teaching strategy in modern education for its unique appeal, enhancing learning efficiency and fostering innovative thinking and practical abilities.

3.3 Intelligent Improvement of the Teaching Evaluation System

Traditional teaching evaluations often rely on final exams or project works, which fail to comprehensively reflect students' learning processes and ability enhancement. The application of intelligent technology enables formative assessments, allowing teachers to collect detailed and objective evaluations through learning management systems.

3.3.1 Formative assessment systems are crucial for educational innovation

emphasizing process over mere outcomes. This dynamic and continuous evaluation method aims to promote holistic development by observing and providing real-time feedback on students' learning processes. It focuses not only on knowledge acquisition but also on skill enhancement, emotional attitudes, and values formation. Teachers act as guides and observers, using daily homework, group discussions, and classroom performance to gather information from multiple perspectives. Formative assessments stress immediacy and specificity, encouraging learning through trial and error, self-reflection, and peer review to adjust learning strategies continually. This approach helps develop self-monitoring skills and critical thinking, making students more proactive learners. It also provides valuable teaching feedback, helping teachers adjust plans and methods to meet individual needs.[5]

3.3.2 Competency-Based assessment

In the field of education today, competency-based assessment is gradually becoming the mainstream evaluation method. This assessment model emphasizes the cultivation of students' practical skills, innovative thinking, and problem-solving abilities rather than mere rote memorization of knowledge. It encourages students to apply theoretical knowledge in practice, showcasing their talents through projects and case analyses. Teachers shift from traditional knowledge transmitters to guides and evaluators, designing real-life tasks, observing and documenting student performance, and providing personalized feedback. In this model, evaluation criteria are more diversified, focusing not only on outcomes but also on learning attitudes, teamwork spirit, and self-improvement during the process. Competency-based assessment promotes educational equity, allowing every student to shine in their areas of strength and cultivating more talents with practical experience and innovation for society.

3.3.3 Peer review mechanism

The peer review mechanism is a widely used assessment method in education that enhances learning outcomes through mutual evaluation among students. Under this mechanism, students receive feedback not only from teachers but also from classmates, gaining different perspectives and suggestions. This approach helps develop critical thinking, communication skills, and teamwork spirit.

When implementing peer reviews, clear standards or guidelines are usually provided to ensure fairness and effectiveness. These standards may include accuracy of content, clarity of expression, and logical coherence. To maintain participants' enthusiasm, it is essential to emphasize positive encouragement and avoid overly harsh or negative comments.

Teachers play a guiding role throughout this process, training students beforehand on how to give constructive feedback and supervising the entire procedure to ensure smooth operation and address potential issues promptly. When used correctly, peer review can deepen students' understanding of their work, strengthen class cohesion, and foster a positive learning environment.

4 CASE STUDY: APPLICATION OF SMART TECHNOLOGY IN PRODUCT DESIGN TEACHING

4.1 Peking University School of Stomatology's Virtual Simulation Smart Lab, AI Technology Reshapes Experimentation and Practice

In today's rapidly advancing technology era, artificial intelligence (AI) is profoundly transforming our learning methods. The School of Stomatology at Peking University recently announced the official launch of its self-developed virtual simulation smart lab, marking a new experimental and practical approach for fields requiring high manual dexterity. This innovative initiative not only reshapes teaching modes but also realizes the independent development of the world's first mixed-type oral virtual simulation training system, providing valuable teaching resources for domestic universities.

The Peking University School of Stomatology's Virtual Simulation Smart Lab is a multi-dimensional intelligent integrated training platform that combines virtual simulation technology, big data support, intelligent IoT, intelligent management, and smart learning and evaluation. The lab consists of teaching areas, online training zones, and virtual simulation training zones, aiming to master skills based on theoretical foundations and provide timely feedback on skill levels through various training methods.

The highlight of the lab lies in its innovative teaching mode. By integrating online and offline, virtual and physical modes, the lab optimizes training methods and improves teaching quality. Students can engage in virtual simulation experiments and automated assessments in the online training area, while the virtual simulation training area offers diverse types of force-feedback virtual simulation training and evaluations. This variety of training methods enhances learning efficiency and practical skills.

Additionally, the lab innovates operational management models. Through an intelligent "appointment-management-evaluation" integrated system, the lab efficiently manages teaching resources and service processes. The system and resources are shared with domestic universities, having served society and students 18,000 times to date, demonstrating its social value and influence.

