IT and Educational Reform: the Impact of Digital Transformation on Educational Quality

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Abstract. The rapid development of Internet technology and digital transformation are profoundly affecting the global education system, promoting the deepening of education reform, and digital education has gradually become an important means to improve the quality of education. This paper aims to explore the application of Internet technology in education reform, and analyzes the impact of Internet technology on education quality in detail, including the improvement of teaching effect, the improvement of personalized learning and student achievement, the optimization of teacher-student interaction and classroom management, and the improvement of educational equity. In addition, the paper discusses the challenges of digital transformation, such as technological barriers and infrastructure issues, changing educational philosophies, privacy and data security issues, and equity in education. Through case studies of South Korea's smart classroom and China's online education platform, the effects and challenges of digital transformation in practical applications are demonstrated. In summary, this paper provides an in-depth analysis of the digital transformation of education, which is of great significance to help educators, policy makers and academic researchers understand its potential and challenges, and to provide theoretical support and practical guidance for educational reform.

Keywords: Digital Transformation; Educational Quality; Educational Reform

1. Introduction

With the continuous development of global society and economy, education, as the cornerstone of social progress, is facing unprecedented challenges and opportunities. In recent years, the rapid development of information technology, especially Internet technology, has promoted the digital transformation in the field of education and become an important driving force for educational reform [1]. The limitations of traditional education models are becoming increasingly apparent, and the information age requires education not only to improve quality, but also to adapt to diverse learning needs and changing social environments.

The rapid spread of Internet technology, particularly through online learning platforms, virtual classrooms and massive open online courses (MOOCs), is changing the face of education, improving its quality and broadening learning opportunities. This technology-driven education model breaks the time and space constraints of traditional education, enabling learners to learn autonomously anytime and anywhere. Especially in remote areas and resource-poor environments, digital transformation promotes the sharing and popularization of educational resources, providing more students with the opportunity to receive quality education.

At the same time, the application of Internet technology also makes education gradually personalized and accurate. With the aid of big data and artificial intelligence, education can provide tailored learning programs according to students' learning habits, abilities and interests, thereby enhancing students' autonomous learning ability and teachers' teaching efficiency. However, despite the positive changes brought about by these technologies, the education sector still faces many challenges [2]. Information overload may lead to the distraction of students' attention, and the unequal distribution of technological equipment may exacerbate the urban-rural education gap. In addition, differences in teachers' abilities in the application of information technology may also affect the overall effect of digital education reform.

2. Literature Review

2.1 The application of Internet technology in education. With the continuous advancement of information technology, the Internet has profoundly changed every level of education. The new mode of education, as shown in Fig. 1, has greatly expanded the boundaries of education and improved the penetration rate and accessibility of education.

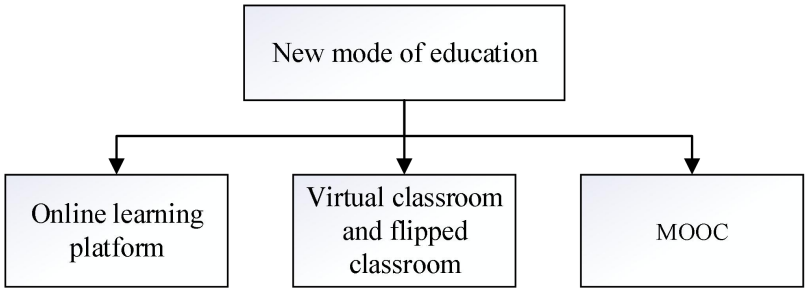

Figure 1. New mode of education

Online learning platforms (such as Coursera, edX, Khan Academy, etc.) have grown rapidly since the late 20th century and become an important part of the education landscape. These platforms provide a large number of learning resources, and students can choose learning content according to their personal interests and needs, breaking the restrictions of time and place, and being able to learn in a more flexible and autonomous way. Coursera, shown in Fig. 2, offers courses from top universities and institutions around the world that users can take anytime, anywhere, greatly improving the accessibility and autonomy of education.

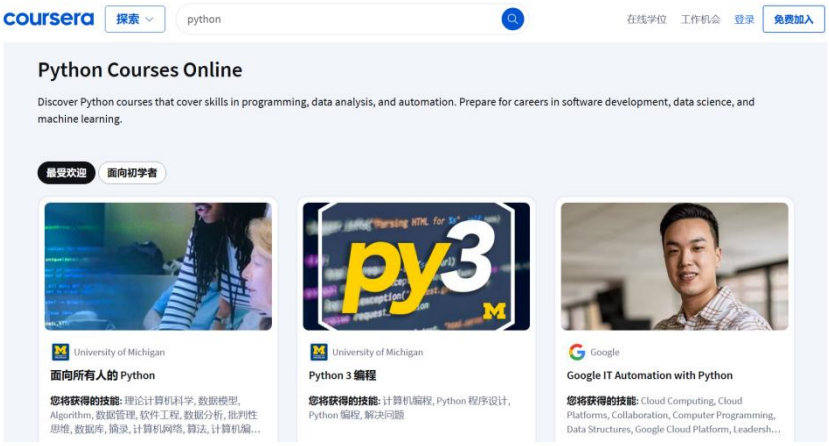

Figure 2. Coursera is an online learning platform

Virtual classroom and flipped classroom are two major innovations in the field of education in recent years. These new teaching models rely on Internet technology and combine classroom learning with self-study after class. Teachers are no longer the sole transmitters of knowledge, but the guides and mentors of students' learning. Through video conferencing, interactive tools and other technical means, virtual classroom enables students to participate in course learning remotely and interact with teachers and classmates in real time. Flipped classroom is to reverse the order of traditional classroom teaching and extracurricular learning. Students first learn basic knowledge by themselves through videos and online resources, and then have in-depth discussions and answer questions with teachers and classmates in class, thus improving the learning effect and initiative of students.

A MOOC (Massive Open Online Course) is a form of education that offers massive, open, free online courses over the Internet. The biggest feature of MOOCs is their openness, allowing anyone with an Internet connection to participate in courses at top universities around the world. Moocs not only provide learning resources for traditional disciplines, but also cover many emerging disciplines

and vocational skills training, becoming an important platform for global educational resources sharing.

The application of these Internet technologies has not only enriched the forms of learning, but also provided technical support for new educational models such as personalized learning and lifelong learning.

2.2 Definition and measurement of educational quality. The definition and measurement of educational quality vary according to different countries, regions, educational systems and times. Traditional definitions of educational quality tend to focus on academic achievement, test scores and students' mastery of knowledge. However, with the progress of society and the change of educational concepts, the measurement standards of educational quality have gradually diversified [3]. As shown in Fig. 3.

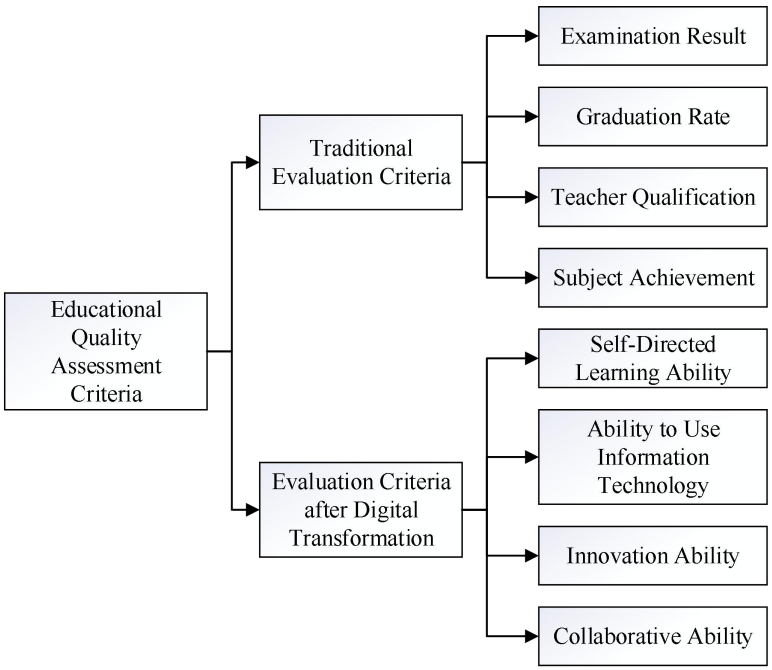

Figure 3. Evaluation criteria for educational quality

The traditional evaluation criteria of educational quality usually include students' test scores, graduation rates, teachers' qualifications, and academic scores. These standards emphasize the transfer of knowledge and the academic achievements of students, pay more attention to the input and output of knowledge, and consider less the learning process and quality development of students.

With the deepening of the digital transformation of education, the evaluation criteria of educational quality have changed. In addition to traditional academic results, students' independent learning ability, information technology use ability, innovation ability, collaboration ability and so on need to be considered. In addition, the popularity of online education platforms has made the evaluation of education quality more diversified, and students' participation, online learning progress, and interaction have also become new quality evaluation indicators.

2.3 Digital transformation and Education reform. Digital transformation is driving education reform globally, especially in the fields of higher education and vocational education [4]. Through the application of digital technology, some countries and regions have not only improved the utilization efficiency of educational resources, but also improved the equity of education. For example, Finland and Estonia have achieved remarkable results in the allocation of educational resources and innovation in teaching models through digital means, narrowing the education gap between urban and rural areas, regions and social classes. Developing countries such as China and India provide a large number of online education resources through Internet technology to help students in remote areas receive a better education.

Successful cases show that digital transformation helps to improve the quality of education and promote innovation in education [5]. However, digital transformation also faces challenges in some regions in terms of technology infrastructure, teacher training, student engagement, and more. Therefore, how to overcome these challenges and ensure the continuous improvement of education quality in the process of digital transformation is an important topic for future education reform.

3. Impact of Internet Technology on Education Quality

The rapid development of Internet technology has ushered in unprecedented digital transformation in the field of education. Through Internet technology, traditional education methods are undergoing profound changes, especially in improving teaching effect, realizing personalized learning, improving teacher-student interaction and promoting educational equity, Internet technology has played a huge role [6]. These changes not only changed the form of education, but also had a profound impact on the quality of education. This section explores how Internet technology can improve the quality of education in these four areas.

3.1 The improvement of teaching effect. The application of Internet technology has greatly improved the learning mode, enhanced the students' autonomous learning ability, and improved the availability of educational resources. The traditional education model usually relies on classroom teaching and teachers' teaching, while Internet technology enables students to conduct independent learning outside of class through online education platforms, virtual classes, educational videos, interactive learning tools and other forms. Moocs and various online learning platforms, for example, provide a wealth of course content that students can access anytime, anywhere, making up for the limitations of traditional classroom time.

In addition, Internet technology helps students broaden their horizons of study. Through the Internet, students can access high-quality educational resources around the world, especially course content from top universities, experts and scholars, and the popularity of these resources has greatly improved the accessibility of education. No matter where they are, as long as they have Internet access conditions, students can enjoy relatively fair educational resources, which has a significant role in eliminating the phenomenon of unequal educational resources.

The improvement of autonomous learning ability is also one of the positive changes brought about by Internet technology [7]. Through the online learning platform, students can choose courses according to their personal interests and progress, stimulate their learning motivation, and enhance learning efficiency through flexible learning methods. Interactive learning tools such as video courses, online tests and instant feedback enable students to monitor and adjust their learning progress at any time during the process of mastering knowledge, which not only improves the teaching effect, but also enables students to gradually develop the habit of independent learning [8].

3.2 Personalized learning and student achievement. Personalized learning is another important aspect of the application of Internet technology in education. Internet technology allows educational content and teaching methods to be tailored to students' individual needs and interests, and this highly customized learning model has a direct impact on student achievement, motivation, and engagement.

Through artificial intelligence, big data analysis and other technologies, online education platforms can collect and analyze students' learning data in real time, identify students' learning blind spots and weak links, and automatically push suitable learning resources based on this information. For example, in subjects such as math and English, the platform can recommend moderately difficult questions based on students' actual level, or provide additional tutoring content for students with poor grades to help them improve gradually.

This personalized learning not only improves students' grades, but also stimulates their motivation and engagement. Personalized recommended learning content can make students maintain a higher interest in learning, and avoid the boring feeling brought by the teaching method of "one-of-a-kind" in traditional education. At the same time, since each student can learn at their own pace, this flexibility also helps to reduce students' learning pressure and improve learning efficiency.

Research shows that personalized learning can not only improve students' academic performance, but also promote their overall development to a certain extent. For example, the online platform can also recommend interdisciplinary learning content based on students' interests, such as programming, art design, etc., to further broaden students' knowledge and stimulate their multi-faceted learning interests and creativity.

3.3 Teacher-student interaction and classroom management. The application of Internet technology makes the interaction between teachers and students more frequent, convenient and efficient. In the traditional education model, the teacher-student interaction is usually limited to face-to-face communication in the classroom, which is limited by time and space. However, with the popularization of online discussion platforms, instant messaging tools, and technologies such as artificial intelligence tutoring, teacher-student interactions have become more diverse and flexible.

For example, online discussion platforms offer students more opportunities to interact with teachers. Outside the classroom, students can answer questions with teachers in real time through the platform, and participate in after-class discussions and thinking collisions. This flexible approach to communication not only increases the student's sense of engagement, but also allows students to continue to deepen their understanding of the course content outside of the classroom. At the same time, teachers can also monitor students' learning progress in real time through the platform, understand their learning difficulties, and adjust teaching strategies in time.

The tutoring system with artificial intelligence technology is also an important supplement to teacher-student interaction. AI tutoring can provide personalized teaching support according to students' learning situation, and help students conduct independent review and improvement. The AI system can feedback students' mistakes in real time, provide targeted explanations to students, and even generate customized learning plans for them, reducing teachers' work pressure and allowing teachers to focus more on students' higher-order learning needs and classroom management.

In terms of classroom management, Internet technology helps teachers better control classroom dynamics. Through real-time voting, questionnaire survey and classroom discussion tools, teachers can know the opinions and feedback of students in real time, so as to flexibly adjust the teaching content and methods, and improve the efficiency and quality of classroom teaching.

3.4 Educational equity. The role of Internet technology in promoting educational equity cannot be ignored. Especially in poor and remote areas, Internet technology provides new possibilities for equal distribution of educational resources [9]. In the past, due to geographical, economic and other factors, many students in poor areas were unable to access high-quality educational resources, and the popularity of the Internet has provided a practical way to solve this problem.

Through the Internet, students in poor areas can access quality courses from famous universities through online education platforms and enjoy equal learning opportunities with urban students. For example, many domestic and foreign universities and educational institutions have provided high-quality educational resources to schools in remote areas for free or at low cost through network broadcast, recording and broadcasting. This not only provides students with a wider learning space, but also helps to improve the overall education standard in these areas.

At the same time, Internet technology has also helped to make the distribution of educational resources more equitable. Through the intelligent management system, the education department can accurately allocate high-quality teachers and teaching resources to the places where they are most needed, reducing the imbalance of educational resources. Distance education and online training allow teachers to effectively guarantee the quality of teaching in remote areas, no longer limited by geographical location or teaching facilities.

To sum up, Internet technology has played a positive role in promoting the quality of education. From improving teaching effect, realizing personalized learning, promoting teacher-student interaction to promoting educational fairness, the application of Internet technology in the field of education has been deepening, helping education break through the shackles of traditional models. With the further development of digital technology, education in the future will pay more attention to individuation, diversity and equity, and promote the overall improvement of education quality.

4. Challenges in Digital Transformation

The emergence of online education, digital tools and platforms has revolutionized the mode of education. However, while these technologies offer great opportunities for education, many challenges remain in their implementation. The following will explore the potential challenges of digital transformation to the quality of education from four aspects: technical barriers and infrastructure issues, changing educational philosophies, privacy and data security issues, and educational equity issues.

4.1 Technical barriers and infrastructure issues. The implementation of digital education first faces the challenge of technical threshold and infrastructure [10]. In different regions, especially in places with a large gap between urban and rural areas, there are significant differences in the hardware facilities and network connection conditions of schools and students. For many students in remote areas or low-income families, the lack of stable Internet connection and suitable terminal equipment (such as computers, tablets, etc.) has become a major barrier to participation in online education. Even if some schools have certain hardware equipment and infrastructure, the speed of technology update is far less than the change in demand, which leads to some schools can only use outdated equipment, limiting the breadth and depth of technology application.

Teachers' digital skills are also an important factor restricting the digital transformation of education. Despite the increasing use of modern technology, many teachers lack adequate training and support in how to use digital tools to improve their teaching. The lack of understanding and application ability of new technology not only affects the teaching quality of teachers, but also makes the learning experience of students limited. Especially in rural and less developed areas, resources for training and support in digital technologies are even scarcer, further exacerbating the technology divide in education.

4.2 The change of educational idea. The digital transformation of education is not only the introduction of technology, but also the profound change of educational concept. The traditional teaching mode is teacher-centered, emphasizing knowledge transfer and classroom control, while the digital education emphasizes student-centered, interactive, personalized and autonomous learning [11]. This shift requires both teachers and students to adapt to new ways of thinking and working.

For many teachers, the transition to digital instruction can be a huge challenge. On the one hand, teachers may lack enough time and resources to redesign the curriculum and adapt to the new teaching mode; On the other hand, some teachers have reservations about the benefits of digital education, believing that traditional teaching methods are still the most effective way. Therefore, the transformation of teachers' educational concepts and technical literacy is a major problem in the digital transformation of education.

For students, digital education requires them to have higher self-management ability and learning motivation. In the traditional education model, students usually rely on teachers' guidance and classroom management, while in the digital learning environment, students need to rely more on their own learning ability and time management ability. However, not all students will be able to adapt to this transition, especially those who lack self-discipline or learning resources and may face reduced learning efficiency.

4.3 Privacy and data security issues. With the popularity of online education, the storage and management of students' personal data and learning records has become a growing problem. Digital educational tools and platforms collect a large amount of personal information, including students' learning progress, grades, interests, etc. However, the privacy and security of these data still have great hidden dangers [12]. In recent years, data leaks and privacy violations have frequently been exposed in the field of education, and the abuse and leakage of students' personal data has aroused widespread concern in the society.

Some online education platforms do not invest enough in data security and even fail to comply with relevant privacy protection regulations, leaving students' sensitive information at risk. In addition, while the use of data analytics can help educators tailor learning programs to students, it can also create a tendency to over-rely on data, ignoring the uniqueness and complexity of

individual students, thus affecting the quality of education. How to ensure data security and privacy protection while promoting the digitization of education has become an important issue to be solved urgently.

4.4 Educational equity problem. Internet technology offers new possibilities for universal and equitable education, especially in remote and poor areas, where digital education can provide learning opportunities for students who otherwise would not have access to quality educational resources. However, access to technology does not happen overnight, and there is still an imbalance in access to technology globally, which makes digital transformation likely to exacerbate inequities in education.

In some developed regions, Internet access and digital devices are almost ubiquitous, and students can enjoy high-quality online educational resources. However, in some developing countries or less developed regions, students do not have access to equal learning opportunities due to poor infrastructure, inadequate equipment and unstable networks. In addition, students from low-income families may not be able to buy the required digital equipment or pay for related online education due to family economic pressure, which inadvertently aggravates the unequal distribution of educational resources.

On the other hand, over-reliance on digital education may also overlook the role of non-digital educational resources, such as face-to-face teacher-student interaction and the development of social skills. Digital transformation may lead to the exclusion of some students who may not otherwise adapt or be able to adapt to online learning, creating new issues of equity in education. Therefore, how to balance the advantages of technology and the fairness of education is an important issue that must be considered in the process of education digitization.

Although Internet technology has brought unprecedented opportunities for the digital transformation of education, the technical, conceptual, privacy and equity challenges faced in the implementation process cannot be ignored. In order to improve the quality of education comprehensively, we must actively solve these problems, and carry out effective adjustment and optimization in the level of policy, technology and educational practice. Only through a comprehensive approach can we ensure that digital transformation truly promotes equity and innovation in education while improving the quality of education.

5. Case Studies

With the rapid development of Internet technology, many countries and regions in the world are actively exploring and implementing digital transformation in their education systems. In this process, some countries have achieved remarkable results in improving the quality of education, expanding educational resources and improving teaching results by introducing Internet technology. The following will explore how Internet technology can play a role in education reform through two specific cases.

5.1 Wisdom classroom in Korea. South Korea is one of the typical success stories of Internet technology application in the field of education. The South Korean government launched the "Smart Education" program in 2013 with the aim of reforming the traditional education system through information technology. By building digital campuses across the country, promoting smart whiteboards, interactive e-textbooks and one-to-one equipment, the program has greatly improved the interactivity of classroom teaching and students' sense of participation. Especially in preparation for the college entrance exam, "wisdom classroom" has become the norm in Korea. Smart classrooms not only enhance the interaction of teaching, but also help students learn according to their personal learning progress through data analysis and personalized learning platforms, promoting the overall improvement of students' abilities.

In the process, South Korea has also provided learning resources that are synchronized with the classroom through online education platforms. Through the platform, students can carry out extra-curricular extended learning, and teachers can track students' learning progress in real time and provide timely feedback to students. This way of integrating online and offline education, while

improving the quality of education, also makes education resources more evenly distributed to urban and rural areas and remote areas.

5.2 China's online education platform. China has also made remarkable progress in the process of digital transformation, especially in the application of online education platforms. Platforms such as "Good Future" and "Xueersi Online School" break the geographical restrictions and provide rich educational resources through innovative Internet education methods. These platforms not only provide students with online courses and tutoring, but also enable personalized learning with the support of big data and artificial intelligence.

For example, "Good Future" uses AI technology to customize learning plans for each student, monitor students' learning process, and adjust course content and progress based on students' learning feedback, improving the quality of education, as shown in Fig. 4. Thanks to these online platforms, students can learn flexibly according to their own time and interests, while enjoying a similar teaching effect to a traditional classroom. In addition, during the epidemic period, online education platforms played a crucial role in ensuring the continuity of education. Especially in the early stage of the epidemic, many students in remote areas had access to high-quality educational resources through the Internet, narrowing the education gap between urban and rural areas [13].

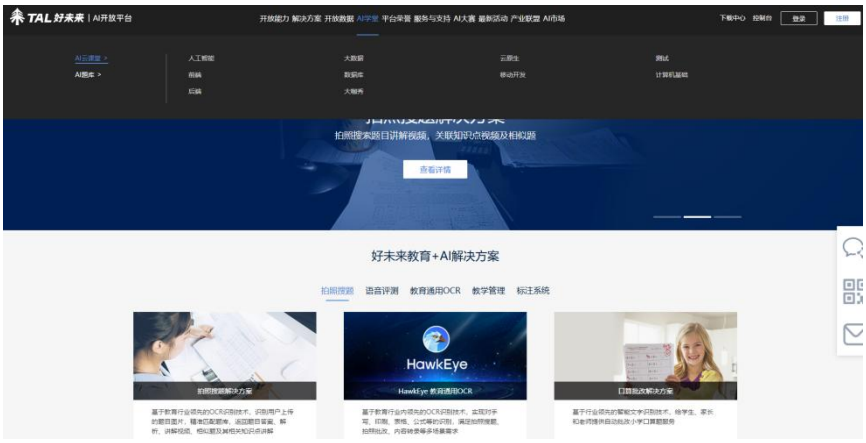

Figure 4. Good future online education platform

The combination of Internet technology and education reform not only improves the quality of education, but also promotes the development of educational equity. Successful cases show that digital education can effectively improve teaching interaction, personalized learning, and break geographical restrictions to provide more educational resources.

6. Summary and Directions

6.1 Summary. The application of Internet technology in education reform has a significant positive role, and has achieved initial results in improving the quality of education. First of all, the popularization of information technology makes the access to educational resources no longer limited by geographical location and time. Distance education and online learning platforms enable more students to enjoy high-quality educational resources, especially students in remote areas and developing countries, to receive high-quality courses on a global scale through the Internet platform. Secondly, the combination of big data and artificial intelligence provides more accurate analysis and decision-making basis for education. Through the data analysis of students' learning behaviors, progress and habits, educators can better grasp students' learning status, conduct targeted counseling and support, and thus improve the education effect.

On the other hand, the introduction of virtual reality and gamified learning makes students more engaged in the learning process, and the fun and interaction of learning has been greatly enhanced. Especially in complex and abstract subjects, virtual reality can provide students with practical operational experience and help them better understand and master theoretical knowledge.

However, the application of Internet technology in education also faces some challenges. The digital divide still exists, especially in low-resource areas, where the gap between students and teachers in terms of equipment, networks and technical support remains wide. In addition, how to avoid the fragmentation of educational content and how to ensure the security and privacy of students when using online learning platforms are also urgent problems to be solved in the future digital transformation of education.

Overall, Internet technology has greatly promoted education reform and improved the quality of education, and its personalization, flexibility and accessibility have brought new opportunities to the education field. With the continuous maturity and popularization of technology, the quality and fairness of education will be further improved in the future.

6.2 Directions Although this paper explores the main impact of Internet technology on education reform and education quality improvement, there are still some key areas that deserve further research and exploration.

First, the relationship between educational technology and students' psychological development is an understudied area. Although technology can provide students with a personalized learning experience, whether long-term reliance on Internet technology, especially online learning platforms, will affect students' mental health, social skills and emotional development remains to be explored. How to ensure the balance between mental health and interpersonal relationship while promoting students' academic performance is an important direction of future research.

Secondly, the integration of technology and the transformation of teachers' roles deserve attention. With the continuous introduction of AI, VR and other technologies, the role of teachers will no longer be the traditional knowledge imparted, but become the guide, helper and motivator of the learning process. However, how teachers adapt to this change, how to maintain high standards of educational quality in the new teaching mode, and how to improve their digital literacy, these issues still need further research.

Third, the issue of educational equity is still a major challenge in the application of Internet technology. Despite the convenience of digital technology for distance education, students in many regions still do not have equal access to online education resources due to differences in equipment, networks and other aspects. Future research can further focus on how to narrow the digital divide between different regions and different social groups, and how to improve equity in education globally through policy and technological innovation.

Finally, education data privacy and security issues also need to be further studied. With the digitalization and large-scale storage of educational data, how to protect students' personal privacy and prevent data leakage and abuse has become an important topic in the application of educational technology. It is of great practical significance to study how to use data analysis to improve education quality while protecting data privacy.

To sum up, future educational research should focus on exploring the impact of Internet technology from multiple dimensions, exploring the potential and limitations of technology application, and providing more useful reference and guidance for educators, policy makers and technology developers.

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AI 's Personalized Learning in Education : Exploration and Challenges

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Abstract. With the continuous advancement of artificial intelligence (AI) technology, the field of education is undergoing profound transformations. In the realm of personalized learning, AI utilizes advanced data analysis and adaptive technologies to customize learning plans for individual students, enhancing both efficiency and effectiveness. This paper examines the role of AI in personalized learning, focusing on its technical foundations, real-world applications, and the obstacles it encounters. First, we define the core concept of personalized learning and analyze how AI provides customized learning experiences for students through intelligent tutoring systems, predictive analytics, and data analysis. The paper further delves into the advantages of AI-driven personalized learning, including increased learning efficiency, greater student engagement, and enhanced support for students with learning difficulties. At the same time, it highlights some challenges AI faces in education, including issues of data privacy, algorithmic bias, and insufficient technological infrastructure. Lastly, this paper envisions the future of AI in personalized learning, highlighting the crucial role of collaboration among educators, technology developers, and policymakers in promoting its sustainable growth.

Keywords: Artificial Intelligence (AI); Personalized Learning; Adaptive Learning Systems; Machine Learning; Educational Technology; Data Privacy

1. Introduction

Amid the rapid development of information technology, artificial intelligence (AI) is progressively transforming the education sector, particularly in the realm of personalized learning[1]. Personalized learning adapts educational materials, pacing, and strategies to suit each student's unique interests, learning preferences, abilities, and needs, aiming to unlock their full learning potential [2]. With advancements in AI technologies, especially intelligent tutoring systems, adaptive learning platforms, and big data analytics, the realization of personalized learning has become increasingly feasible [3].

Traditional educational models often struggle to fully accommodate students' diverse individual needs, leading many to encounter difficulties in their learning journey or lose motivation due to a lack of engagement. The incorporation of AI into personalized learning empowers educators to design individualized learning plans for students, refine teaching methods, and enhance both the efficiency and quality of learning. By tracking students' progress in real time and utilizing intelligent feedback mechanisms, AI can dynamically adjust instructional content and strategies, ensuring that students remain on an appropriate learning path, thereby fostering their continuous growth [4].

Despite the significant potential of AI in personalized learning, its application faces numerous challenges. The protection of data privacy and security is a crucial challenge, especially in light of the large-scale collection and processing of student information. Furthermore, concerns about the fairness and transparency of AI algorithms have sparked extensive ethical discussions. Additionally, the widespread adoption of AI in education depends on robust technological infrastructure and the professional skillset of educators [5].

This paper explores the application of AI in personalized learning, analyzing the opportunities and challenges it presents, and envisions potential future development directions. This necessitates joint efforts from educators, technology developers, and policymakers to promote the responsible advancement of AI technology in education.

2. The Theoretical Foundation of AI in Personalized Learning

Personalized learning refers to an educational model that flexibly adjusts teaching content, methods, and approaches based on each student's learning progress, interests, ability levels, and other individual characteristics. In contrast to the conventional "one-size-fits-all" teaching model, personalized learning focuses on a "student-centered" approach, prioritizing the individual differences of students in the design of instruction. It aims to provide tailored learning experiences for every student, helping them reach their full potential. By customizing learning plans based on specific needs and feedback, personalized learning efficiently addresses the unique educational requirements of each student.

Personalized learning not only focuses on knowledge acquisition but also emphasizes students' cognitive, emotional, and social development. It enables students to progress at their own speed and based on their interests, allowing them to actively participate in the learning process while gaining a deeper understanding of the material. A critical aspect of personalized learning is its data-driven approach, which tracks students' learning progress, changing interests, and emotional reactions in real time to adjust learning materials and teaching approaches as needed. For instance, if a student struggles with a particular concept, the system can provide additional exercises or alternative resources to help reinforce foundational understanding. After students have grasped the fundamentals, the system can present more advanced tasks to promote deeper learning [6].

Furthermore, personalized learning highlights the importance of students' self-directed learning abilities. In this approach, students shift from being passive recipients of knowledge to active contributors in the learning journey. Through flexible learning choices, personalized learning encourages students to engage in self-directed learning based on their interests and objectives, nurturing independent thinking and problem-solving abilities. This approach not only enhances students' learning motivation but also promotes self-management skills, preparing them to adapt more effectively to changes in their future studies and careers[7].

In summary, personalized learning not only improves learning efficiency but also boosts student motivation and engagement while cultivating their self-directed learning capabilities. It enables holistic development in knowledge, skills, and competencies. As technology continues to advance, personalized learning will increasingly provide genuinely customized learning experiences for every student, driving greater inclusivity and efficiency in education.

2.2 How AI Supports Personalized Learning. Through big data analysis and intelligent algorithms, AI can track students' learning progress in real-time, predict their future performance, and adjust learning content and teaching methods based on data feedback. This ability allows educators to gain a clearer insight into students' learning progress and adjust teaching methods accordingly, and ensure students continue progressing on the learning paths most suitable for them. The following are the main ways in which AI supports personalized learning:

Data Analytics and Recommendation Systems. Data analytics and recommendation systems are among the core functionalities of AI in personalized learning. By deeply analyzing students’ learning behaviors, performance, and interaction data, AI can predict their learning needs and provide personalized learning suggestions. For instance, AI can automatically identify students' strengths and weaknesses based on information such as assignment grades, quiz results, and classroom participation. It then recommends suitable learning materials, practice questions, or supplementary activities. These recommendations not only consider the student’s current learning status but also leverage historical data and learning patterns to predict future learning needs, proactively offering relevant learning resources.

Moreover, recommendation systems can continuously update and optimize their recommendations to ensure that students' learning progress and needs are consistently met. The framework for AI-enabled personalized learning is illustrated in Fig. 1.

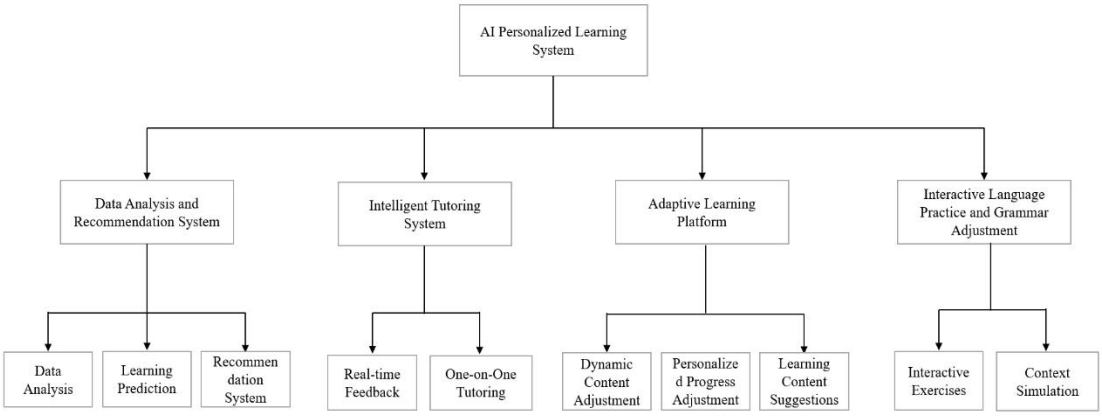

Figure 1 Framework of the AI Personalized Learning System

Intelligent Tutoring Systems (ITS). Intelligent tutoring systems (ITS) leverage AI technology to simulate the effects of one-on-one tutoring, helping students achieve better results on personalized learning paths. These systems can automatically adjust the difficulty of instructional content based on students' learning progress, comprehension levels, and feedback. For instance, if a student encounters difficulties with a particular concept, the ITS will automatically reduce the complexity and provide additional explanations or exercises to help reinforce foundational knowledge. When the student has grasped the fundamental concepts, the system raises the difficulty level by providing more complex problems or content to promote a deeper level of understanding.

It not only offers real-time feedback but also adjusts teaching methods according to students' performance, allowing them to learn effectively at a pace that fits their individual needs [8].

Adaptive Learning Platforms. Adaptive learning platforms are another significant application of AI technology in education. These platforms dynamically adjust learning content based on students' real-time performance, ensuring that every student progresses along their most suitable learning path. By leveraging intelligent algorithms, these platforms assess students' learning progress and adapt instructional content and pacing according to their abilities, interests, and comprehension levels.

For instance, a student might quickly master a specific topic while requiring more time and support for another. Adaptive learning platforms respond to such differences by adjusting content in real time, preventing students from feeling bored with easily understood material or overwhelmed by challenging concepts. This guarantees that students encounter the right level of challenges and assistance at each stage of their learning process.

Engaging Language Practice and Grammar Complexity Adjustment. In the field of language learning, AI can assist students in personalized grammar and vocabulary practice while providing an interactive language learning experience. Using Natural Language Processing (NLP) technology, AI can assess students' language proficiency and grammar usage, automatically modifying the difficulty level and type of exercises. For example, AI can provide customized practice tasks based on students' performance in vocabulary, grammar, or pronunciation, helping them correct errors and reinforce knowledge in a timely manner.

In an interactive learning environment, AI can also simulate real-life language conversation scenarios, helping students apply the language they have learned in context, thus improving their language proficiency and confidence. Moreover, AI can offer instant feedback based on students' performance, encouraging them to continuously challenge themselves to achieve higher levels of language mastery.

Through these methods, AI not only provides strong support for personalized learning but also adjusts instructional content and methods in real time according to students' specific needs, By allowing each student to progress consistently according to their own pace and skill level, these technologies significantly improve learning efficiency while also increasing student engagement and motivation.

3. Technologies Related to AI-Powered Personalized Learning

In personalized education, generative AI, Natural Language Processing (NLP), and computer vision are three essential technologies, each contributing significantly to various learning scenarios. Their technological framework is illustrated in Fig. 2. Generative AI helps create personalized content and feedback, NLP enhances the level of personalization in language learning and writing guidance, while computer vision provides richer support for education through emotion analysis, behavior monitoring, and image analysis. The integration of these technologies can offer students more precise, timely, and effective learning experiences, driving the process of intelligent and personalized education forward [11].

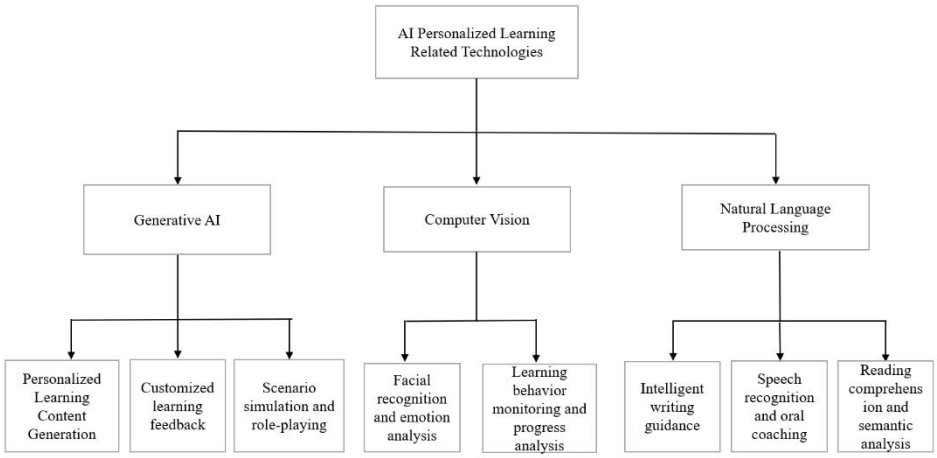

Figure 2 Technical Framework of the AI Personalized Learning System

3.1 Generative AI. Generative AI is an artificial intelligence technology that can generate new content based on existing data. In personalized education, generative AI provides a richer and more personalized learning experience by simulating and generating content such as text, images, and audio.

Personalized Learning Content Generation. Personalized Learning Material Creation: Generative AI can automatically create customized learning content tailored to students' specific learning needs and interests. For example, AI can create customized practice questions, reading materials, experimental guides, and more, based on students' current learning progress and knowledge mastery, helping them continue learning within their areas of interest and ability.

Customized Learning Feedback. In writing tutoring, generative AI can provide personalized writing suggestions for students, including real-time feedback on content structure, language style, grammar errors, and more. AI not only identifies mistakes but also generates improvement recommendations to help students enhance their writing skills.

Scenario Simulation and Role-Playing. Generative AI can also be used to create virtual scenarios and simulate dialogues, providing an immersive learning experience. For instance, in language learning, students can engage in conversations with AI characters. Generative AI can replicate various social situations, aiding students in improving their language communication abilities.

3.2 Natural Language Processing (NLP). Natural Language Processing (NLP), a key AI field, focuses on the interaction between computers and human language. In personalized education, NLP helps by providing intelligent support and feedback, assisting students' progress in language learning, writing, and reading comprehension.

Intelligent Writing Guidance. NLP technology can assess students' writing, automatically detecting issues like grammar, spelling, and vocabulary usage, while offering specific suggestions for improvement.

For example, AI can help students improve sentence structure, choose more accurate vocabulary, or offer smoother expressions, thereby enhancing their writing skills.

Speech Recognition and Speaking Tutoring. By combining NLP with speech recognition

technology, AI can provide real-time assessments of students' spoken expressions. For example, AI can identify errors in pronunciation, intonation, grammar, and provide instant feedback. Additionally, AI can simulate conversation environments, helping students improve their speaking skills. This is especially valuable in second language learning, where NLP plays a significant role in enhancing pronunciation and language fluency.

Reading Comprehension and Semantic Analysis. NLP technology can assist students in the reading comprehension process by performing semantic analysis, automatically generating questions and answers, and assessing students' understanding of the text. AI can provide personalized reading materials for students and even adjust the complexity of articles based on their comprehension abilities, ensuring that students continue to progress within an appropriate level.

3.3 Computer Vision. Computer Vision (CV) is an important branch of AI technology, aimed at enabling computers to "understand" and "analyze" visual data such as images and videos. In personalized education, computer vision technology offers feedback and assistance through techniques like image analysis, facial recognition, and gesture detection.

Facial Recognition and Emotion Analysis. Facial recognition technology can analyze students' facial expressions to determine their emotional states (such as happiness, frustration, focus, etc.). This technology helps AI adjust learning content and interaction methods in real time, especially for students with fluctuating motivation and emotions. Emotion analysis technology can optimize learning paths based on students' emotional responses, reduce anxiety, and enhance learning motivation.

Learning Behavior Monitoring and Progress Analysis. Computer vision can monitor students' learning behaviors in real time through cameras, such as their level of focus during the learning process or how often they refer to hints. AI can analyze this data and adjust the learning pace and content accordingly. For example, if a student spends too much time on a particular question, the system can automatically offer assistance to ensure the student stays on track.

4. Advantages of AI in Personalized Learning

4.1 Improving Learning Efficiency. A key benefit of AI in personalized learning is its potential to greatly enhance learning efficiency. Traditional teaching methods often rely on a standardized teaching pace and content, neglecting the differences among students. In contrast, AI can analyze students' learning progress and performance in real time, allowing for the customization of learning content for each student, ensuring they progress at a pace that suits them. This approach helps students avoid feelings of frustration or boredom caused by learning too quickly or too slowly, thereby improving learning efficiency[10].

For instance, intelligent tutoring systems can provide immediate help to students when they face challenges, avoiding the learning stagnation that can occur in traditional classrooms where teachers may not be able to address each student's individual needs. Additionally, adaptive learning platforms can automatically adjust content based on students' actual conditions, ensuring that students are always facing the right level of challenge, rather than tasks that are either too easy or too complex.

4.2 Increasing Student Engagement. AI can boost student engagement by offering personalized learning content and interactive experiences. Traditional teaching methods often rely on a single approach, which can be especially challenging for students with lower interest in learning to maintain engagement. In contrast, AI can better stimulate students' interest and initiative by dynamically adjusting learning content, providing personalized feedback, and using motivational mechanisms.

For example, AI-driven learning platforms like Duolingo use gamification elements to motivate students to continually challenge themselves, enhancing learning motivation through rewards and achievement systems. Through ongoing interaction, students receive feedback and a sense of achievement, enhancing their involvement in the learning process.

4.3 Providing Targeted Support for Struggling Students. AI can help identify students with

learning difficulties and provide timely, personalized support. In traditional classrooms, due to the limited attention of teachers, many struggling students often do not receive the necessary intervention. AI technology, through data analysis and learning tracking, can quickly identify students who may be struggling in specific areas and provide targeted tutoring.

For example, AI can automatically offer additional learning materials or practice questions based on a student's performance on a particular topic, helping them reinforce their knowledge and reduce learning gaps. This real-time intervention not only prevents students' learning issues from worsening but also boosts their confidence and motivation.

4.4 Scalability and Accessibility. AI can break through the limitations of traditional education models and provide large-scale, widespread personalized education. Especially in resource-scarce areas, AI technology can help deliver high-quality personalized learning, addressing the issue of inadequate educational resources. Through cloud computing and online platforms, students, regardless of their location, can access quality learning resources via AI.

For example, in some developing countries, AI technology has been applied to online education platforms, providing equal learning opportunities for students who would otherwise have limited access to high-quality educational resources. Adaptive learning platforms and intelligent tutoring systems can provide tailored learning content for these students, ensuring they get personalized educational assistance.

5. Challenges of AI in Personalized Learning

5.1 Data Privacy and Security. The application of AI technology in personalized learning relies on a large amount of student data, including information about students' learning behaviors, grades, interests, and more. The gathering, storage, and utilization of this data present major concerns regarding privacy and data security. Safeguarding student information and preventing data breaches or misuse are vital issues in applying AI to education[12].

To tackle these concerns, educational institutions must ensure their AI systems adhere to privacy protection regulations like GDPR (General Data Protection Regulation). Furthermore, AI developers should implement encryption and data de-identification techniques to safeguard students' personal privacy.

5.2 Algorithmic Bias. AI systems rely on large amounts of historical data, which may contain implicit biases. For example, an AI system may recommend learning content based on historical exam scores, but if the data contains biases related to gender, race, or other factors, the AI system may amplify these biases, which in turn impacts the fairness and overall learning experience for students.

Therefore, developers need to focus on ensuring the fairness of algorithms and avoid algorithmic bias. On one hand, diverse datasets can be used to train AI systems, ensuring that they do not favor any specific group. On the other hand, making the AI decision-making process transparent can ensure that it can withstand scrutiny and verification.

5.3 Resistance from Teachers and Students. Despite the significant advantages of AI technology in personalized learning, many teachers and students may resist this new technology in practice. Teachers may be concerned that AI will replace their teaching roles, while students may feel unfamiliar or uncomfortable with AI systems that differ from traditional classroom teaching methods.