In this lab, students transition from passive knowledge recipients to active explorers and practitioners. They simulate real-world surgical procedures in a virtual environment, with each practice honing their skills. The introduction of virtual simulation technology allows students to try complex surgical procedures without risks, crucial for enhancing their hands-on abilities and clinical thinking.

The establishment of the Peking University School of Stomatology's Virtual Simulation Smart Lab also profoundly impacts teaching methods for educators. Teachers can utilize this platform for more flexible and diverse teaching activities, adjusting content and methods based on student feedback to better meet their needs.[6]

The success of the Peking University School of Stomatology's Virtual Simulation Smart Lab provides a new perspective for the education sector in China and globally. It demonstrates the immense potential of AI technology in education, with prospects for broader application across more professional fields. As technology continues to advance and innovate, we have reason to believe that education will become increasingly intelligent, personalized, and efficient.

4.2 Tsinghua University Leads the Innovation of AI Technology in Educational Models, with Multiple Schools Following to Explore New Paths for Intelligent Teaching

On March 5th, Tsinghua University announced that the application of AI technology in education is gradually changing traditional teaching models, bringing new opportunities and challenges to educational instruction. Starting from the fall semester of 2023, the university launched a pilot program titled "AI-Empowered Teaching," with eight courses participating in the pilot phase. Among these, five courses have completed the development and deployment of their intelligent teaching assistant systems. These AI teaching assistants provide round-the-clock personalized learning support, intelligent assessment, and feedback, as well as assist students in deep thinking and inspiring learning insights.

In the "Chemical Thermodynamics" course, Professor Lu Dian Nan from the Department of Chemical Engineering used over a hundred related articles and books for continuous training and calibration of a vertical model. The system has been preliminarily developed and now features capabilities for generating and answering questions. It was used as an auxiliary tool in the final project of the course at the end of the semester. Associate Professor Qian Jing from the School of Social Sciences, who teaches "Mind, Individual, and Culture," reported that after one semester of initial trials, students found the intelligent teaching assistant superior in terms of content accuracy, clarity of structure, degree of agreement, and helpfulness compared to general large models (such as GPT-4) and even human assistants.

Tsinghua University stated that in 2024, it plans to launch 100 pilot courses empowered by artificial intelligence. By leveraging AI to assist or deeply integrate into courses, the university aims to create AI teaching assistants and teachers, continuously innovate teaching scenarios, and enhance the efficiency and quality of teaching and learning.

Simultaneously, Peking University introduced its AI teaching assistant—Brainiac Buddy (BB), an AI interaction project based on GPT-4. In the fall semester of 2023, BB was implemented in the course "Mathematical Methods in Image Processing" taught by Professor Dong Bin, a distinguished professor at Peking University's Beijing International Center for Mathematical Research. Students were able to preview the course and establish personalized knowledge bases through interactions with "BB."

Nanjing University released the overall plan for its "General Education Core Curriculum System on Artificial Intelligence," set to be offered to all freshmen starting September 2024, a pioneering initiative among national universities. Led by top scholars including academicians, the course employs diverse teaching methods to help students understand AI applications across different fields. Tan Zhe Min, president of Nanjing University and an academician of the Chinese Academy of Sciences, stated that the university mobilized its entire strength to offer this core curriculum system. Tailored to the cognitive characteristics and disciplinary features of different majors, the course adopts a teaching format of "collective lectures + small group discussions + practical internships + AI teaching assistants," aiming to construct an AI classroom that deeply integrates AI technology and promotes in-depth human-machine interaction.[7]

Furthermore, the upgraded version of Ma Shang V2.0 was officially launched on the teaching cloud platform of Beijing University of Posts and Telecommunications. Developed, operated, and supported by the university's EZCoding team, Ma Shang is an intelligent programming teaching application platform empowered by large models. Addressing the urgent need for one-on-one tutoring in programming education, Ma Shang utilizes iFlytek's Spark Cognitive Model and BUPT's proprietary core technology to offer real-time, personalized, and heuristic programming guidance to students. For challenging problems that cannot be resolved independently, students can click the "Seek Help from Teacher" button, alerting teachers or teaching assistants via in-platform notifications and email, enabling timely and targeted guidance. This facilitates a collaborative service model between AI and teachers. Teachers can customize tutoring functions and modes for their classes, such as toggling code generation capabilities, and access detailed learning behavior data of allowing them to conduct teaching experiments freely and provide more targeted, high-quality educational services to students.[8]

4.3 The Integration and Challenges of Virtual Reality Technology in Product Design Education

With the rapid development of technology, virtual reality (VR) has gradually permeated various fields of product design education. Recently, numerous design institutes have adjusted their curriculum to incorporate VR technology, aiming to cultivate students' innovative design capabilities and practical skills in the context of the new era.