To address these issues, schools and educational institutions need to provide comprehensive training for teachers, enabling them to fully understand and utilize AI technology, thus better integrating AI systems into the classroom. At the same time, schools should encourage students to gradually adapt to AI tutoring systems, helping them understand the value of AI and reducing their resistance.

5.4 Technical Infrastructure. For AI to be effectively implemented in education, a robust technical infrastructure is needed, including fast internet, cloud computing platforms, and sufficient data storage and processing capabilities. However, in some regions or schools, there may be weak infrastructure and a lack of technological resources, which limits the widespread adoption and

application of AI technology.

Therefore, to ensure that AI can be widely applied in education, educational institutions need to increase investment in technical infrastructure and gradually promote the adoption of educational technologies, especially in underdeveloped areas, to help bridge the gap in technological resources.

5.5 Fairness and Accessibility. AI technology has the potential to provide personalized learning experiences, but its application must ensure fairness and accessibility for all students. In some cases, there may be disparities in access to AI-powered learning tools due to factors such as socioeconomic status, geographic location, or technological resources.

To overcome these challenges, it is essential to design AI systems that are inclusive and fair. Educational institutions should focus on providing equal access to AI-powered learning platforms, regardless of students' backgrounds or circumstances. Additionally, AI systems should be continuously monitored and evaluated to ensure they are not perpetuating biases or unfair treatment, ensuring that all students can benefit from personalized learning opportunities[9].

6. Conclusion and Outlook

6.1 Integration of AI and Traditional Education. The rapid advancement of artificial intelligence (AI) technology is transforming education through personalized learning. By leveraging cutting-edge technologies like generative AI, natural language processing (NLP), and computer vision, AI can deliver customized learning experiences to students, significantly enhancing learning efficiency and student engagement, while offering timely support for struggling students and promoting educational fairness and inclusivity.

However, the application of AI in personalized learning also faces numerous challenges, including data privacy and security, algorithmic bias, insufficient technological infrastructure, and reluctance from both teachers and students toward adopting new technologies. These issues require the joint efforts of educators, technology developers, policymakers, and society to resolve. Particularly, against the backdrop of the uneven distribution of global educational resources, ensuring equal promotion of AI technology across different regions and social groups is a critical focus.

6.2 Outlook. In the future, as AI technology continues to mature, personalized education will deeply integrate with traditional education, creating a new student-centered education model. AI will no longer be limited to simple learning path recommendations, but will dynamically adapt to students' personalized needs, providing them with real-time adjusted learning plans and accurately predicting learning difficulties and requirements. Both inside and outside the classroom, AI will seamlessly collaborate with teachers to provide strong support for the students' learning process. Teachers will use the intelligent analysis and feedback provided by AI to optimize teaching strategies, achieving truly tailored instruction.

AI-powered personalized learning systems will enhance learning assessments and feedback speed. By analyzing student performance in real-time and offering multidimensional feedback based on big data and deep learning models, AI will help students identify weaknesses and receive targeted support, accelerating their progress.

The future development of AI technology requires close collaboration between educators and technology developers. Educators offer practical insights to ensure AI meets real educational needs, while developers optimize the system for better functionality. This collaboration will enhance the flexibility and efficiency of personalized education, providing intelligent, inclusive solutions to meet society’s diverse needs and achieve educational equality and quality growth.

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Engagement between Humans and Computers in Mobile Education

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Abstract. The role of Human-Computer Interaction (HCI) in enhancing the performance and user experience of mobile learning platforms is unarguably significant. Given the increasing use of smartphones and tablets in the classroom, it is a big challenge to design interfaces that are easy to use and engaging. This paper explores the application of HCI principles such as usability, user-centered design, and flexibility to meet the needs of various learners. Cognitive load, accessibility, and personalization are some of the factors considered to identify ways to improve learning outcomes. The paper also looks at some of the technologies that have the potential to transform mobile learning in the future and they include; augmented reality, artificial intelligence, and adaptive learning systems. It is also important to collaborate between developers, designers, and educators in developing effective mobile learning environments. As such, discussing HCI design problems, this paper analyzes Udemy, a mobile learning platform, to discover the challenges for the current and future design. The findings show how mobile learning based on HCI principles can break through barriers and create a more inclusive and engaging learning experience.

Keywords: Human-Computer Interaction;Mobile Education ; Artificial Intelligence

1.Introduction

Education is the primary emphasis of the quickly evolving discipline of mobile learning. Numerous projects demonstrate how mobile learning overcomes several constraints. that affect the education system, Making learning more accessible [1]. This has resulted in a dedicated group of experts skilled in designing and delivering mobile learning experiences. Learning through mobile devices, a subset of e-learning depends on the device's specific capabilities, computer, bandwidth, and network characteristics [2]. E-learning uses digital electronic tools and media to support the learning process. Mobile learning, on the other hand, refers to the same concept. Instead, it focuses primarily on mobile devices and wireless connectivity [3]. Mobile learning describes the use of mobile devices to facilitate education. Mobile learning is also recommended for use in any education system, with mobile devices as the main technology in recent years [4]. There has been extensive research on mobile learning. This contributes to understanding the effective use of mobile technology in education. However, some studies lack an educational focus and fail to clarify the research design. According to the researchers, Some findings have been published concerning the educational level of the participants [5]. Mobile learning interactions are guided by pedagogical needs and technological capabilities to meet user needs. There is a consensus that mobile learning depends on technology that supports the learning process. As can be seen from many research studies, mobile learning centers involve travel and high-quality education [6], [7], [8]. Accessible anywhere, anytime. The field of human-computer interaction (HCI) focuses on exploring all aspects of human-technology interaction. Including design processes, software, and technological tools. The primary purpose of Mobile HCI is to provide mobile users with access to information when interacting with technology who use a variety of motivations and strategies Historically [9]. HCI has prioritized the human element. This is to ensure that the technology will effectively meet users' needs. This principle is considered consistent with the goals of today's smart technology landscape. As a result, HCI has grown significantly. Expand the research center and have achieved significant progress. However, the adoption of emerging technologies continues to increase and requires greater sophistication. Moreover, the relationship between humans and technology is changing.

People are more aware and concerned. but also more critical and assertive [11]. Implementing HCI in education faces many challenges. This is especially true of students preparing for lessons. Communicate during class and recognize these interactions. These challenges encourage educators to explore new approaches. To engage with target groups in educational environments the resulting problem is considered an interactive challenge rather than a representative one [12]. Furthermore, mobile context can be understood as information relevant to user interactions with applications, apps, and environments. Surrounding... This is despite calls to develop learning environments that enable students to engage with real-world users. Educators have also noted several barriers that prevent such interactions [13]. Building relationships between students and potential users takes much time and effort. Research in [14]. reveals that the most prominent feature of mobile HCI is user mobility. In research, a distinction has been made between highly mobile interactions. Moderately mobile and stable interaction [14]. Mobile HCI researchers argue that the user's movement significantly affects the physical environment of the interaction. They identified mobility as a key challenge, adding that remote access to information and interaction with mobile devices can promote social relationships and communication. In terms of interactive activities. The findings are not mutually exclusive. This is because both aspects are related [15]. Therefore, by interacting with technology, users can achieve their goals. Students demonstrate different abilities and speeds of development when engaging in design thinking. Many people struggle with analyzing results and generating new ideas [16]. This article reviews the role of mobile HCI in education. This study explores the challenges and importance of HCI in educational environments. It focuses on current platforms and tools for developing mobile learning using HCI frameworks. Future developments in mobile learning to address HCI challenges on HCI are also discussed. mobile, which can be improved for better efficiency and effectiveness. This paper is organized as follows: Section II discusses the importance of mobile HCI in education. Section III outlines the HCI design for mobile learning tools. While Section IV covers current mobile learning platforms or tools. Part V explores the future of mobile learning. And this article will conclude in part VI.

2.Mobile HCI's Importance in Education

HCI covers principles and techniques that help humans engage with computers. It covers computer systems' design, implementation, and evaluation [17]. The main focus of HCI is to ensure the usability of software applications. Users can easily access technology and provide a good interface. One of the most important factors affecting technology adoption is usability. When people accept a new system, they strive to use it effectively. The use of mobile devices promotes informal learning. The students can switch between different tasks according to their situation [18]. Another advantage of mobile HCI is that it makes outdoor learning more engaging and fulfilling. Research indicates that outdoor education increases learners' knowledge and practical skills. Planning, organizing, and implementing activities appropriately [19]. Mobile HCI integration can enhance students' learning experiences by providing contextual learning opportunities [20]. Mobile HCI aims to provide information. Related to students. Improve the learning environment and optimize their locations. Smartphones are increasingly seen as a tool for accessing information and services [21]. Smartphones are also essential for accessing information and promoting interpersonal interactions related to various activities. Educators encourage students to use search engines and other applications. For news updates, language learning, and social media to communicate with others. Mobile devices are especially useful for learners who need to access documents. Conduct research and surveys, summarize content, read, photograph, and share information. Various studies Have shown that mobile website usage is affected by factors such as lighting and the presence of others. Movement and Environmental Sound [23]. Janders said their experiment generated exciting discussions and reflections among the 64 participants. In addition to contextual information, Video production also offers a new way for students to develop creative communication ideas by effectively presenting knowledge and skills. Some researchers have found that students involved in collaborative video production demonstrate increased media literacy and better digital skills [24]. Additionally, creating video presentations fosters a collaborative environment. Fair competition for

various materials, such as paper and software prototypes. As a result, students gain a more meaningful experience creating videos than writing reports or making presentation slides to convey information. The power and accessibility of video have increased with the availability of more smartphone cameras. This makes teachers recommend using videos for assessment. But even the most reliable human memory is prone to inaccuracies [25]. The role of mobile HCI in education highlights the discrepancy between how designers remember interactions and what happens in those interactions. Students who engage with mobile HCI in the learning process may remember the interactions and user-centered design process differently than those recorded in the video. Mobile HCI approaches in education provide a structured learning experience. Help students draw insights from interactive sessions.

3. The HCI Design for Mobile Educational Devices

This section summarizes the HCI design for mobile learning tools. Section III(A) discusses HCI design challenges related to human-technology interaction. Security and privacy concerns User well-being, accessibility, and creativity enhancement Identifying key focus areas and defining key areas for learning is a complex task. Section III(B) details the approaches and approaches for mobile HCI, addressing the initial design challenges. Let's start with the interface guidelines. And presents a set of practical design principles for mobile device interfaces.

3.1 Challenges in HCI Design New Obstacles for Human-Computer Interaction (HCI) Human-computer interaction experts are exploring how HCI can solve important social problems. It emphasizes the need for a multidisciplinary approach. And identified 16 key challenges related to socio-technological concerns. The result is smarter, interactive technology and higher social needs that it meets. The six main challenges of HCI design are individual and community expectations and integrating humans and technology. Interaction between humans and the environment Privacy and security health and well-being universal access and creative learning Living with technology is part of the integration process between humans and technology. It has technological features that combine language understanding, learning, and creativity. This has become necessary with the rise of smart ecosystems consisting of smart devices, services, materials, and environmental factors that work seamlessly and uncluttered. Intelligent ecosystems create complex networks of interdependent relationships with humans that extend beyond technological boundaries. An important consideration is the prioritization of human control. Over automation or focusing on addressing humanist rather than purely deterministic concerns [27]. Integrating practical factors into design strategies addresses important aspects such as human control, System Accountability and Transparency, and the uncertainty of intelligent systems. Examine how people in human-environment interactions engage with more intelligent interactive technology systems. This often involves multiple devices in smart and autonomous environments [28]. These interactions are often subtle and suggestive.

Challenges and opportunities with new interactive possibilities lead to new meanings and uses. Digital content is blended with physical structures. And data moves naturally from one object to another. These challenges guide the development of current design and evaluation methods to keep up with the ever-changing technological landscape. Especially in understanding how these increased opportunities for interaction affect humans… The core issue of privacy lies in the user's ability to control the collection and distribution of data. And how that information is used.

On the other hand, computer security involves protecting the hardware, software, and services within a computer system. To make intelligent systems beneficial to each individual, a system must be more than just functional. Empower users and protect their privacy and security. Introducing new dimensions in smart environments increases the importance of privacy, trust, and security in the digital world [30]. An important consideration is the privacy challenge in this digital era. And how do these issues play out in different contexts? Privacy needs even more protection. Due to modern technology's advanced data processing capabilities, including AI, it can collect huge amounts of user data and behavioral insights from which to conclude. Being healthy is more than just avoiding being sick. But also encompasses social, mental, and physical health. A sense of well-being

includes purpose, happiness, and a comfortable standard of living. New technological advances offer the opportunity to live a healthier life. And there are cheaper ways to help you live a longer, healthier life. Technology can also help people achieve their emotional and personal well-being goals. Which affects physical health and feelings of happiness. Despite the widespread use of healthcare technology, many research questions remain unanswered. However, the broader issue is how to use technology best to enhance well-being. Especially in solving interaction problems while remaining human-centered. With advances in equipment, services, products, and environments, Accessibility becomes a key consideration for designers. Universal access to information technology makes these technologies available to everyone. Regardless of time or place.

Increasing technological complexity in innovative environments creates new challenges in access and universal accessibility. Which has a huge impact on daily life. Although past HCI efforts have focused on human needs, there is growing momentum to expand these efforts to include the well-being of other groups, such as people with disabilities, although Long has long discussed this. But it is more important than ever due to changing demographics and increasing technological sophistication. Responsive accessibility will not meet future design complexity and scalability needs. A comprehensive HCI solution is essential to meet these growing demands. Learning involves acquiring new information—skill development, or facing new situations. The ability to generate unique concepts or develop something novel and inventive is referred to as creativity. By promoting collaboration among individuals with diverse backgrounds, skills, and interests. Creativity leads to the development of new knowledge. And solutions to complex problems. Emerging technologies offer new opportunities. To support new and distinctive learning styles as they become more integrated into everyday life. Especially for the younger generation… The appropriate role of technology in education is more relevant than ever. It addresses issues such as privacy, ethics, pedagogical considerations, etc. Human-computer interaction plays a key role in shaping educational technology. Creativity is considered an important element. In the future, as technology continues to revolutionize learning styles and educational tools, it is important to find ways to support creativity.

3.2 Guidelines and Methods

1) Mobile Human-Computer Interaction: Humans interact with computers in many ways, making appropriate interface design important. As shown in Fig. 1, as people begin to engage with computers, the field of HCI has evolved in terms of interaction quality, research centers, and multimodal interactions rather than convergence. Traditional configuration focuses on concepts such as intelligent adaptive interfaces and active interfaces. Human-computer interaction is the discipline dedicated to developing, testing, and implementing interactive human-use systems. It also examines the basic nature of such interactions [32]. This field uses knowledge of human and machine behavior. They draw from various areas, such as computer graphics. Operating systems, programming languages, and application design create new technology and pay attention to human factors such as user satisfaction.

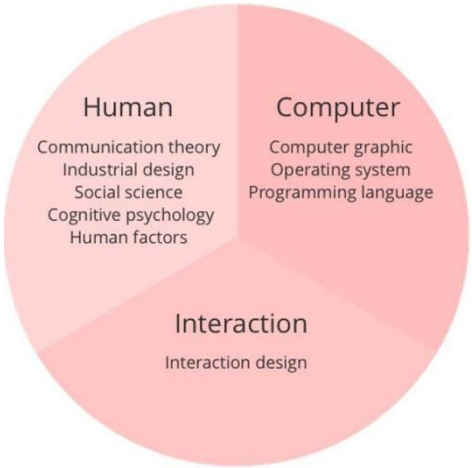


Figure 1. Overview of Human, Computer and Interaction

Human-centered fields of study, such as communication theory, graphic design, Industrial design, social science, cognitive psychology, etc., play an important role in facilitating these interactions smoothly on the multidisciplinary nature of HCI. Individuals from various fields contribute to the development of HCI. Human-machine interaction is often referred to as human-machine interaction (HMI), machine-machine interaction (MMI), or computer-human interaction (CHI) [33,34]. In the 1980s, there were many approaches to designing human-computer interactions. The basic idea of these design approaches is the interaction between the user, the designer, and the technical system. Methods in the early days It is assumed that the user's cognitive processes can be predicted and measured. It allows design professionals to apply findings from cognitive science, such as memory and reasoning. Applied to user interfaces one tool in HCI uses activity theory to analyze the physical and sociotechnical context [35]. In which interactions occur, a framework and guidelines for designing activities are provided. It helps researchers and designers structure interactions around activities [36]. Furthermore, user-centered design (UCD) is a modern and widely accepted design philosophy emphasizing the user at the center of any computer system. There are multiple roles within a project, including users, designers, and technical experts. These people work together to understand.

User needs and limitations: It facilitates user participation in developing new products and services. However, unlike participatory design, which emphasizes collaboration between design partners, customers, and end users, UCD focuses on users' needs [37]. There are seven key principles of user interface design: tolerance, simplicity, visibility, robustness, consistency, structure, and responsiveness [38]. These principles are central to interface design, user-friendly. Value-based design (VSD) is another approach that aims to create technology that incorporates the values of those who use it and those affected by the technology [39]. VSD involves a three-step process that includes conceptual, empirical, and technical studies. Conceptual studies focus on identifying and understanding the values of all potential users and potential value conflicts. Empirical studies collect qualitative and quantitative information about user values, behavior, and needs. Finally, technical studies involve developing systems to ensure the resulting technology is consistent with the values identified during the research process. [40]. Although the accessibility of mobile applications has not been researched as thoroughly as the accessibility of websites, it is equally important. Mobile applications are complex and need to work with various form factors and interaction formats. This makes it difficult to achieve full accessibility to compare mobile HCI guidelines to develop a more comprehensive set of recommendations for mobile design [41,42]. This includes reducing clutter. Improve navigation efficiency. Creating user-friendly touch interfaces Helps ensure the message is readable. Make all interface elements easily visible. Moreover, user attention is a valuable asset and must be managed effectively. As Babich explains, a cluttered interface makes users Difficulty find necessary information such as buttons, images, and text This results in a decrease in overall usage [43].

2) Mobile Learning: Taking a systematic approach to designing mobile learning resources and materials can greatly improve efficiency when HCI principles are applied [44]. As shown in Fig. 2, learners should be able to integrate information easily. Regardless of any uncertain situations, they also need tools that reduce risk within the user interface and protect against errors or unintended actions. The design of mobile learning applications can facilitate easy acquisition of information with little effort from the user [45,46]. The interface design must be according to specific standards to ensure the content is visually appealing. Navigation is easy to use. Animated elements and graphics enhance the learning experience. Make the process engaging and fun for all learners. Research is being conducted to identify mobile learning challenges that need attention. Interactive teaching methods are often used to ensure that learners understand the content completely [47]. Various solutions can be used depending on the problems that arise during this process [48]. The development team evaluates whether the content can be delivered via video or other forms of teaching materials and then selects the most appropriate type of learning materials [49]. And the actual design phase of the mobile learning application begins. HCI principles guide this phase to ensure the solution meets industry standards and best practices [50]. The design has been adjusted

to meet the needs of each student. This includes aspects such as layout, fonts, color scheme, and overall interface structure. When the design is complete, learning resources are evaluated from both technical and non-technical perspectives, followed by a testing phase under HCI standards and guidelines to verify that the solution works as intended.

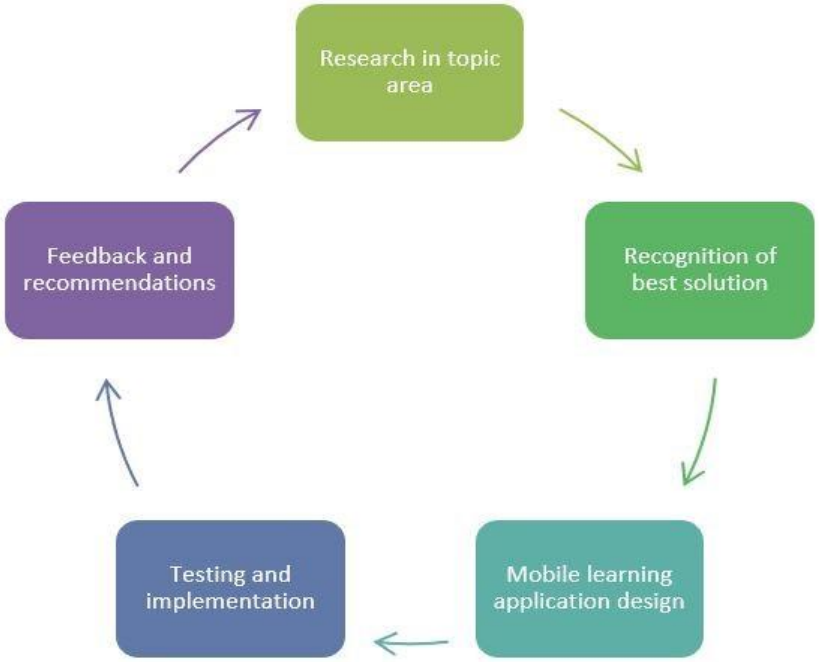


Figure 2. HCI Guideline Concepts in Mobile Learning

In a successful experiment, learning tools are provided to learning users [51]. Finally, feedback from user surveys is collected. It provides valuable insights into the product's strengths. And highlight areas that need improvement and further improve the design process.

4. Existing Mobile Learning Tools and Platforms

Existing mobile learning tools/platforms While e-learning on personal computers provides a dynamic learning experience. Integrating mobile learning on digital platforms brings additional benefits. The benefits of mobile learning include any-time, anywhere access, cost-effectiveness, and the ability to provide learning opportunities over short distances. In Section IV(a), we briefly discuss the tools or Different Types of Mobile Learning Platforms. Subsequently, Section IV (b) provides examples and evaluation designs of two specific mobile learning tools or platforms.

4.1 Types of Mobile Learning Tools / Platforms. The Internet offers countless educational opportunities. Each occasion has a specific delivery method. Mobile learning has transformed the e-learning space by making education more accessible and engaging. Most mobile learning tools are designed with one main purpose in mind: preparing for exams or learning a new language [52]. Educational institutions, organizations, and other organizations Mobile learning platforms are widely used. To enhance the learning experience and promote effective knowledge acquisition. This section explores several types of mobile learning tools. Including online course tools, memorization, and assessment preparation. and additional support… Online Course Tools: Many students today prefer online learning over traditional classrooms. Due to their greater convenience and wider availability, video is generally the cornerstone of most online courses. This is often supplemented with textual content [53]. Platforms like Udemy and Coursera offer a variety of programs suitable for professionals and academics. For example, language learning apps like Duolingo take a unique approach by combining quizzes. Typing exercises and repetition using sound Instead of relying

solely on video lectures, Duolingo also has a system for tracking progress. Remind users to revisit and practice areas where they frequently make mistakes.

Teaching skills increase. Memorization tools: Modern teaching strategies greatly influence the creation of memorization tools. These applications use visual tools to improve data retention. Flashcards are a traditional, proven mnemonic tool widely used in educational settings to help students memorize vocabulary. Flashcards in mobile learning continue to be an efficient and effective way to increase retention and retention. Assessment Preparation Tools: These apps are made to help students prepare for tests by offering a large database of assignments in different subjects, along with scheduling and evaluation features. Examples of these apps include SAT Up, ExamPrep, and GradeUp. Key features like push notifications and continuous evaluation aid in ensuring a more structured learning process, and some apps also include extra resources, like vocabulary databases that correspond to particular assessments. Make exam preparation more intense and flexible. Help tools: Additional applications That are called support tools. It helps increase the learning process [54,55]. Examples include online dictionaries such as Oxford Dictionary, resource-sharing platforms such as Scribd, and note-taking apps such as Evernote, although these tools do not directly provide educational content. But it provides valuable assistance for a wide range of academic tasks. It helps students organize and optimize their learning efforts.

4.2 Examples and Design Evaluation of Udemy's Mobile Learning. According to research, many students prefer Eudemy for its value for money. Wide selection of courses Using Udemy has become an essential part of modern online education [56]. The platform offers a wide range of categories. Including development IT & Software, Business, Design, Marketing, and more, are compared to evaluate Udemy's user experience alongside the competing Coursera platform, based on analysis, Students notice that Udemy offers a wide variety of courses, including courses that focus on hobbies. This makes them feel like they can learn something.

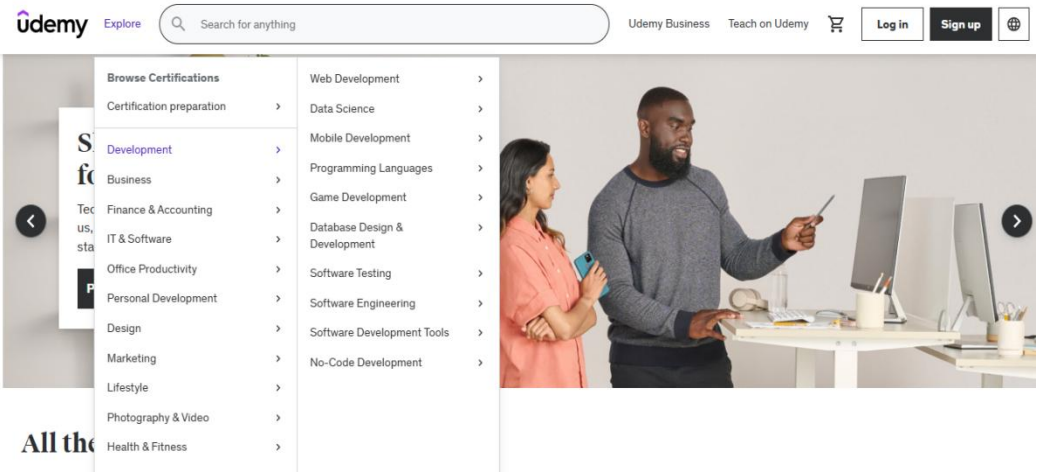


Figure 3. Categories Offered on Udemy

Figure 4. The Course Suggested based on users' Enrollment

Eudemy also offers more than 100,000 courses in 65 languages, which are easily accessible [56]. Students praise Udemy's teaching methods, emphasizing practical learning and encouraging broad understanding. Studies have shown that Eudemy is easy to use. Its landing pages are clean and straightforward. It features prominent category buttons that provide quick access to the 13 main sections of the platform. As shown in Fig. 3, the search function has been improved. The catalog linked on the home page can retrieve any course. The platform (Global Course) makes it easy to search for specific courses. Creating a Seamless Experience, the platform also displays features such as the course the user is currently viewing [57]. Newly added courses and courses that engage in popular subject areas that users have registered. As seen in Fig. 4, each course includes a detailed description. Prerequisites and review criteria and teacher history, in summary, the learning objectives, Educator's expectations, and topics are covered clearly [58]. From the category menu, Users can navigate to category pages. Specialized content is just the beginning. It allows users further to refine their searches for specific categories and popular topics.

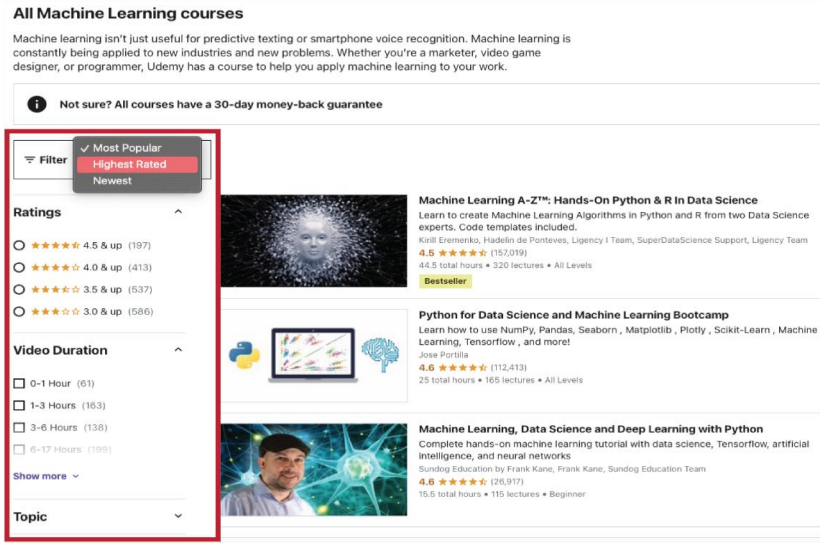


Figure 5. A Filter Feature Provided on Udemy

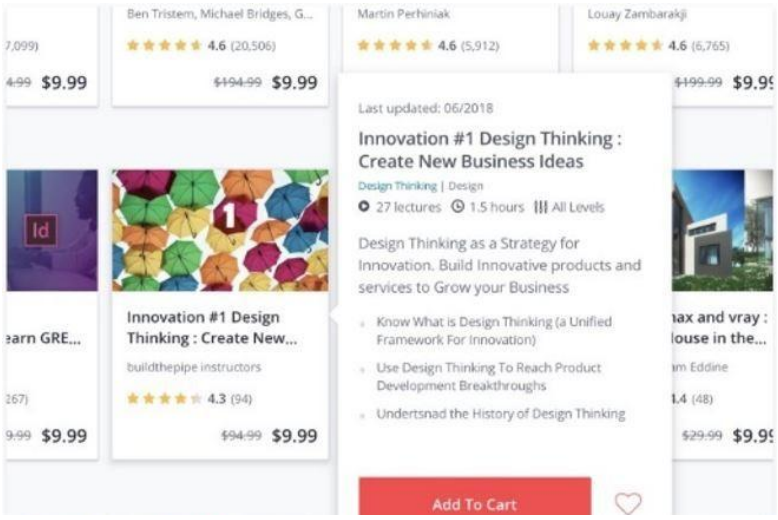


Figure 6. The Tooltip to Display Perceptible Information about the Course

Get Listings courses within the chosen class can be further filtered, as depicted in Fig. 5. This filtering characteristic offers a disguise and unhide characteristic, allowing a streamlined and user-friendly view. Additionally, the tooltip functionality proves especially fantastic on the platform. When users hover over a direction card, a tooltip seems, as shown in Fig. 6. This feature is extraordinary to computing device customers and is available on choose pages, supporting enrolled

customers preview what the route entails. Furthermore, the Add to Car and Favorite buttons beautify the widget's discoverability and usability for the platform's users. An onboarding wizard, designed to assist users in navigating the platform correctly—inclusive of mobile software—may be included, as illustrated in Fig. 7. This function should preemptively kind courses based on customers' pursuits by asking about famous subjects and categories amongst pinnacle Udemy novices.

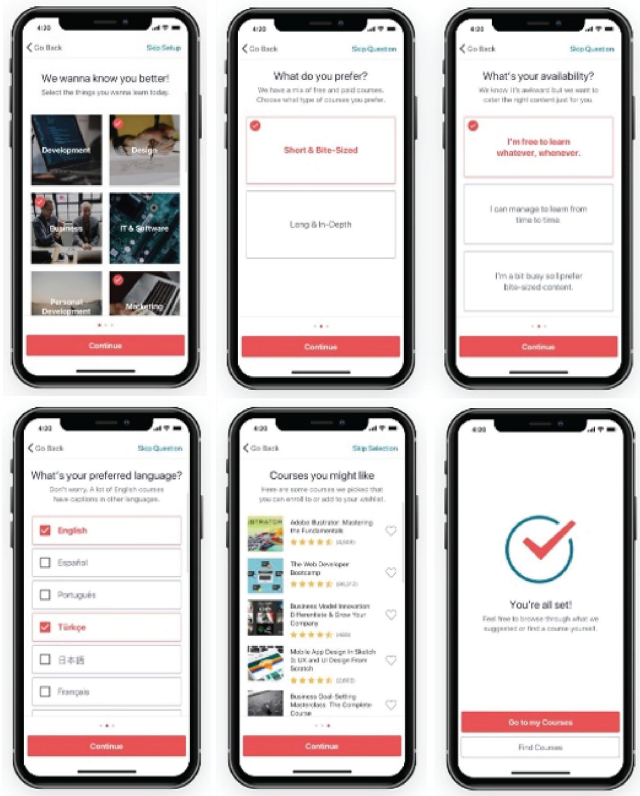
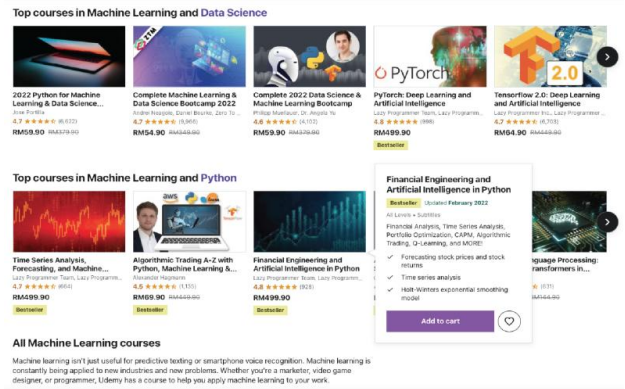


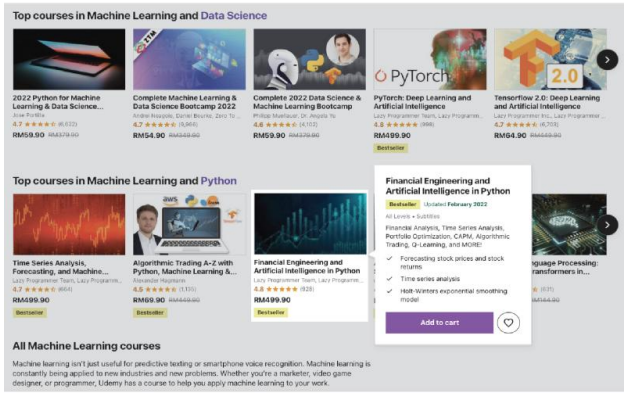
Figure 7. Onboarding Wizard on Mobile Platform

These questions can vary, ensuring personalization. If users choose not to interact with the onboarding procedure now, they can pass it without issue. Platforms with similar onboarding capabilities have verified first-rate success. The onboarding process is similar to that used by platforms like Netflix and Canva, where every design element, such as fonts, colors, and images, is precisely customized. Udemy has proven to be effective by adopting this approach, and it aims to redefine its marketing strategy. Although ads often emphasize that Udemy members can access content from anywhere, this claim may not be entirely accurate. Perhaps it is an attempt to increase user engagement by promoting mobile content consumption. Another important aspect of the user interface is to ensure that the text's subject matter is distinct. For example, a tooltip function that integrates course cards might benefit from an overlay instead of just a shadow. As shown in Fig. 8, this adjustment will help capture attention more effectively. Design must prioritize clarity to keep readers focused on important information. To achieve this goal. The background of the tooltip must be slightly darker. Add contrast and draw attention to content within the tooltip feature.

4.3 Future of Mobile Learning. This article presents the results of this comprehensive review. It is emphasized that smartphones not only facilitate the learning process. However, further investigation is also warranted to determine effective methods and activities for lifelong learning. Java-enabled mobile devices are becoming popular as many manufacturers offer these phones at affordable prices. It has a variety of features. It is recommended that students adopt Java-enabled smartphones for their future educational endeavors [59]. These devices enable students to engage in various advanced and fun learning tasks, including preparing for the exam and answering multiple-choice questions, or watching short videos in lectures.



(a) before overlay implementation



(b) after overlay implementation

Figure 8. Overlay Implementation for the Tooltip Feature

Many students also face challenges using free Wi-Fi in public places. Because this poses a significant security risk, some people may experience technical issues or limitations related to their device's user interface [60]. Other problems are also frequent, like longevity and decreased battery performance because of exterior materials. Upgrading networks and equipment to satisfy the requirements of mobile learning is essential to resolving these issues. Children must have the proper equipment from their parents to participate in mobile education. Carriers must also introduce advanced mobile plans to reduce reliance on insecure public Wi-Fi. Communication, social expectations, and reflective practice emphasize the importance of focusing on important aspects of HCI in education. Future research in HCI education can provide learners with hands-on experience and integrate reflective HCI into mainstream teaching methods. A well-designed platform that aligns with current educational principles can drive innovation. In learning technology, these platforms can also provide teachers with resources such as pre-made lecture notes and customized materials for students. This makes learning resources available for use as needed.

5. Conclusion

Design procedures, software, and tools are only a few components that make up human-computer interaction (HCI). Mobile devices make Informal learning possible by letting students participate in extra activities as needed. The disparity between how designers envision interactions and what users experience throughout them is brought to light by the use of mobile HCI in education. The importance of interdisciplinary approaches is highlighted by emerging difficulties in HCI that Centre on how it may address important social issues. Relationships between people and technology, user-computer interactions, privacy and security issues, well-being, universal accessibility, and encouraging creative learning are some significant challenges in HCI design. Additionally, this study investigated current mobile learning resources, including online courses, memory aids, assessment preparation tools, and support systems. Udemy has been chosen as a case study to evaluate the design and possible enhancements. While some students pointed out problems with the

device's functionality or user interface, others pointed out disadvantages, including the lower battery life brought on by additional peripherals. Therefore, tackling these issues will probably be necessary to make sure networks and devices are prepared for the future to facilitate mobile learning. To ensure efficacy, parents must also supply appropriate mobile learning gadgets.

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Research on Teaching Object-Oriented Technology Courses

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Abstract. As computer science and software engineering advance rapidly, particularly in the realm of intricate systems and extensive computer program schemes, traditional process-aimed programming approaches have increasingly revealed challenges, including maintenance difficulties and limited scalability. To address these issues, object-aimed technology emerged. This paper commences with an introduction to object-oriented technology, followed by an overview of the relevant course. The core focus of this paper lies in exploring enhancements to the teaching of the object-oriented technology course. By analyzing the course characteristics and the current state of teaching, it is identified that issues such as monolithic teaching methods, inadequate student engagement, and suboptimal resource allocation hinder the cultivation of students' practical programming skills and overall learning experience.In this regard, a series of innovative initiatives are proposed, including the reform of teaching methods based on project-driven and blended teaching, and finally, through the evaluation and analysis of teaching effects, it can be verified that the students' abilities in programming practice, problem solving, teamwork, etc. are substantially enhanced and the power of the instructional innovation. Upon conducting teaching research for the course, educators can, based on the ultimate analysis outcomes, devise a more refined and effective practical teaching framework, thereby establishing a solid groundwork for students' comprehensive development.

Keywords: Object-oriented Technologies; Course Teaching; Teaching Methods; Practical Teaching

1. Introduction

Before the object-oriented programming model became common, the main move towards to computer program development was 'purpose -aimed'. The core of this approach lies in the need to first have a comprehensive grasp and understanding of the overall function of the target system, and then, through a series of orderly steps, gradually refine and decompose these overall functions into a number of more specific and easier to manage functional modules. Although this function-based development strategy has a certain degree of rationality and feasibility in the historical context of the time, its inherent limitations are also obvious.

Specifically, when a function-based development approach is used to write software, developers often need to modify and adjust a large amount of code once the specifications of the system change or when certain new functional features need to be added. Such modifications not only involve a wide range, but also often require a relatively large adjustment to the original system architecture, which undoubtedly increases the complexity of software maintenance and upgrading [1]. More seriously, it is difficult to achieve effective reuse of software code because the function-based development approach lacks sufficient flexibility and scalability. The result of this is not only a decline in the efficiency of computer program development, but also an elevation in the expenses and hazards associated with software creation.

The aim of object-oriented technology lies in facilitating easier maintenance and reuse of software. Its core concept revolves around emphasizing individual components, enhancing their autonomy, and integrating these components to fulfill the overall functionality of the system. By increasing the independence of the components, when modifications occur, they can be reused in other systems with minimal impact [2].

Hence, prior to engaging in computer programming, students must possess a profound understanding of object-oriented technology principles. When teaching the course titled "Object-Oriented Technology (Java)," the primary objective is to nurture students with robust

foundations in object-oriented programming concepts, logical reasoning, and problem-solving abilities [3]. The ultimate goal of this curriculum is to empower students to develop exemplary programming practices, master fundamental programming techniques, and proficiently apply the programming language to address real-world challenges effectively. By combining the fundamental theories of object-oriented programming with its practical techniques, the course aims to develop students' ability to adapt to technological developments and market demands.

Object-oriented originally appeared as a programming language, and in the following 40 years, through continuous development, it has gradually been applied to various fields of development. The full picture and development process of object orientation is shown in Fig. 1.

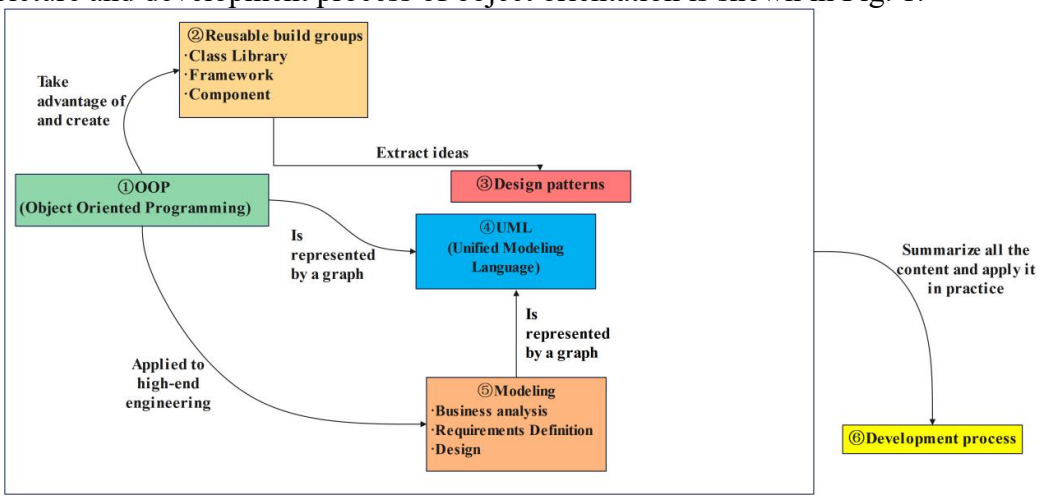

Figure 1. The whole picture and development process of object orientation

2. Course Overview of Object-Oriented Technologies

The Object-Oriented Technology course serves as a fundamental offering within computer science and technology, software engineering, and affiliated disciplines. Its objective is to equip students with proficiency in object-oriented programming concepts, methodologies, and skills, enabling them to adeptly apply object-oriented programming languages in software development endeavors.

First of all, students are allowed to study and understand the basic concepts of object-oriented in depth, including encapsulation, inheritance, polymorphism, object, class, abstract class, interface, etc. In particular, the first three are key components of Object-Oriented Programming (OOP). Their distinctive attributes are outlined in Table 1. By grasping the meanings, characteristics, and interconnections of these concepts, one can precisely elucidate the distinctions and benefits of OOP over traditional OOP. This understanding is crucial for fostering an OOP mindset [4].

Table 1 The three main elements of OPP

Three Major Elements	Encapsulation	Inheritance	Polymorphism
Explanation	Summarizes subroutines and variables, creating software components.	Achieves the commonalization of repeated class definitions.	Achieves the commonalization at the method invocation end.
Purpose	Organization	Elimination of redundancy	Elimination of redundancy
Notation	Structure that "summarizes, hides, and creates many"	Structure that creates a common main program	Structure that summarizes the common parts of classes into another class.

Secondly, once the foundational concepts of object-oriented programming are grasped, students

must proceed to master the fundamental syntax and programming structure of a prominent object-oriented programming language (such as Java, C++, or Python, among others). This entails understanding data types, variables, operators, control flow statements, arrays, strings, and other essential elements. Additionally, they must become proficient in object-oriented specific features, including classes, objects, and member functions, constructor, destructor and other specific syntax and methods of using the language to write object-oriented programs of a certain scale and complexity [5], and solve practical problems. Mastering the specific syntax and application of object-oriented features is crucial, enabling students to craft object-oriented programs of varying scales and complexities to address real-world problems [5]. Ultimately, they should acquire familiarity with the fundamental techniques and procedures involved in Object-Oriented Analysis and Design (OOAD). Additionally, proficiency in the Unified Modelling Language (UML) is essential, encompassing knowledge of the graphical notations used in its commonly employed diagrams. (e.g., class diagrams, use case diagrams, timing diagrams, etc.), as well as their uses, as shown in Table 2 [6]. Students should learn to use OOAD methodology to conduct requirements analysis and system design for real-world problems, establish reasonable class hierarchies and object relationship models, furnish precise and unambiguous design schemas that serve as the foundation for subsequent coding implementations, thereby enhancing the effectiveness and quality of computer program arrangement development.