In basic design courses, aesthetics, as a traditional strength, provides students with a solid foundation in aesthetic appreciation. However, facing the comprehensive requirements of VR technology, institutions are actively exploring how to integrate aesthetic theories with virtual technologies to foster interdisciplinary thinking and innovative abilities. The foundation course in computer-aided design has also been strengthened, with three-dimensional modeling and image processing becoming essential skills for students to better construct and modify virtual environments. Through desktop virtual systems, teachers can transform theoretical knowledge into hands-on practice, allowing students to explore and experience the history and craftsmanship of product design in a virtual environment. In the teaching of historical and theoretical knowledge, virtual technology makes the content more vivid and engaging. Teachers can use desktop virtual systems to recreate specific historical periods' design environments, making students feel as though they are traversing time and witnessing the birth process of various design products firsthand. This all-encompassing display not only breaks through spatial and temporal boundaries but also deepens students' memory and understanding of product characteristics.

In professional courses, virtual reality software has become a focal point and challenge in teaching. Since much of this course content is presented in English, it presents significant barriers for art students who generally have weaker English proficiency. Moreover, these courses often involve multiple programming languages such as C and Java, demanding higher levels of coding ability and logical thinking from students. Surveys indicate that most art students find these technically intensive courses daunting and struggle to master them efficiently. For teaching materials and processing techniques, virtual technology also demonstrates substantial advantages. Traditionally, students could only understand the production process through pictures or on-site visits, which hardly spark interest. With virtual technology, however, teachers can present the manufacturing process in three dimensions, allowing students to experience more authentic and detailed process information in a virtual setting. This not only enhances students' cognitive level but also reduces the investment in time and economic costs. Besides classroom teaching innovation, virtual technology plays an important role in teacher-student communication and creative inspiration. By establishing convenient interactive platforms, teachers and students can exchange opinions on design works in real-time. Additionally, students can gain more inspiration based on the platform or collaborate on projects around a particular design theme, thereby eliminating communication barriers among students and significantly improving teaching efficiency.

In terms of modeling skill training, virtual modeling technology offers students more flexible and efficient learning tools. Students can freely modify models during the design process, using mouse movements to adjust and perfect product models. This iterative process helps students better master three-dimensional software application skills until they achieve satisfactory results. Finally, in comprehensive courses like product design, virtual experiments provide valuable practical experience for students. Through desktop virtual systems, students can conduct virtual experiments after completing three-dimensional modeling, such as car design or water dispenser design for home use. They can test whether the designed products meet safety standards and practical application needs in a virtual environment, thereby summarizing human application habits and specific demands to reference in designing products that align with usage habits.[9]

Institutions adopt mainly two modes in curriculum settings: one is integrating with related fields like digital technology to form a more complete teaching system; the other is offering elective courses, allowing students to choose learning content based on interests. While the former covers a wide range of knowledge, it may impose a heavy course load affecting overall student development; the latter might result in insufficient breadth of knowledge, making it difficult to elevate competency levels.

Educators face challenges in balancing course difficulty with student receptivity and integrating resources to improve teaching quality. They need to scientifically plan course content and teaching objectives by combining institutional characteristics, professional features, and actual student situations to ensure that while mastering necessary skills, students also develop innovative thinking and problem-solving abilities.

The application of virtual reality technology in product design education not only challenges traditional teaching models but also represents a comprehensive enhancement of future designers' capabilities. By continuously optimizing curriculum setup and teaching methods, we have reason to believe that future designers will be better equipped to meet the demands of the digital age, creating even more astonishing works.[10]

5 SUMMARY AND OUTLOOK

Although intelligent technologies have brought numerous opportunities to product design education, they still face several challenges in practical applications, such as high technological costs, insufficient teacher skills, and significant differences in student adaptability. These issues need to be addressed through policy support, teacher training, and technological optimization. In educational reform, it is crucial to strengthen interdisciplinary cooperation, promote the integration of intelligent technologies with educational theories, intensify technical training for teachers, enhance their ability to use intelligent technologies, and focus on educating students about information literacy to better adapt them to an intelligent learning environment.

It is anticipated that intelligent technologies will be more deeply integrated into product design education in the future, creating more personalized and efficient teaching models. Additionally, as technology continues to advance and costs

decrease, more educational institutions will be able to afford and widely adopt these technologies.

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COMPETING INTERESTS

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