Table 2 Names of the 13 graphs defined in UML and their uses

No.	Name	Purpose
1	Class Diagram	Represents the specification of a class and the relationship between classes
2	Composite Structure Diagram	Represents the runtime structure of a class with a whole-part structure
3	Component Diagram	Represents the implementation structure of software such as files and databases, processes and threads
4	Deployment Diagram	Represents the physical structure of a system, such as a hardware, network, etc
5	Object Diagram	Represents a relationship between instances
6	Package Diagram	Represents a relationship between packages
7	Activity Diagram	Represents a control flow in a series of processes
8	Sequence Diagram	The interactions between instances are represented as time series
9	Communication Diagram	Represents the interactions between instances as an organizational structure
10	Interaction Overview Diagram	A sequence diagram that performs different actions according to different conditions is represented in an activity diagram
11	Timing Diagram	A time axis with a digital scale is used to represent state transitions and interactions between instances
12	Use Case Diagram	Represents the relationship between the functions provided by the system and the consumers
13	State Machine Diagram	Represents a state change for an instance

3. Analysis of the Current State of Teaching and Learning

The Object-Oriented Technology course plays a key role in developing students' programming skills and systems development thinking, however, the teaching process of the course currently displays a diverse array of progress, marked by both successes and hurdles. The problems in teaching the course are shown in Fig. 2.

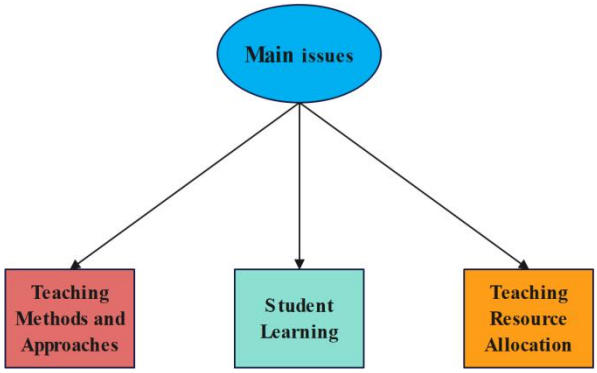

Figure 2. Curriculum Teaching Issues

3.1 Teaching Methods and Tools. Currently, the most frequently utilized teaching approach in object-oriented technology routes remains the lecture manner. Teachers systematically explain the knowledge of object-oriented concepts, principles, syntax rules and programming examples through PPT presentations and board books in the classroom. The primary benefit of this manner lies in its ability to convey extensive information within a confined timeframe, ensuring a comprehensive and systematic acquisition of knowledge. Nevertheless, its drawbacks are equally prominent. Students often find themselves in a passive position, merely receiving knowledge without active engagement or contemplation. This can result in a superficial understanding of concepts and hinder the development of practical application skills and innovative thinking among students [7].

Although practical teaching has an important position in the course, in actual teaching, the connection between practical teaching links and theoretical teaching is not close enough. The design of practical projects sometimes lacks systematicity and comprehensiveness, and fails to fully consider the actual level and ability enhancement needs of students. For example, some of the practical projects are only a simple verification of theoretical knowledge. Upon completing these projects, students gain a certain intuitive grasp of the scholarly knowledge, however, they still fall short in their capacity to independently analyze and tackle intricate practical problems. Furthermore, there is room for enhancement in the methodology employed for practical teaching instruction. Teachers may not be able to give adequate guidance and feedback to each student in time during the practical process, which affects the practical effect of students.

Case teaching method has an important role in object-oriented technology courses, but there are some problems in the selection and use of cases. Certain cases are overly outdated and disconnected from present-day industrial applications, failing to ignite students' interest and keenness in knowledge. Additionally, during case-based instruction, the depth of the teacher's analysis and guidance is inadequate. Consequently, students tend to merely follow the teacher's train of thought, lacking the opportunity for independent thinking and discussions. This hinders their ability to genuinely acquire knowledge and experience from the cases, and to enhance their problem-solving skills and object-oriented thinking abilities.

3.2 Student Learning Situation. The abstraction and complexity inherent in Object-Oriented Technology courses often lead students to encounter challenges during their learning journey, which can diminish their enthusiasm and proactive learning attitude. When it comes to learning strategies, numerous students continue to rely on traditional manners such as rote memorization and repetitive exercises when studying object-oriented technology courses, lacking systematic summarization and generalization of knowledge, and failing to form their own knowledge system and way of thinking. They tend to rely too much on textbooks and teachers' explanations in the learning process, lack the spirit of independent learning and exploration, and are not good at using network resources, reference books and other channels to acquire knowledge and solve problems.

In addition, students' programming practice ability generally needs to be improved. In the classroom experiments and post-course assignments, many students are able to complete basic programming tasks, but the code quality is not high, with problems such as code redundancy, confusing structure and lack of comments. This shows that they still need more guidance and

training in programming specifications and the development of good programming habits.

When solving complex programming problems, students' ability to analyze problems and debug programs is weak. When encountering the situation that the programmer reports an error or the running result does not meet the expectation, some students are often at a loss as to what to do, and they lack effective debugging methods and skills to locate and solve the problems quickly, which to a certain extent affects their confidence in learning and the practical effect.

3.3 Allocation of Teaching Resources. Rapid advancements are being witnessed in computer technology, accompanied by the continual evolution and expansion of object-oriented technology. New programming paradigms, frameworks, and utilities are continually emerging.However, the content of many existing textbooks is updated slowly and fails to reflect the latest developments and technology trends in the industry in a timely manner. For example, there is insufficient introduction to the characteristics of emerging object-oriented programming languages, the improvement of design patterns, and the application cases in new fields such as artificial intelligence and big data processing, which creates a certain disconnect between what students have learnt and the actual industry needs, and is not conducive to students' rapid adaptation to the technical requirements of the workplace after graduation.

Regarding hardware facilities, numerous colleges and universities have been furnished with dedicated computer laboratories tailored for the instruction of this course, but there are cases of aging equipment and uneven performance. The hardware configuration of some computers is difficult to run complex object-oriented development environments and large-scale projects smoothly, resulting in students may encounter problems such as lagging and crashing during practice, which affects the learning efficiency and practical experience. Moreover, the opening hours of the labs are limited, which often fails to meet students' needs for independent learning and practice after class, restricting students’ full use of hardware resources.

The campus network can basically meet the demand in terms of coverage, but there are deficiencies in network speed and stability. Especially during instances where students focus on utilizing the network for online learning, software updates, or collaborative team projects, network congestion becomes more prevalent. This often leads to issues such as sluggish loading of online course videos, delayed submission of code, and other related problems, thereby disrupting the smooth flow of instruct and knowledge actions. Furthermore, it impacts the prompt and seamless access of students to online educational resources.

In terms of instructor resources, the teaching staff for object-oriented technology routes collectively possess a certain degree of specialized knowledge and expertise, but there are problems of aging knowledge structure and insufficient practical experience of teachers. Some teachers have been engaged in theoretical teaching for a long time and lack of practical project development experience, which makes it difficult to combine theoretical knowledge with practical application in the teaching process, and incapable to furnish students with lifelike and authentic case studies, as well as practical directions and advice. Moreover, with the continuous updating of technology, teachers' own knowledge updating speed cannot keep pace with the development of the industry, resulting in a disconnect between the teaching content and the actual needs [8].

4. Teaching Methodology Innovation and Practice

Old-fashioned teaching approaches typically emphasize the imparting of abstract knowledge, often leading students to find the knowledge process monotonous. Applying acquired knowledge flexibly in real-world project development remains challenging. To alter this scenario, enhance the course's teaching quality, and nurture high-caliber talents capable of meeting the demands of contemporary software development is imperative, this paper will carry out an in-depth exploration of the teaching methods of the object-oriented technology course and innovative practice, which is mainly divided into the following aspects. As shown in Fig. 3.

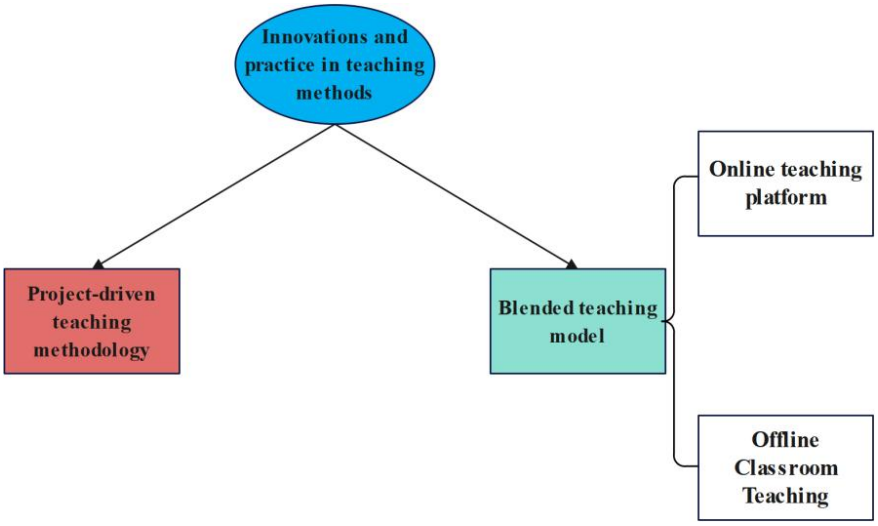

Figure 3. Innovation and practice of teaching methods

4.1 Project-Driven Teaching Methodology Based. First of all, the teacher should select a project with practical application background and covering the main knowledge points of object-oriented technology as the main teaching line of the course [9], for example, to develop a small 'library management system', 'student information management system' or 'online shoe shopping system', and so on. For example, the development of a small 'library management system', 'student information management system' or 'online shoe shopping system' and so on. Prior to embarking on the development and plan of these projects, students are required to acquire and grasp the fundamental procedures of object-oriented analysis and plan, as shown in Fig. 4.

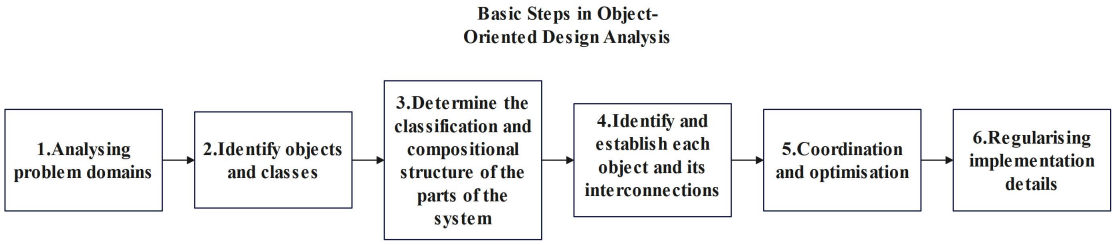

Figure 4. Innovation and practice in teaching methods

(1) Examine the problem domain thoroughly. Ascertain user needs by comprehending the business knowledge pertinent to the issue. Clearly delineate the system's user requirements, establish its responsibilities and boundaries, and investigate preliminary solutions to the problem.

(2) Recognize and define objects and classes within the system. This involves analyzing and pinpointing the entities that comprise the system, followed by abstractly categorizing these objects. Envision the system as consisting of various subsystems, and subdivide each subsystem into themes, which are constructed from collections of classes and objects.

(3) Determine the classification and composition of the various parts of the system. Firstly, ascertain the inheritance hierarchy among classes and establish the classification structure based on the general-to-specific relationship. Secondly, determine the constituents of an object according to the whole-part relationship and delineate the composition structure accordingly.

(4) Identify and establish each object and its relationship to each other. That is to identify the object based on the application, define the internal characteristics of the object (properties and methods) , establish instance connection and message connection. Message Connection embodies the communication relationship and interface protocol between objects.

(5) Harmonization and Enhancement. Further refine and optimize the performance and interactions among the diverse components of the model (encompassing class instances), honing potential classes or objects in the process, so that the system is a minimum set of different

components.

(6) Codify implementation details. Analyze and design the functional implementation details for each component of the model, including class objects, and check the consistency and integrity of the analysis model.

These projects are not only capable of sparking students' enthusiasm for learning but also fostering a profound understanding of the practical significance of object-oriented technology in real-world software development. Furthermore, instructors can decompose the project into multiple sub-tasks, progressively guiding students through the completion process in accordance with the actual progression of the course. At each stage, the instructor first elucidates the pertinent theoretical knowledge and technical aspects, subsequently allowing students to engage in practice, either in groups or individually, flexible use of knowledge to complete the arrangement of sub-tasks. For example, in the“Online Shoe City Shopping System” project, first introduced the concept of class and object, let students create“Commodity class” and“User class”; then explain inheritance and polymorphism, guide students to design different types of goods (such as sports shoes, high heels, casual shoes, etc.) and the inheritance of the corresponding order, returns and other operations of the polymorphic realization; Bring in the knowledge of database association and interface plan to faultless the purpose of the whole system.

4.2 Blended Learning Model. The blended teaching model, as its name implies, integrates online and offline instruction seamlessly to construct an educational framework tailored for object-oriented technology routes, as shown in Fig. 5.

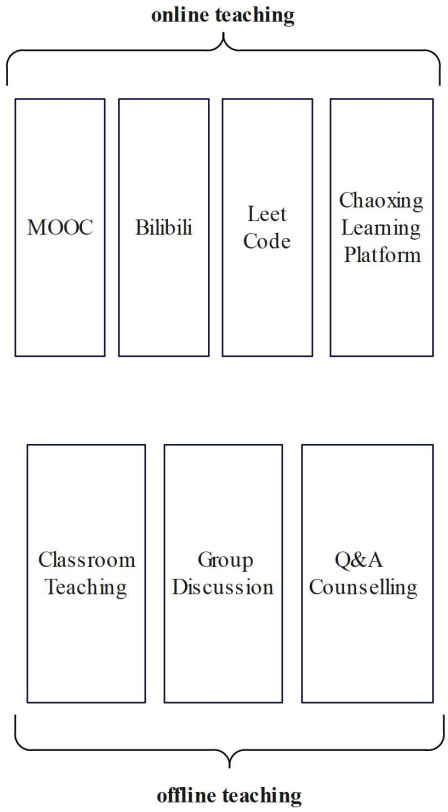

Figure 5. Blended learning model

Online teaching includes the selection of teaching platforms (e.g., course websites, online learning communities, MOOC platforms, etc.), the development and integration of teaching resources (e.g., teaching videos, e-textbooks, online test questions, discussion topics, etc.), and teachers can recommend students to use some high-quality online programming learning platforms (e.g., LeetCode, NiuKe.com, etc.), which provide a large number of object-oriented programming These platforms provide a large number of object-oriented programming practice questions and real-life project cases, and students can engage in online programming custom on the stages, thereby enhancing their programming skills progressively through hands-on experience. The

platforms also provide real-time evaluation and feedback on students' codes, pointing out errors and deficiencies in the codes and providing corresponding optimization suggestions to help students improve their programming level quickly [10].

Offline teaching, on the other hand, includes the organization and design of classroom teaching activities (e.g., classroom lectures, group discussions, project practice, etc.) Teachers can provide students with an open laboratory environment after class, equipped with sufficient computer equipment and related software resources, and arrange instructors on duty to answer the problems encountered by students in the course of practice. Based on their individual learning pace and interests, students can autonomously allocate time for programming exercises and project development in the lab, thereby fully harnessing their learning initiative and enthusiasm. Ultimately, educators can assess the students' learning outcomes and experiences before and after the implementation of the blended teaching model, confirming its advantages and viability. Subsequently, they can discuss the challenges encountered during implementation and promptly devise appropriate solutions.

5. Evaluation and Analysis of Teaching Effectiveness

To gain a comprehensive and impartial understanding of the course's teaching effectiveness and identify any issues or shortcomings in the instructional process, it is imperative to conduct a thorough evaluation of its teaching impact. This will facilitate further refinement of teaching methodologies and enhancement of educational quality. The teaching evaluation and analysis is shown in Fig. 6.

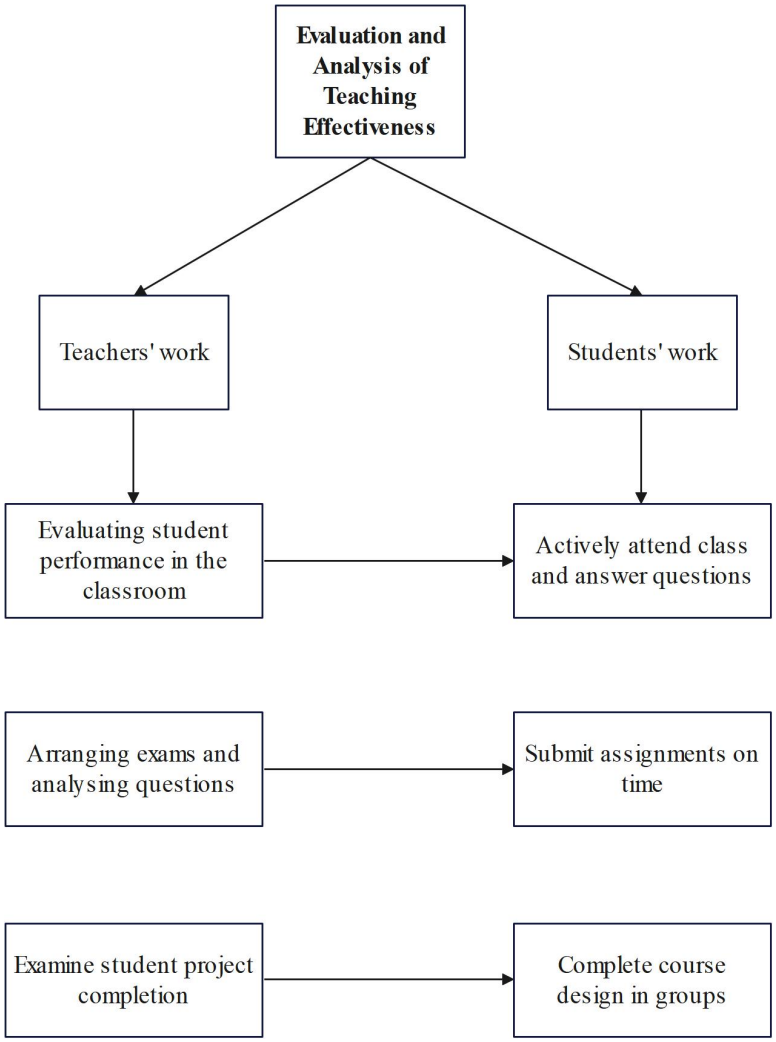

Figure 6. Teaching evaluation and analysis

Initially, educators can monitor students' in-class performance, encompassing attendance rates, the frequency of questions posed, eagerness to respond, and proactive engagement in class discussions and group activities. Students who actively participate in classroom activities often exhibit greater interest in the course and enthusiasm for learning, which also serves as an indicator of the appeal of the teacher's instructional methods and the vibrancy of the classroom ambiance. Prior to the conclusion of class, assignments closely aligned with theoretical knowledge, such as programming tasks and essays, are assigned. These assignments require students to apply their acquired knowledge to address practical challenges or respond to theoretical inquiries. By assessing these assignments, educators can gauge students' comprehension of the key concepts, their depth of understanding, and their ability to apply knowledge flexibly to solve problems [11].

Secondly, students are tasked with collaborating in small groups to complete a relatively intricate course design project, such as a small-scale information management system or game development. This project requires them to comprehensively analyze various aspects, including demand assessment, system plan, principles script, testing and debugging, as well as teamwork skills. Throughout the project completion process, educators can observe students' performance, focusing on the progress of the experimental project, the completeness and accuracy of functional implementation, and the quality of the code written (e.g., normality, readability, extensibility, etc.). In addition, the experimental projects should cover all aspects of object-oriented technology, such as class design and implementation, application of inheritance and polymorphism, exception handling, graphical user interface development, etc., To assess students' practical programming skills and their ability to comprehensively apply knowledge, teachers arrange a timely course design presentation once students have submitted their projects. An evaluation panel comprising both teachers and students presents and evaluates each group's project outcomes. Evaluation criteria encompass innovation, practicality, technical complexity, functional completeness, and teamwork skills. Additionally, a semester-end closed-book exam is conducted to evaluate students' understanding and retention of fundamental object-oriented concepts (like objects, classes, encapsulation, inheritance, polymorphism, etc.), syntax rules, programming paradigms, and pertinent algorithms and data structures. The exam questions are diversified, including multiple-choice, fill-in-the-blank, short-answer, and programming questions, to comprehensively gauge students' theoretical knowledge. Upon reviewing the exam results, teachers analyze the distribution of student scores, such as the average score, pass rate, and percentage of excellent scores, to ascertain students' overall grasp of theoretical knowledge. Furthermore, they compare these data across different classes and semesters to observe the stability of the teaching effect and identify trends in performance.

By conducting an exhaustive examination of the particular effects that diverse practical teaching components and their methodologies exert on various facets of students' practical competencies, teachers aim to comprehensively and accurately identify the significant advantages and potential shortcomings of the current teaching system, so as to provide a strong and scientific basis for the subsequent optimization and upgrading of the teaching system. In this process, data analysis tools should be fully utilized to quantitatively assess the effectiveness of different practical projects and teaching methods. Certain well-designed practical projects have shown remarkable results in enhancing students' specific abilities, which are often closely in line with the needs of the industry and focus on the in-depth integration of theory and practice, consequently, there is a significant advancement in students' practical skills. Nevertheless, it is crucial to acknowledge that certain teaching methods have encountered challenges in practical application, including insufficient interactivity and difficulty in sparking students' learning enthusiasm, which, to a certain extent, hinders the full realization of the teaching effectiveness.

By conducting such an analysis, educators can gain a clear insight into both the strengths and advantages of the existing teaching system, as well as precisely pinpoint the aspects that require enhancement and refinement, so as to provide a clear direction and goal for the subsequent teaching reform. This will help teachers to build a better and more efficient teaching system to better cultivate students' practical abilities so that they can be more confident in their future job search.

6. Summary

The problem-solving plan of object-oriented technology is to start from the factual objects in the true earth (such as persons and object), and try to use human's natural way of thinking to construct the software system, and it can be seen from the epistemological point of view that the object-oriented technology has changed the way of people's understanding of the world.

During the process of acquiring object-oriented technology, instructors ought to adapt the prevailing traditional teaching approaches based on current circumstances, embracing suitable methodologies such as project-based learning and the hybrid teaching model discussed in this paper. These innovative teaching methods should provide students with a revitalized learning environment and atmosphere. Additionally, educators should prioritize fostering students' interest in the course. Ultimately, a series of evaluative measures can be implemented to further refine and enhance the teaching system.

Under the meticulous guidance of instructors, students engage in a blend of online and offline learning to attain a profound understanding and mastery of object-oriented programming concepts, including classes, objects, inheritance, polymorphism, and encapsulation, among other fundamental principles. This mastery necessitates the integration of theoretical knowledge with practical application through a multitude of hands-on projects. By engaging in these project-based practices, students accumulate substantial programming experience, thereby enhancing their code quality and programming efficiency. Moreover, in the current environment, innovation and collaboration are particularly important. Object-oriented technology courses can cultivate students' sense of innovation, so that they can constantly explore new programming ideas and methods. And group projects can exercise students' teamwork ability, so that students understand how to play their respective advantages in the team and complete the task together.

As educational technology continually advances and the domain of object-oriented technology undergoes constant updates, the teaching of this course in the future will make more use of artificial intelligence and big data analysis technology to provide a more effective way to continue to optimize the teaching evaluation system to better meet the needs of knowledge, and to propel forward the research endeavors related to the instruction of object-oriented technology routes.

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Research on AI-assisted Education Based on the "use and Satisfaction" Theory in Communication Studies

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Abstract. With the rapid progress of artificial intelligence technology, especially in the fields of natural language processing, machine learning, deep learning and other significant breakthroughs, AI technology has shown a wide range of application prospects in the field of education. It is of great academic and practical value to conduct in-depth research on AI-assisted education based on the theory of "use and satisfaction". Under this framework, students are no longer limited to passively receiving knowledge, but can actively choose and use AI tools to meet their individual learning needs. This paper focuses on how AI-assisted education can effectively map the "use and satisfaction" theory, and aims to comprehensively explore its potential advantages and possible challenges. At the same time, this paper also deeply analyzes the current problems in AI-assisted education, and puts forward targeted circumvention or solutions, in order to provide strong support for promoting innovation and development in the education field. With the rapid progress of artificial intelligence technology, especially in the fields of natural language processing, machine learning, deep learning and other significant breakthroughs, AI technology has shown a wide range of application prospects in the field of education. It is of great academic and practical value to conduct in-depth research on AI-assisted education based on the theory of "use and satisfaction". Under this framework, students are no longer limited to passively receiving knowledge, but can actively choose and use AI tools to meet their individual learning needs. This paper focuses on how AI-assisted education can effectively map the "use and satisfaction" theory, and aims to comprehensively explore its potential advantages and possible challenges. At the same time, this paper also deeply analyzes the current problems in AI-assisted education, and puts forward targeted circumvention or solutions, in order to provide strong support for promoting innovation and development in the education field.

Keywords: Communication Science; Use and Satisfaction Theory; Ai-assisted Education

1. Introduction

The integration of AI into education has become a new orientation for education development, and how to use AI technology to support education has become a topic that needs to be discussed at present [1].In view of the significant differences in learning ability, interest and background among students, it is difficult for traditional education models to fully meet the individual needs of all students. However, AI-assisted education, with its unique advantages, can accurately grasp the individual needs of each student, and provide customized learning content and learning plans accordingly to meet the diversified learning needs of students. In recent years, in order to promote the in-depth application of AI in the field of education, governments have successively introduced relevant policies. For example, China's "Strong Teacher Plan for Basic Education in the New Era" and "Overall Layout Plan for Digital China Construction" have clearly proposed that they will vigorously implement national digital education strategic actions and constantly improve the national smart education platform, and the introduction of these policies provides solid policy support for the development of AI-assisted education.

As a kind of audience behavior theory, the core point of the "use and satisfaction" theory of communication is that the audience actively contacts the media and seeks satisfaction based on specific needs and motivations. This theory emphasizes the initiative and selectivity of the audience in the communication process, highlighting its important position and role in the whole

communication process. Through the "use and satisfaczztion" theory, we can understand the audience's media contact behavior from a unique perspective, and emphasize the audience's subjective initiative in the process of communication. At the same time, this theory provides a new theoretical support for the study of the effect of mass communication. As a kind of audience behavior theory, the core point of the "use and satisfaction" theory of communication is that the audience actively contacts the media and seeks satisfaction based on specific needs and motivations. This theory emphasizes the initiative and selectivity of the audience in the communication process, highlighting its important position and role in the whole communication process. Through the "use and satisfaction" theory, we can understand the audience's media contact behavior from a unique perspective, and emphasize the audience's subjective initiative in the process of communication. At the same time, this theory provides a new theoretical support for the study of the effect of mass communication.

In the research field of AI-assisted education, the application of "use and satisfaction" theory has far-reaching significance. It helps us to have a deeper insight into the needs and motivations of students when using AI educational tools, and then design educational products that are more in line with the actual needs of students, so as to improve the educational effect. In addition, the theory also reminds us that in the design and promotion process of AI educational products, we must attach great importance to the feedback and needs of the audience, and realize the optimization of education by constantly adjusting and optimizing the product to meet the expectations of the audience.

2. "Use and Satisfaction" in AI-assisted Education

2.1 "Use" in AI-assisted Education. AI technology has the ability to deeply analyze various learning data of students, including but not limited to their learning progress, interests, and specific learning needs. Through careful interpretation and accurate analysis of these data, AI can fully understand the learning status and learning characteristics of each student. On this basis, AI further translates this information into concrete actions, tailoring personalized learning programs and teaching resources for each student. Such a personalized learning program not only takes into account the student's learning progress, but also fully respects the student's personal interests and learning preferences. Students can independently choose the most suitable learning content according to their actual situation and needs, which not only improves the efficiency of learning, but more importantly, encourages students to take the initiative to learn and explore, making the learning process more vivid and interesting, and fully mobilizes students' enthusiasm and initiative in learning. The provision of this personalized education path marks the arrival of the era of personalized education, and also indicates that the education method will be more flexible and efficient.

Ai-assisted education platforms have powerful analytics that can track and evaluate students' learning status in real time and quickly provide personalized feedback. This feedback not only points out the student's strengths and weaknesses, but also provides suggestions for improvement and helps students optimize their learning path. Thanks to this efficient information feedback mechanism, students can more actively use AI education tools to enhance their self-learning ability, while satisfying their desire for academic achievement and relentless pursuit of progress. Such educational models not only enhance the efficiency of learning, but also enhance students' sense of participation and satisfaction in the learning process, thus playing a crucial role in the ever-changing educational environment. Through the application of AI technology, students can obtain customized learning support anytime and anywhere, which not only promotes their personal development, but also contributes to the innovation and progress of the entire education system.

Ai-assisted education completely subverts the existing model of the traditional classroom, making learning no longer limited by the boundaries of physical space and time. Students now enjoy unprecedented freedom to embark on their learning journey whenever and wherever it is convenient for them. This flexibility means that whether it is the early morning hours after waking up in the morning, or the quiet moments before going to bed at night, or even on the road, at home,

or any environment with access to the Internet, students can start the learning mode, so that the learning of knowledge is no longer restricted by any external conditions.

With the help of AI technology, access to educational resources has also become extremely convenient, and students can easily access massive learning materials and information through smart devices. This personalized learning experience provides customized learning plans and resources based on the specific needs and progress of each student. Students can choose their own learning pace, explore the knowledge points they are interested in, or practice repeatedly to master the concept that is not solid enough. Ai-assisted education not only improves the efficiency of learning, but also makes learning more enjoyable and autonomous.

The application of AI technology in the field of education not only brings new possibilities for teaching, but also provides more choices and possibilities for students' learning, making education more personalized, intelligent, and full of infinite possibilities.

2.2 "Satisfaction" in AI-assisted Education. The integration of education and digital technology is a key feature of the future development of education [2]. Ai-assisted education, through the efficient analysis of students' learning data, interests and personal learning needs, can be tailored to students a set of learning plans that meet their characteristics. This kind of education model not only pays attention to students' learning progress, but also attaches more importance to students' personalized development. With the help of AI technology, educators can accurately grasp the learning status of each student, including learning efficiency, understanding and knowledge mastery, so as to provide appropriate guidance and support on the way to student learning.

The personalized learning content and path provided by AI-assisted education enable students to give full play to their subjective initiative in the learning process and absorb knowledge in their preferred way and pace, which not only greatly improves the learning efficiency, but also enables students to feel fun and joy in the process of exploring and mastering new knowledge, thus enhancing their sense of self-identity and achievement. This kind of education, truly people-oriented, fully respects the individual differences of students, aims to stimulate each student's learning potential, cultivate their innovative spirit and problem-solving ability, and lay a solid foundation for students' lifelong learning and all-round development.

The AI-assisted education model, through its advanced technical means, can realize the real-time monitoring and accurate feedback of students' learning. This model can not only quickly assess the learning outcomes of students, but also provide customized learning suggestions and programs according to the individual differences of students. For students, through AI-assisted education, they can get timely detailed information about their learning process, which includes not only the assessment of knowledge mastery, but also the effectiveness of learning methods and other aspects of feedback.

When students learn about their learning results through the AI system and see their academic progress, this positive feedback can stimulate their internal motivation, resulting in a strong sense of satisfaction and confidence. The satisfaction comes from the substantial rewards of their efforts, while the enhancement of self-confidence comes from the fact that students can intuitively see their own growth trajectory, which is a positive emotional experience that is very valuable to students.

More importantly, this positive emotional experience and feedback of learning outcomes can encourage students to be more actively involved in learning activities. They will maintain a higher enthusiasm and interest in learning, willing to invest more time and energy to explore the unknown and solve problems. Such a learning attitude will undoubtedly greatly improve the learning efficiency and promote students to grasp knowledge comprehensively and deeply, so as to achieve better results in the long-term learning career.

Because of this, the introduction of AI-assisted education not only optimizes the teaching process and improves the teaching quality, but also greatly promotes the self-drive and self-growth of students, which is of great significance for building a more efficient and more humane education system.

3. Current problems in AI-assisted education

Artificial intelligence has greatly changed the education ecology, and has broad application prospects in the field of education. It is an effective way to overcome the deficiency of traditional education, and helps to change the education model and form, provide personalized services for students, provide precise teaching for teachers, and provide scientific management for schools [3]. Ai-assisted education has shown significant advantages in the provision of personalized learning content and paths, however, limited by the current level of technology and data resources, its personalized satisfaction ability is still insufficient. AI may not be fully accurate in understanding and meeting the unique needs of each learner, which results in some learners having a poor experience with AI-assisted educational tools.

Ai-assisted education can provide instant learning feedback, but the quality of feedback is affected by a variety of factors. For example, the evaluation criteria for AI may be incomplete or inaccurate, resulting in biased feedback results. In addition, some learners have insufficient adaptability to the feedback method of AI, which affects the feedback effect.

Ai-assisted education actively advocates independent learning, but not all learners have enough self-discipline and motivation. Some learners may rely too much on the assistance of AI, which weakens the ability to actively think and solve problems. At the same time, the autonomous learning mode may also lead to the difficulty of getting timely help and support when learners encounter difficulties.

Ai-assisted education breaks the time and space constraints of traditional education, but it also causes some problems. For example, some learners feel lonely or anxious due to the lack of face-to-face communication and interaction. Over-reliance on electronic devices for learning can also be potentially harmful to learners' eyesight and physical health.

In the process of providing precise and personalized services, AI-assisted education requires the collection and processing of large amounts of learner data. However, this also comes with data privacy and security risks. If this data is not properly protected, it may be at risk of misuse or disclosure, which could adversely affect learners.

4. Ai-assisted education problem solving avoidance strategies

4.1 Improve AI personalization capabilities. Online teaching must rely on professional and stable digital technology platform in order to be effectively implemented[4]. In order to improve the learning experience and effect, more investment can be made in the research and development of AI algorithms, in order to more accurately identify learners' personalized learning styles and needs. At the same time, more learning data will be actively collected and deeply analyzed, which will be used to optimize AI's personalized recommendation and learning path planning, ensuring that each learner can get the most suitable learning content and progress. In addition, learners are encouraged to actively provide feedback so that the AI system can continue to learn and improve, and bring a better learning experience to the learners.

4.2 Improve instant feedback. Perceptual intelligence is the basic intelligence in artificial intelligence, which can be regarded as the 1.0 stage of artificial intelligence, cognitive intelligence is the 2.0 stage of artificial intelligence, emotional intelligence is the 3.0 stage of artificial intelligence, and behavioral intelligence can be regarded as the 4.0 stage of artificial intelligence. The current development of artificial intelligence has entered the era of AI 2.0. Future AI 3.0 and AI 4.0 are still to be worked on [5]. Although AI technology performs better than humans in many areas, such as complex computation and logical reasoning, AI technology performs relatively poorly on human emotions, values and morals [6]. In the process of promoting the development of artificial intelligence technology, in order to ensure the accuracy and comprehensiveness of AI feedback results, it is necessary to constantly improve its evaluation criteria. In order to meet the diverse needs and habits of different learners, multiple forms of feedback should be provided. In addition, in order to ensure the accuracy and professionalism of the feedback results, it is also necessary to introduce a review mechanism of teachers or experts to verify and make necessary corrections to the feedback results generated by AI.

4.3 Encourage independent learning and provide support. The intelligent tutoring system entering the 2.0 stage, after generating students' learning data, focuses on analyzing the reasons why students draw wrong conclusions in the learning process, and realizes continuous training and learning in the iterative process of "discovering mistakes - analyzing the causes of wrong thinking - correcting wrong thinking" [7]. We are committed to improving the motivation and enthusiasm of learners through carefully designed incentive mechanism. At the same time, it provides a wealth of learning resources and necessary tools to fully support learners in independent exploration and collaborative learning. Online learning communities or forums can also be set up to promote communication and cooperation among learners and realize knowledge sharing and mutual assistance.

4.4 Balance virtual and real learning. In a virtual learning environment, learners are strongly advised to maintain a close connection with the real world, including but not limited to active participation in various social activities and physical exercise. At the same time, in order to improve the learning effect and experience, a series of learning activities that integrate virtual reality and reality are designed, such as virtual reality experiments and comprehensive projects that combine online and offline. In addition, for the sake of visual health and physical health of learners, all learners are especially reminded to pay attention to eye hygiene and avoid the continuous use of electronic devices for long periods of time.

4.5 Strengthen data privacy and security protection. In order to ensure that learners' personal information is properly protected, strict data collection and use norms should be developed and implemented. Under this regulation, learners' personal information will not be misused or disclosed. Advanced data encryption and security protection technology is adopted to ensure the security of learners' data to the highest standards. It is also necessary to conduct regular security checks and vulnerability fixes on the system to prevent any potential hacking and data breach risks. These measures are implemented to ensure that AI services always meet the highest standards of data security and privacy protection.

4.6 Provide diversified services. In the process of product design, it is necessary to strengthen the examination of our local culture, and avoid completely imitating foreign practices and resulting in "acclimatization" [8]. In the process of providing educational services, it is necessary to meet the diverse needs of different learners. In addition to adopting innovative ways of AI-assisted education, it also offers a variety of education forms, including online courses, face-to-face courses and blended teaching, to ensure that each learner can find their own learning style. At the same time, in order to enrich the learning experience of learners, we actively introduce more diversified educational resources, such as books, videos, audio, etc., to provide learners with more abundant and comprehensive learning materials.

5. Summary

When discussing the implementation strategy of AI-assisted education, the "use and satisfaction" theory of communication provides a solid theoretical foundation and clear direction. The theory emphasizes the central position of meeting the needs of learners in the educational process. Through the precise application of AI technology, AI-assisted education can more accurately respond to the personalized learning needs of learners, providing them with instant learning feedback and personalized autonomous learning support. This not only helps to optimize the allocation of educational resources, but also significantly improves the learning efficiency and experience of learners, and creates a more high-quality and efficient learning environment for them.

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Exploring the Reform of Teaching Methods in Computer Network Courses

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Abstract. In today's world, as a core area of information technology, computer networks are extremely significant for cultivating high-quality human resources that fulfill the needs of current society. As information technologies advance swiftly, the investigation and implementation of innovative teaching strategies have emerged as a pivotal factor in enhancing the quality of computer network instruction. This paper analyzes the interdisciplinary, rapid technological updating and powerful practical features of the course, and at the same time, it argues the necessity of reform in view of the current status quo of outdated teaching content, single method, weak practice and imperfect assessment mechanism of the current course. On this basis, this article proposes a string of specific reform initiatives, including refining learning content, innovating teaching methods, strengthening experiential learning and changing evaluation methods. Ultimately, this paper summarizes the full text and analyzes the subsequent reform trends, which will provide a highly informative path for teaching reform.

Keywords: Computer Networks; Teaching Methodology Reform; Practical Teaching; Reform Measures

1. Introduction

In today's digital era, computer network technology has become a key force for social progress, with a wide range of applications in various fields such as online office, distance education and intelligent transportation. The convergence of 5G, IoT, cloud computing and other technologies is increasing the demand for computer network professionals in society, requiring not only solid doctrinal knowledge and excellent practical ability, but also innovative mindsets, teamwork and interaction skills. However, the conventional instructing method has been tough to fulfill these requirements. Accordingly, it is particularly prominent to promote the change of instructing methods in the curriculum, which can not only improves teaching quality and the fostering innovative talents in networks, but also sets the benchmark for education reform and promotes the adaptation of the education system to current times, thus fueling social development [1].

2. Characteristics of the Course and Current Status of Teaching

2.1 Course Characteristics. The computer network course is characterized by comprehensiveness, practicability, dynamics and systematicity. On the one hand, it integrates the knowledge of computer science, communication engineering, electronic engineering and other disciplines, including data transmission, network protocols, network architecture, network security, etc. With the aim of thoroughly apprehend its working principles and applications, students ought to acquire numerous doctrinal knowledge and expertise. Another aspect, the course emphasizes the close combining doctrine and practice, students not only need to learn network protocols, network equipment and other theoretical knowledge, but also need to carry out practical operations, such as building a small local area network, configure network equipment, network troubleshooting, etc. What's more, because of the prompt progression of computer network technology, new protocols, equipment, applications continue to emerge, the course content needs to be continuously updated, the teacher must understand and explain the latest network technology and cases to the class, so that students can master the current mainstream network technology and development trends. Finally, course content organization needs to comply with a certain logical sequences, starting from the

basic concepts of the network, the framework, and then gradually to the network protocols, network equipment, network applications and other levels, which will assit students to construct a extensive learning system.

2.2 Teaching Current Situation. In the teaching exploration of computer network courses, many colleges and universities are attempting to combine theory and practice closely, concentrating on practice-based teaching of theoretical knowledge rely on real project cases. However, the swift development of network technology makes it difficult for teachers to be in parallel with the latest trend.Consequently,it challenging to find a balance in current educational reforms. Thereafter, we will analyze the status of teaching, as shown in Fig. 1.

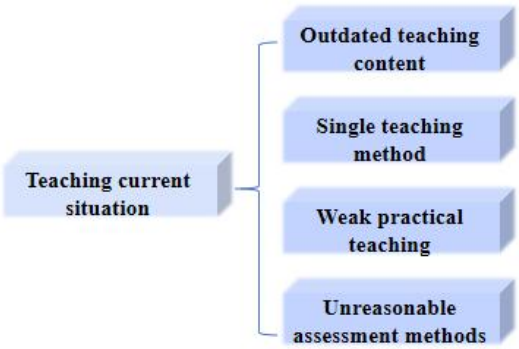

Figure 1. Teaching current situation

2.2.1 Outdated Teaching Content. Against the background of the speed development of today's technology, existing curriculum materials are generally slow to update content. Many textbooks still use a lot of space to introduce traditional network theories, protocols and technologies. However, for the popular cloud computing, Internet of Things and other cutting-edge knowledge, the textbooks only briefly mentioned or not involved at all. This makes students find that the knowledge they have learned cannot be applied to their work when they enter the society.Thus, they must expense much time to re-learn the extending ahead technologies who can adjust to the development needs of the work. In the teaching process, some teachers are overly dependent on textbooks and do not closely integrate theoretical knowledge with current practical applications. For example, in the explanation of network architecture construction related content, if only stay in the theoretical level, such as topology drawing and protocols, but not the introduction of actual engineering projects in the case, such as large-scale data center network architecture, intelligent factory network layout, etc., students have difficulty understanding the criteria for selecting different network architectures, the crucial points of performance optimization and effective strategies for dealing with failures in real scenarios, which can lead to a serious disconnect between theory and practice. Therefore, students are often at a loss when confronted with practical problems.

2.2.2 Sigle Teaching Method. In the teaching of computer network courses, the traditional lecture method is still the mainstream teaching method. In class, the teacher mainly imparts the theoretical knowledge, while the students are not actively absorbing content. This monotonous teaching mode makes the classroom atmosphere dull, and students' learning enthusiasm and initiative are inhibited to a certain extent, which makes it easy for students to produce an aversion to learning. For example, in teaching network protocols, if the teacher simply explains the principles of the protocol, field composition and workflow, without guiding students through actual case studies or simulation experiments to explore the protocol in different network environments and interactive processes, students can’t truly apprehend the core of the protocol.Although the theoretical knowledge has a certain understanding, the hands-on ability is weak, and unable to apply the theoretical knowledge flexibly to practical projects.After graduation, for the requirements of practical skills in the workplace, they can not quickly adapt.

2.2.3 Weak Practical Teaching. Some colleges and universities due to financial constraints, not enough attention to practical teaching and other reasons, computer network laboratory equipment

appears old and aging. For example, in the development of cloud computing, SDN and other experimental teaching, the laboratory lacks high-performance servers, professional SDN switches and other key equipment, students can only stay at the theoretical level and cannot experience practical points, and the cultivation of manual dexterity is challenging to implement. Bound by traditional instructing concepts and the confines of the cumulative course hours, the practical hours isn’t generally enough, and students lack sufficient time for hands-on practice and skill-building exercises. This leads to students in the limited practical hours can only rush to complete some simple experimental projects, can not explore complex network technology problems, and it is difficult to achieve the teaching goal of mastering practical skills below [2].

2.2.4 Unreasonable Assessment Methods. Currently, most of the curriculum evaluation is primarily rely on the conventional theoretical examination, the examination content focuses on the memorization of learning points and simple understanding, such as the concept of network protocols dictated, network topology drawing, etc. This way of a evaluation overlooks students' practical skills, capacity for innovation, and ability to apply knowledge to address questions, resulting in students to cope with the examination, rote memorization of theoretical knowledge, is not facilitate the cultivation and enhancement of the overall quality of students. In the current course evaluation framework, the assessment pertaining to students' learning process lacks sufficient comprehensiveness and granularity, and the ordinary grades are often based on attendance, homework completion, lack of participation in classroom discussions, group project collaboration, experimental performance and other process indicators of in-depth consideration. This makes part of the students usually study perfunctorily, before the test, can also make good results in the assessment, can not truly reflect the effectiveness of students' learning and ability level, loss of assessment of fairness and science [3].

3. The Need for Reform of Teaching Methods

3.1 Adaptation to Social Needs. In today's era, computer network technology develops rapidly and becomes the core driving force to promote the forward development of society.In the intelligent transportation system, the application of vehicle networking technology enables instantaneous sharing of data and intelligent scheduling between vehicles, effectively alleviating traffic congestion; in the field of industrial Internet, factory machinery is interconnected via the network, realizing precise control and optimization of the production process, thus enhancing production efficiency; in the case of telemedicine, the real-time transmission of high-definition images and physiological data provides powerful support for the consultation and surgical guidance of experts in other places, breaking through the geographical limitations of medical resources. In the remote medical scenario, the real-time transmission of high-definition images and physiological data provides powerful support for consultation and surgical guidance of experts in other places, breaking through the geographical limitations of medical resources. The utilization of computer networks is extensive and profound. These rapidly developing industrial applications have put forward high requirements for computer network talents.

3.2 Refining the Teaching Quality. The conventional instructing mode has largely impeded the improvement of educational quality . In the theoretical teaching, teachers continue to elaborate network principles, protocols and other abstract knowledge, and students can only be in a passive acceptance of the state, busy recording notes, there is no opportunity for active thinking and interactive exchanges, which leads a monotonous classroom atmosphere, and the students' enthusiasm for learning has been significantly impacted. Experimental teaching also faces many problems. Owing to the scarcity of equipment, cramped space, and stringent time limitations, experimental projects are frequently designed in a relatively straightforward and fragmented manner, most of which are verification experiments, such as basic network configuration commands, simple network topology construction. This kind of experiments can't effectively stimulate students' enthusiasm for exploration and innovation potential, and can't enable students to deeply understand the practical application of technology and problem solving methods in complex network environment.

4. Reform Measures for Teaching Methods

In this current age, the realm of education is encountering unparalleled transformations and trials. To more effectively fulfill the demands of societal progress and nurture talents of high caliber who possess both innovative spirit and practical capabilities, the urgency of reforming teaching methodologies is palpable. Next, the specific measures of teaching method reform will be discussed in depth from four aspects: optimizing teaching content, innovating teaching methods, strengthening practical instruction and innovating evaluation approaches, as shown in Fig. 2.

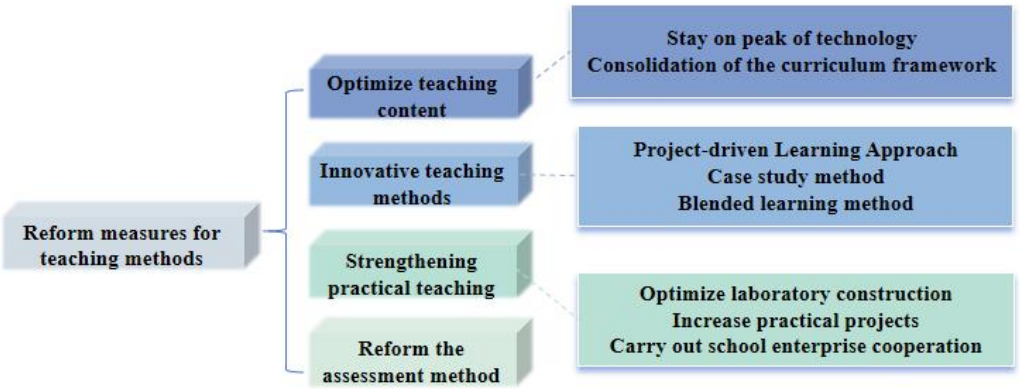

Figure 2. Reform measures for teaching methods

4.1 Optimizing Teaching Content.

4.1.1 Stay on Peak of Technology. Computer network technology is advancing at a breakneck pace, with a constant stream of novel theories, cutting-edge technologies, and innovative applications coming to the fore. So as to make the teaching content run parallel to the development of the sector, teachers must pay constant attention to the latest developments of international authoritative academic journals, top industry conferences and famous technology enterprises, and grasp the research hotspots of frontier technologies such as quantum communication networks in a timely manner; at the same time, they should pay close attention to the innovative practices of Google, Microsoft, Huawei and other technology giants in the field of networking, and analyze in depth the information of their technical white papers and product launches, and integrate the frontier knowledge into the teaching content [4].

When teaching network architecture, cutting-edge concepts such as software-defined networking (SDN) should be introduced and contrasted with conventional network architecture; and how SDN technology can be utilized to build an agile and intelligent network infrastructure to meet diversified business needs in scenarios such as 5G and industrial Internet should be explored. In terms of network security teaching, it should follow the industry hotspots and analyze the principles and applications of emerging security technologies such as artificial intelligence-driven malware detection, etc., so as to facilitate students to comprehend the cutting-edge dynamics of network security defense.

4.1.2 Consolidation of the Curriculum Framework. The knowledge system of computer network course contains many interrelated knowledge points. However, traditional teaching methods often show these knowledge points in a piecemeal manner, resulting in students can only see one isolated knowledge point, but can not see the whole picture of the entire knowledge system, and it is challenging to construct a systematic and complete knowledge framework. Therefore, it becomes necessary to integrate the course system [5]. When imparting network topology, we should introduce the characteristics of traditional topologies such as star, bus, ring, etc., and conduct students to choose the appropriate topology by considering various factors such as reliability, scalability, cost, etc. Moreover, it is necessary to further explore the key points of IP address allocation scheme and routing protocol configuration that match the selected topology, so that students can understand the intrinsic connection between the knowledge points and learn to plan the network architecture from a holistic point of view.

Theoretical knowledge and practical operation complement each other and are indispensable. During the process of integrating the curriculum framework, there should be a significant enhancement in the share of practical teaching, and a series of practical projects covering the whole life cycle of the network should be designed from easy to difficult. For example, in the introductory stage, students can be arranged to build a small home LAN project, so that they are familiar with the connection of network devices and basic configuration commands; in the advanced stage, carry out the enterprise branch network construction project, which involves the division of multiple subnets, dynamic routing configuration, deployment of network security policies, etc.; In the advanced phase, the incorporation of analog for extensive data center network operation and maintenance initiatives, leveraging SDN technology to attain automated network management and flexible resource allocation. Through these practical projects, students intensify their apprehension of abstract concepts, exercise their operational capability to tackle complicated network problems, and ensure that students can swiftly adjust to the work require.

4.2 Innovative Teaching Methods.

4.2.1 Project-driven Learning Approach. The project-driven teaching method is use the real or simulated projects as the key driving force that permit students to take the initiative explore in the process of project practice, so as to achieve the synchronous improvement of learning and ability [6]. Teachers should first carefully select suitable projects, which can originate from actual network engineering projects commissioned by enterprises, such as building office networks for native small and medium-sized enterprises (SMEs); they can also carry out cutting-edge exploratory projects based on scientific research topics, for example, researching distributed network storage based on the blockchain; what's more, they can also choose ingenious practical projects approach daily life, such as designing a wireless network coverage program for campus, building network control system for smart home, etc.

Taking the construction of an enterprise office network project as a case in point, the instructor directs the students to establish a project team and proceed in accordance with the operational procedures of a corporate project. Starting from the demand research in the project initiation stage, students go into each department of the enterprise to comprehend amount of office workers, service types, application situations of the network, and collect the demand for network performance; Subsequently, the project transitions into the planning and design phase. Leveraging insights gleaned from the demand analysis, we apply expertise in network topology, IP address allocation, network security protocols, and other pertinent areas, to design a detailed planning Then in the implementation and deployment phase, students personally install and debug network devices, configure VLANs, routing protocols, firewall rules, and turn the planning blueprint into an actual network; finally, during the test optimization phase, network testing tools are used to measure the network performance indicators, and network optimization techniques are used to adjust and optimize the problems found, such as blind areas of signal coverage and congested nodes of the network, to ensure that the network can operate stably and efficiently.

During the whole project implementation, teachers play the dual role of mentor and coach, they will give students technical guidance and resource assistance at the right time, and at the same time control the speed and overall direction of the project. The students, driven by independent learning and teamwork, can not only master the configuration of network equipment, troubleshooting techniques and performance optimization strategies and other professional skills, but also develop good cooperation capacity, problem addressing skills and active innovative mindset, thereby developing a range of comprehensive qualities in the process, so as to realize the transformation from simple knowledge learners to qualified network engineers with professional qualities. In this way, you can successfully realize the transformation from a mere knowledge learner to a qualified network engineer with professional qualities.

4.2.2 Case Study Method. Case teaching method refers to the teaching process, the teacher takes the case as a clue to guide students in conducting through analysis and discussion . First of all, throw out questions, such as "In the evolution of data center network architecture, what are the advantages of SDN technology over traditional architecture? What are the challenges?"

“E-commerce enterprises 'double eleven' network traffic surge, how to predict the traffic trend in advance, accurate deployment of network resources?” etc., to stimulate students' interest; then organize students to discuss in groups, encouraging each group to analyze the problem from different perspectives and put forward their insights; finally, each group will report the results of the seminar, and the teacher will comment and summarize, sorting out the knowledge contained in the case, the technical methods, and instructing the students to ponder over the initiatives under similar scenarios.

4.2.3 Blended Learning Approach. As a new trend in the development of education, blended teaching integrates the dual advantages of online and offline instruction, and injects strong vitality into the innovation of teaching methods [7].

On the one hand, in terms of course resource integration, the online platform integrates a large number of high-quality learning resources. For example, it provides high-definition online course videos, cutting-edge academic papers and electronic teaching materials, etc., which students can independently choose and study at any time according to their own learning progress and needs. The offline link focuses on providing students with in-depth practical experience, such as in the computer network training courses, students can operate real network device, intuitively feel the whole process of network architecture and data transmission, so as to better understand the theoretical knowledge.

On the other hand, in terms of the organization of teaching activities, online teaching through live broadcasts, recordings and other forms of theoretical knowledge, the use of online forums, instant messaging tools to promote interaction between instructors and pupils, breaking the space-time constraints, to ensure the timeliness of knowledge transfer. The offline classroom conducts team cooperative study, project practice reporting and other events, teachers can observe students' performance in close proximity, and provide targeted guidance to enhance learning effect. For example, in the web application development course, students first grasp the framework, and then to complete the actual project development offline. In this process, students routinely use the online platform to record the project advancement, discuss the issues encountered, and the teacher follows up and guides the whole process online and offline, thereby enabling this integrated educational model to allow students to fully reap the advantages of both learning approaches and significantly enhance the efficacy of learning [8].

4.3 Enhanced Practical Teaching. Enhancing practical instruction is pivotal to boosting students' capabilities. First of all, Enhancing the development of laboratories, which serve as crucial venues for hands-on instruction, is imperative. The quality of their physical infrastructure directly impacts students' practical skills.Colleges and universities are supposed to enlarge financial investment, update network laboratory equipment, and introduce high-performance routers, switches, firewalls, etc., in order to meet the practical needs of students for high-speed networks, SDN, network security and other cutting-edge technologies. In addition, it is necessary to equip sufficient server resources. In terms of laboratory layout, it should simulate real network scenarios and deploy network management systems, traffic monitoring tools, and simulated attack platforms to provide students with a full range of practice scenarios.

Secondly, it is necessary to increase the number of practical projects, which should be both comprehensive and innovative in design, covering network planning, equipment configuration, protocol analysis, performance refinement and additional dimensions of the whole life cycle of the network. For example, the campus network upgrading project requires students to use a variety of knowledge and skills, starting from the research of the existing network architecture, user needs, business traffic characteristics, and designing an upgrading plan to meet the needs of the next five years of campus information technology development, including equipment selection, IP address planning, network redundancy link deployment, etc. Students are also required to implement equipment installation and commissioning, protocol analysis, performance optimization, security protection and other network life cycle aspects. Students also need to implement equipment installation and commissioning, configure VLANs, routing protocols, access control lists, and use network testing tools to monitor performance and solve practical problems during implementation.

Finally, a comprehensive security protection system is developed from a network security perspective. At the same time, students are encouraged to innovate independently and incorporate elements of emerging technologies in their projects.

Finally, school-enterprise cooperation serve as an significant bridge between the campus and the workplace. Colleges should establish intensive partnership with network equipment manufacturers, Internet enterprises, etc., to build off-campus internship bases. During the internship period, students can participate in actual projects of enterprises, such as 5G network deployment, cloud data center operation and maintenance, industrial Internet platform research and development, etc., so as to experience cutting-edge practices and understand industry needs and technology trends. Schools and enterprises can also jointly carry out order-based talent training, customize the curriculum system based on the needs of the enterprise, the enterprise selects engineers to serve as part-time teachers, and university teachers go to the enterprise to work as part-time teachers, forming a good pattern of teacher interaction and collaborative training, so that students can quickly become practical network talents urgently needed by enterprises after graduation [9].

4.4 Reform of Assessment Methods. Transforming the evaluation approach holds immense significance in enhancing the efficacy of teaching. The traditional theoretical examination method is difficult to comprehensively assess the comprehensive quality of students, therefore, it is necessary to construct a diversified assessment system [10]. The diversified assessment is shown in Fig. 3. In order to reflect students' learning achievements more comprehensively, the assessment indicators should contain theoretical knowledge, hands-on capability,creative mindset and other dimensions. In the assessment of theoretical knowledge, it should also increase the forms of stage quizzes, classroom interactive quizzes and knowledge competitions, which examines the students' proficiency of the elementary knowledge of the network principles, protocols, algorithms and other basic knowledge, but also avoids the students' exams on a temporary basis. Practical ability assessment should be carried out throughout the entire practical teaching process, by observing the performance of students in the experimental operation and project practice, assessing their proficiency in network equipment configuration, troubleshooting accuracy, the rationality of the program design, and the standardization of the practice report, etc., to insure that the students can comprehend the knowledge,and apply it adeptly in practical situations. The inventive mindset assessment encourages students to introduce new technologies and propose innovative solutions in course design.

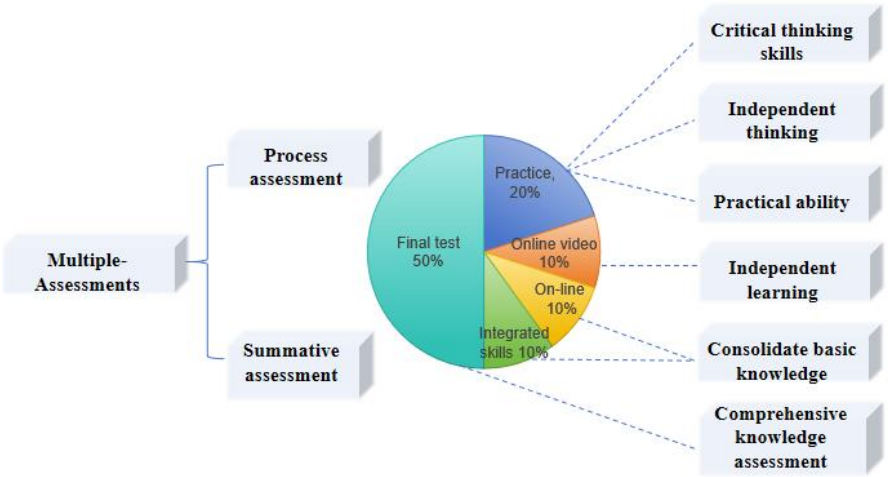

Figure 3. Multiple-Assessments

5. Summary

This paper discusses the complex issues concerning the innovate of instructing methods, expounds the significance for such reform, and devises and carries out a range of concrete reform initiatives. In the age of digitalization, the social demand for computer network professionals is increasingly diversified and high standards, the shortcomings of the traditional guidance mode is highlighted, the

reform is imperative.

The reform of the teaching method faces both new challenges and unlimited opportunities. Accelerated technology iteration, quantum communication and other cutting-edge technologies are developing rapidly, requiring rapid updating of course teaching content, so that what students learn is closely synchronized with the forefront of industry development. Meanwhile, the thorough integration of AI, big data, and computer networks has set forth elevated demands regarding teachers' reserves of interdisciplinary knowledge and their pedagogical competencies, and teachers need to continue self-advancement to lead students to explore cutting-edge knowledge in depth. To further advance the reform, the teaching mode should be innovated, and the capability of virtual reality (VR), augmented reality (AR) in teaching should be explored, so as to create immersive and interactive learning scenarios, make abstract knowledge tangible, and enhance the learning experience.

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Application of New Media Technology in Education

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Abstract. Under the cyberspace continuously built up by algorithms, big data and smart technologies, the application of new media technologies in education is becoming more and more widespread, bringing new opportunities for educational innovation. This study systematically explores the current situation, challenges and opportunities of the application of new media technologies in education. Firstly, the relevant theoretical foundations are sorted out through literature review; secondly, combined with case studies, it provides an in-depth analysis of how new media technology promotes educational content innovation and learning effect enhancement in the new era; thirdly, through case collection and empirical research, it verifies the advantages of new media technology in enhancing learning interactivity and personalisation, improving learning motivation, promoting knowledge sharing and building learning communities, and reveals the challenges such as technology acceptance, digital divide, and data security and privacy protection; finally, coping strategies are proposed to address these challenges, and the role of new media technologies in promoting educational equity and enhancing educational quality is emphasised. This study aims to provide educational institutions and educators with practical suggestions for the effective use of new media technologies to enhance teaching effectiveness and learning experience, which is of great significance in promoting the process of educational informatisation and facilitating educational innovation and development.

Keywords: New Media Technology; Education Field; Education Informatisation; Education Innovation

1. Introduction

In today's information society, with the rapid development of mobile Internet technology and the widespread popularity of intelligent terminal devices, the field of education is undergoing profound changes. The rapid development of new media technologies has revolutionised the dissemination of educational content, not only greatly enriching access to educational resources, but also significantly enhancing the learning experience. With their unique interactivity, immediacy and extensiveness, these technologies enable the rapid and wide dissemination of educational content to all corners of the globe, breaking the time and space boundaries of traditional education and promoting the optimal allocation and sharing of educational resources. However, although the application of new media technology in education has achieved remarkable results, it still faces many challenges. Uneven acceptance of technologies has led to a growing digital divide, with a portion of the population unable to fully enjoy the convenience of these technologies, exacerbating educational inequality. At the same time, the issue of data security and privacy protection has also become an urgent challenge, how to use big data and artificial intelligence technology to optimise learning results at the same time, to protect personal privacy and data security has become an important issue. In addition, the establishment and improvement of the evaluation system of education quality and effect is also an important challenge at present, and how to accurately assess the effect of the application of new media technology in the field of education to ensure the steady improvement of education quality is a problem that educators and policy makers need to deeply think about and solve. Therefore, this study aims to comprehensively explore the status quo, advantages and challenges of the application of new media technologies in education and put forward targeted coping strategies, with a view to providing useful references for educators, policy makers and researchers in related fields, promoting the process of education informatisation, and facilitating the fairness and quality improvement of education.

This study is significant at both the theoretical and practical levels. At the theoretical level, this study helps to deepen the understanding of the application of new media technologies in the field of education. By systematically sorting out and analysing the theoretical foundations, development history and specific applications of these technologies in the field of education, this study is able to reveal the internal logic and operation mechanism of these technologies, and provide new theoretical perspectives and frameworks for research in related fields. At the same time, this study can also enrich the research results of many disciplines, such as pedagogy, communication and information technology, and promote the in-depth development of interdisciplinary research. At the practical level, this study can play a positive role in promoting the process of education informatisation, improving the quality of education and promoting education equity. By exploring the status quo, advantages and challenges of new media technologies in education, this study can provide practical guidance to educators and policy makers, helping them to make better use of these technologies to innovate teaching and learning styles, and to improve students' learning efficiency and experience. In addition, this study can provide useful references and insights for solving the problems and challenges encountered in educational practices, and promote the sustainable and healthy development of education.

2.New Media Technology Base

2.1 Technologies and Classification of New Media. The technology and classification of new media is an important topic in the field of contemporary media. From a technical point of view, new media mainly rely on modern information technologies such as digital technology, network technology and mobile communication technology to provide users with information and entertainment services through channels such as the Internet, wireless communication networks and cable networks, as well as terminals such as computers, mobile phones and digital television sets. New media are media forms that appear under the new technology support system, such as digital magazines, digital newspapers, digital radio, mobile phone text messaging, mobile TV, internet, desktop windows, digital TV, digital movies, touch media, mobile phone networks, etc [5].

New media technologies cover a wide range of technological fields, including social media, mobile Internet, virtual reality (VR) and augmented reality (AR), artificial intelligence (AI), blockchain technology, cloud computing, and the Internet of Things. These technologies not only enable new media to disseminate information in real time, quickly and widely, but also provide rich interactive experiences and personalised services. For example, social media platforms make use of Internet technology to enable users to share information, communicate and interact in real time, forming a huge social network; the popularity of the mobile Internet has led to the emergence of mobile applications (APPs), which provide users with a rich variety of functions and services, such as online shopping, online payment, map navigation, etc.; and the development of AI technology promotes the intelligence and personalisation of new media. Through intelligent algorithms and data analysis, new media can more accurately understand users' needs and preferences, and provide users with more personalised content and services.

From a classification point of view, new media can be divided into various types based on different criteria and characteristics. According to communication channels and terminals, new media can be divided into online media (such as web portals, search engines, social media platforms, video sharing websites, etc.), mobile media (such as mobile applications, mobile games, mobile advertisements, short message services, etc.), digital TV and IPTV. According to user engagement and interactivity, new media can be classified into social media (e.g., WeChat, Weibo, Instagram, etc., where users can create and share content for social interaction), self-media (where an individual or a small team publishes content through an Internet platform, such as personal blogs, video bloggers, live anchors, etc.), etc., as shown in the classification of common new media apps in Fig 1. In addition, new media can also be classified as new media art based on the form of content and artistic expression, such as digital painting, interactive installation art, etc. These classifications are not fixed, and with the continuous development of new media technology and the continuous expansion of application fields, new classifications may emerge. The diversity and

flexibility of new media make it the most dynamic and innovative part of the modern media field.

Figure 1. New media classification display

2.2 The Role of New Media Technologies in Information Dissemination. New media technologies have three significant characteristics. First, interactivity. With the help of computers and network platforms, new media technology has realised the transformation of the new information dissemination mode from the passive reception of information to the active participation in information creation, editing, dissemination and feedback interaction. Second, digital. Through digital storage and processing, new media technology breaks the time and space limitations and greatly improves the speed, scope and flexibility of information dissemination. Globalisation. New media technology realises global information dissemination and sharing through network platforms, which promotes cultural exchange and international understanding [6] .

The influence of new media technology in information dissemination is far-reaching and extensive. Firstly, new media technology has greatly broadened the channels and scope of information dissemination. Traditional media are limited by physical media and geographical restrictions, and the dissemination of information is often limited by time and space. However, the development of new media technologies, especially the Internet and mobile communication technologies, has made it possible for information to spread rapidly and widely across the globe, transcending geographical and time constraints. New media channels, such as social media platforms, news websites and mobile applications, provide a virtually borderless platform for the dissemination of information, which can be accessed and shared by users anytime and anywhere, greatly enhancing the accessibility and timeliness of information. In addition, new media technologies have promoted the diversification and personalised dissemination of information. Through various forms such as pictures, videos, audios and live broadcasts, as well as intelligent algorithms and data analysis, new media are able to accurately push content that meets the interests and needs of users, making the dissemination of information more precise and efficient.

New media technologies have significantly enhanced the interactive and participatory nature of information dissemination. The information dissemination model of traditional media is often unidirectional, with the audience receiving information passively and lacking effective feedback and interaction mechanisms. New media technology, especially the rise of social media and self-media platforms, makes the user no longer only the receiver of information, but also the creator and disseminator of information. Users can actively participate in the process of information dissemination through commenting, liking, sharing, forwarding and other ways, forming a two-way interactive mode of information dissemination. This interactivity and participation not only enhances the effect of information dissemination, but also promotes the formation of social opinion and the discussion of public topics, making information dissemination more active and diversified. Through its powerful information dissemination capacity and interactivity, new media technology is profoundly changing the mode and pattern of information dissemination, and has had a far-reaching

impact on information exchange and public opinion guidance in modern society.

3. Application of New Media Technologies in Education

3.1 Application of New Media Technology in Teaching Content Innovation. The application of new media technology in teaching content innovation is gradually changing the face of education, bringing unprecedented vigour and change to the field of education. This technology greatly enriches the teaching content by integrating text, pictures, audio, video and other media resources, making the learning process more vivid and intuitive. For example, in the history classroom, teachers can use new media technology to play historical documentaries, display valuable historical pictures and maps, and even let students "experience" historical events through virtual reality technology, which not only enhances the sense of immersion in learning, but also promotes students' in-depth understanding of historical knowledge and memory. This kind of immersive learning not only enhances the sense of immersion, but also promotes students' deep understanding and memory of historical knowledge.

At the same time, new media technologies have also promoted innovation in teaching methods. Through online learning platforms, social media and specialised educational APPs, teachers can easily release pre-testing materials, post-course assignments and even conduct live lectures, while students can ask questions and participate in discussions at any time, forming a good learning atmosphere of teacher-student and student-student interaction. This instant feedback mechanism not only improves teaching efficiency, but also stimulates students' interest and enthusiasm in learning. In addition, based on big data and artificial intelligence technology, the new media technology is also able to analyse students' learning behaviours and performance, and recommend personalised learning resources for them, such as customised practice questions and interest-orientated reading materials, so as to satisfy the learning needs of different students and realise tailor-made teaching.

In concrete practice, the application of new media technology is even more colourful. For example, in the teaching of science and engineering, virtual laboratories created with virtual reality (VR) and augmented reality (AR) technologies allow students to carry out experimental operations in virtual environments, which not only reduces the cost of experiments and avoids safety risks, but also provides a more intuitive and realistic learning experience. In terms of cross-cultural communication and cooperation, through video conferencing software and online social networking platforms, students from different countries and regions can cross geographical boundaries and jointly participate in project cooperation and cultural exchange activities, which broadens their international horizons and enhances their cross-cultural communication skills. In addition, the flipped classroom model is also one of the applications of new media technology in teaching. By releasing teaching videos, PPTs and other pre-study materials in advance, students learn independently at home, while the classroom is mainly used for discussion, problem solving and practical operation, this teaching model flips the traditional teaching process, emphasises the importance of active learning and improves learning efficiency, and its conceptual schematic diagram is shown in Fig 2.

Figure 2. Schematic diagram of flipped classroom

The "Digital Forbidden City" project launched by the Palace Museum using virtual reality technology allows students to tour the Forbidden City online, see the details of cultural relics up close, and even participate in interactive puzzle solving games, which is an attempt to digitise the cultural heritage of the Scenario Revolution 3.0 [7]. This vivid and interactive learning method greatly enriches the teaching content of history and culture. In STEM education, through the online programming platform, students can design, programme and control robots to complete various tasks in the virtual environment, and this teaching method not only exercises students' logical thinking and programming ability, but also stimulates their interest in science and technology and their sense of innovation.

In summary, the application of new media technology in teaching content innovation not only enriches the teaching means and improves the quality of teaching, but also promotes the development of educational fairness and individualisation, and lays a solid foundation for the cultivation of innovative talents adapted to the needs of the future society.

3.2 Interactive Teaching and Learning Community Building. Interactive teaching and the establishment of learning communities are gradually becoming the new normal in the field of education, driven by new media technologies. With its immediacy, interactivity and extensive connectivity, new media technology greatly facilitates interactive communication between teachers and students, and also provides strong support for the establishment and operation of learning communities.

Through online learning systems, social media and other new media channels, teachers can release teaching materials and answer students' questions at any time, while students can participate in learning, questions and discussions anytime and anywhere. This all-weather, all-round interactive mode not only enhances communication between teachers and students, but also stimulates students' interest in learning and promotes the effective transmission of knowledge and deepening of understanding.

In terms of learning communities, new media technology has made it easier to share resources, organise activities and display results. Learners can independently choose learning contents, participate in online discussions and share learning tips and experiences, forming an open, collaborative and innovative learning environment. For example, Xi'an University of Technology (XUT), for example, has established a learning community of "Xi'an University of Technology Network Teaching Platform Communication Circle" in the online platform of Learning Channel, as shown in Fig 3. Some online education platforms can also make use of new media technology to provide learners with personalised learning path planning, intelligent recommendation and other functions, and at the same time set up social modules such as learning communities and online forums to facilitate interaction and communication among learners.

New media technology plays an important role in promoting teacher-student interaction and establishing and operating learning communities, which breaks the time and space constraints of the traditional classroom and provides learners with a more flexible and convenient way of learning. With the continuous development and popularisation of new media technology, it is believed that more learning communities will emerge in the future, bringing more innovation and change to the field of education.

Figure 3. Online learning community shown in the example of Xi'an University of Technology

The profound impact of new media technology on the field of education in the new era is mainly reflected in three aspects: first, new media technology can effectively stimulate students' positive initiative. The use of new media technology, user demand-oriented innovative communication methods, effectively enhance the relevance of education and student learning enthusiasm. Secondly, new media technology can break through the time and space limitations. New media technology helps traditional education to break through the time and space limitations, enhance students' self-management ability with vivid forms and innovative modes, and derive new values in education. Thirdly, new media technology can increase the attention of education. Teachers use new media technology to communicate with students in real time through online social platforms, which helps to increase the attention of students [8].

4. Challenges and Opportunities of New Media Technologies in Education

4.1 Challenges of New Media Technologies in Education. Despite the fact that new media technologies are currently being used in education in a promising way, bringing many innovations and conveniences to education, they are also facing a number of difficulties and challenges.

Firstly, technical difficulties and equipment updating are a major problem. With the continuous development of information technology and the emergence of new technologies and tools, schools need to update and upgrade their teaching equipment and facilities to meet the new teaching needs and technological environment [9]. The diversity and rapid development of new media technologies have brought about the problem of poor equipment compatibility. Different brands and models of equipment may have differences in display content and interaction methods, which brings troubles to the presentation of teaching content and students' learning experience. In addition, network instability is also a major challenge. When conducting real-time interactive learning such as online live streaming and video courses, problems such as network lag and delay can seriously affect the teaching effect and learning experience.

The quality of educational resources is uneven, and new media technology provides a huge amount of resources for education, so the quality of resources will inevitably be uneven. There exists a large amount of low-quality, erroneous and even harmful content on the Internet, and it is a difficult problem for learners, especially those with weak independent learning abilities, to filter out quality educational resources. This not only requires learners to have a high level of information screening and judgement, but also requires education departments and schools to strengthen the regulation and assessment of new media educational resources.

In the context of the rise of new media technologies, the technological literacy and role of teachers have been transformed, and there are certain challenges to the authority of teachers. In the new media era, information is presented in various forms, which can provide students with more different learning channels, and this will weaken the educational role of teachers to a certain extent, posing a greater challenge to the authority of teachers [10]. However, some teachers may not be skilled enough in new media technologies to adapt to this role change. They need to change from traditional knowledge transmitters to guides and organisers to help students make better use of new media resources for learning. This not only requires teachers to continuously improve their own learning literacy, but also requires schools and educational organisations to provide teachers with more training and learning opportunities on the application of new media technologies.

Along with the convenience and innovation of new media technology, the physical and mental health problems caused by students' over-reliance on electronic devices have attracted attention. Prolonged use of electronic devices for learning can easily cause students to suffer from fatigue and lack of concentration. In addition, over-reliance on electronic devices may also have negative impacts on students' physical and mental health, such as vision loss and cervical pain. Therefore, how to guide students to use electronic devices reasonably and cultivate good learning habits and lifestyles has become a major challenge for new media education.

The issue of data security and privacy protection has always existed, and in new media education, students' personal information and learning data may be over-collected and misused, which not only violates students' privacy, but also may cause a series of social problems. Therefore, it is crucial to

strengthen data security and privacy protection. Education departments and schools need to establish a sound data protection mechanism to ensure that students' personal information and learning data are not leaked and misused. A questionnaire survey on the problems brought about by the use of new media technologies in the field of education by teachers and students in colleges and universities was obtained as shown in Fig.4 .

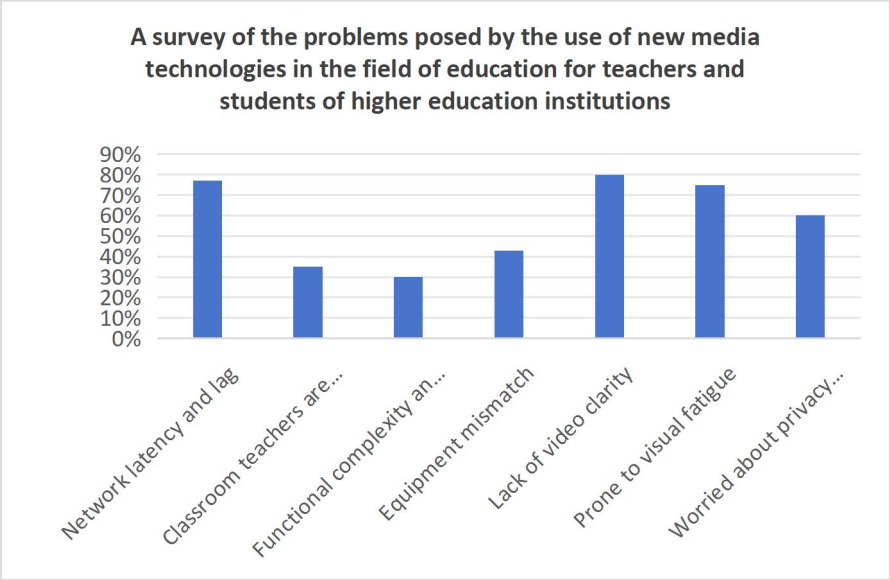

Figure 4. Survey on the problems posed by the use of new media technologies in the field of education for teachers and students of higher education institutions

In summary, although the application of new media technologies in education has brought about many innovations and conveniences, it also faces difficulties and challenges in terms of technical compatibility, resource quality, teachers' technical literacy, students' physical and mental health, and data security. In order to give full play to the advantages of new media technologies and promote the digital transformation of education, it is necessary for education departments and schools, teachers, students and all sectors of society to work together to actively address these challenges and jointly explore new paths for education that are adapted to the development of the times.

4.2 Opportunities and Prospects for New Media Technologies in Education. Although the rapid development of new media technology brings inevitable difficulties and challenges, it also brings unprecedented opportunities for the field of education. It not only broadens the boundaries of education, but also promotes the fair distribution of educational resources and the realisation of personalised learning, opening up a broad prospect for the future of education.

Firstly, new media technologies offer the possibility of sharing and collaborative development of educational resources. Through new media forms such as online course platforms, educational APPs and social media, high-quality educational resources can cross geographical restrictions and be shared by learners worldwide. This not only helps to narrow the geographical differences in educational resources, but also promotes educational exchanges and cooperation in different cultural contexts.

Secondly, new media technology provides strong support for personalised learning. Through big data analysis, artificial intelligence algorithms and other technical means, new media platforms are able to accurately analyse learners' learning behaviours and preferences and provide them with customized learning resources and paths. This kind of personalised learning not only improves learning efficiency, but also stimulates learners' interest and motivation.

In the future, the application of new media technology in the field of education will be more extensive and in-depth. With the continuous development of 5G, Internet of Things, virtual reality and other technologies, new media education will show a more diversified and intelligent trend. For example, through virtual reality technology, learners can immerse themselves in historical events, scientific experiments and other scenes, so as to obtain a more intuitive and vivid learning

experience. At the same time, new media education will also pay more attention to the participation and interaction of learners, and promote communication and cooperation among learners through online discussion and collaborative learning.

In addition, new media technologies will also promote changes in the way education is evaluated. While traditional examination and evaluation methods tend to focus on the memorisation and reproduction of knowledge, new media education pays more attention to the evaluation of learners' innovative and practical abilities. Through big data analysis and artificial intelligence technology, we can track and assess learners' performance in the learning process in real time, providing them with more comprehensive and objective evaluation results.

In conclusion, the opportunities and challenges of new media technology in the field of education coexist, and in the future development, in view of the challenges brought by new media technology, it is necessary to analyse the problems rationally and pay attention to solving the practical application problems [11]. Recognising the double-edged sword nature of new media technology, understanding the characteristics of the development of the times, understanding the current media development environment, responding positively and innovating continuously, we will be able to seize the opportunities and meet the challenges, and promote the digital transformation and high-quality development of education.

5. Conclusions and Recommendations

5.1 Research Summary and Key Findings. With the rapid development of information technology, the application of new media technologies in the field of education is becoming more and more widespread, providing new opportunities for news dissemination and educational innovation. This study delves into the current situation, advantages and challenges of the application of new media technologies in the field of education, and systematically analyses how these technologies can promote the innovation of educational content and enhance the learning effect through a variety of methods such as literature review, case study, case search and empirical research.

It has been found that the use of new media technologies can significantly enhance the interactivity and personalisation of learning, and improve the attractiveness and dissemination efficiency of educational content. This combination not only breaks the time and space limitations of the traditional education model, but also meets the needs of different learners through intelligent learning platforms and personalised learning path design. At the same time, it provides rich interactive functions, such as online discussion, real-time feedback, collaborative learning, etc., which enhances the sense of participation and belonging in learning.

In addition, empirical studies have shown that new media technologies have significant advantages in enhancing students' motivation to learn, promoting knowledge sharing and building learning communities. Through immediacy, interactivity and extensive connectivity, it promotes interaction and communication between teachers and students, and also provides strong support for the establishment and operation of learning communities, forming an open, collaborative and innovative learning environment.

However, the study also reveals a number of challenges, including the issue of digital divide due to uneven technology acceptance, issues such as data security and privacy protection, and how to effectively manage learning time without the constraints of a traditional classroom environment and avoid learner distraction. These issues require the joint attention of educators and policymakers, and the adoption of appropriate response strategies.

In summary, the application of new media technologies in the field of education brings both unprecedented opportunities and a series of challenges. This study not only deepens the understanding of the application of these technologies in the field of education, but also verifies their effectiveness in practical application through empirical research and proposes targeted coping strategies. These findings are of great significance for promoting the process of education informatisation and educational innovation and development, and also provide practical suggestions for educational institutions and educators on how to effectively use these technologies to enhance teaching effectiveness and learning experience.

5.2 Implications and recommendations for educational practice. In the era of rapid development of new media technology, the application of new media technology in the field of education not only changes the traditional mode of education, but also brings new insights into educational practice. Firstly, in educational practice, the flexibility and convenience of mobile learning should be fully utilised to break the time and space limitations and provide students with learning opportunities anytime and anywhere. Educational institutions can develop diversified mobile learning resources, such as online courses and interactive teaching materials, to meet the learning needs of different students. At the same time, the richness and interactivity of new media technologies are used to innovate teaching content and methods, such as simulating experimental scenarios through virtual reality technology or using social media platforms to promote collaboration and communication among students.

In terms of application strategies, educators should focus on the design of personalized learning paths, analyse students' learning behaviours and preferences with the help of big data and artificial intelligence technologies, and provide them with customized learning resources and advice. In addition, students should be encouraged to take the initiative to participate in learning, and their interest and motivation should be stimulated through discussions, competitions and other activities on the mobile learning platform.

However, new media technologies also face many challenges in educational practices, such as uneven technology acceptance, digital divide issues, data security and privacy protection. To address these challenges, educators and policymakers need to take proactive measures. First of all, investment in new media technologies should be increased to improve the balanced distribution of educational resources and ensure that every student can enjoy high-quality educational services. At the same time, technical training and guidance should be strengthened to enhance students' information literacy and digital skills and help them better adapt to the digital learning environment.

In terms of data security and privacy protection, educational institutions should establish a sound data management system to strengthen the protection and management of learning data and prevent data leakage and misuse. They should also strengthen data security education for students and parents to raise their awareness of data protection.

In summary, the application of new media technologies in education has brought new opportunities and challenges to educational practices. Educators should make full use of the advantages of these technologies to innovate teaching methods and content, while actively addressing the challenges to ensure that every student can develop holistically in a digital learning environment.

5.3 Future Research Directions and Perspectives. In exploring the application of new media technologies in education, this study has achieved some results, but there are still limitations. For example, this study has not yet proposed comprehensive solutions to the challenges of digital divide issues, data security and privacy protection due to uneven technology acceptance. In addition, the significant differences in access to mobile learning resources and new media technology devices among learners in different regions and economic conditions have also constrained the in-depth development of education informatisation, which needs to be further explored and addressed in future research.

Future research directions could focus more on how to narrow the digital divide and improve the balance of educational resources. For example, research can be conducted on how to provide learners in economically disadvantaged areas with more access to mobile learning resources and new media technology devices through policy guidance and technological innovation. Meanwhile, with regard to data security and privacy protection, future research could delve into the application of encryption technology, anonymisation and other means in education to ensure the security of learners' information.

In addition, future research can further explore the potential of new media technologies in promoting education equity and enhancing education quality. For example, research can be conducted on how to meet the needs of different learners and improve learning outcomes through intelligent learning platforms and personalised learning path design. Meanwhile, attention can also

be paid to the application of new media technologies in cross-cultural communication and co-operation, exploring how to use new media technologies to promote mutual understanding and respect among learners from different cultural backgrounds, and to cultivate a global perspective and cross-cultural communication skills.

In conclusion, with the continuous optimisation of technology and the further deepening of the curriculum reform of university subjects, new media technology will certainly play a greater role in the field of education, assisting teachers to continuously improve teaching and continuously improve the quality of talent cultivation [12]. Future research should continue to deepen the understanding of the application of new media technology in the field of education, and put forward more comprehensive and specific solutions to promote the process of education informatisation, and to promote the fairness and quality improvement of education.

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Exploration on the Integration of OBE Concept into Computer Foundation Courses

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Abstract. With the continuous development of educational concepts and teaching models, the "Outcome-Based Education (OBE)" model has been widely applied worldwide. This article first elaborates on the definition of the OBE educational concept and its core issues, emphasizing that this model promotes the reform of teaching content, teaching methods, and assessment systems by clearly setting learning outcomes as the goal, especially in university computer foundation courses. The article explores how to integrate the OBE concept into the teaching system design of this course, including adjusting teaching objectives, optimizing classroom teaching methods, and improving assessment methods, to comprehensively enhance students' computer literacy and the effectiveness of course teaching. Through this practice, students' participation and enthusiasm have increased, and the teaching quality of the computer foundation course has improved.

Keywords: OBE Educational Concept; Computer Basics; Teaching Design

1. Introduction

Computer fundamentals courses are essential in information technology majors at higher education institutions.As technology advances, traditional teaching methods no longer meet students' evolving needs. The Outcome-Based Education (OBE) framework has emerged as a solution. OBE focuses on designing teaching content and methods around specific learning outcomes, prioritizing practical skills development. Widely adopted in fields like engineering and medicine, OBE has also proven effective in computer fundamentals instruction.

In regions such as Europe, the U.S., and developing countries, OBE is increasingly implemented in higher and vocational education. In the U.S., the model has evolved through various stages and is used to assess learning outcomes, improving educational quality and students' competitiveness. Countries like Australia and Canada utilize OBE to structure courses and assessments, ensuring students gain essential competencies by course completion.

As educational reforms progress, the implementation of OBE in China has gradually gained prominence, particularly in higher education, where it is viewed as a key approach to improving education quality and fostering innovative talent. Many Chinese universities have begun to adopt the OBE model from international contexts and tailor it to local needs. In some application-oriented, engineering, and science-based colleges, OBE has been widely applied in curriculum design, teaching method improvements, and student assessments. Recently, many higher education institutions and scholars in China have begun exploring the applicability of OBE within the Chinese education system and investigating how to combine OBE with local educational characteristics.

OBE's application in China, though starting later, has made significant progress and is now central to the Ministry of Education's higher education reforms. It has also been gradually adopted in vocational and adult education.

2.Theoretical Basis and Development of the OBE Model

2.1 Definition of the OBE Model. OBE (Outcome-Based Education), proposed by Spady et al. in 1981, quickly became a key focus of educational reform in Europe, America, and other regions. It emphasizes students as the central focus, with learning outcomes guiding the process, highlighting the achievements students should attain through this approach. The OBE model centers on "learning outcomes," ensuring that the design and evaluation of education align with students' learning

achievements. The core concept of the OBE model is to start from students' ultimate abilities, determine teaching objectives and content, and ensure that each student can achieve the predetermined learning outcomes. Compared with traditional teaching models, the OBE model pays more attention to individual differences among students and emphasizes their ability for autonomous learning and solving practical problems [1].

2.2 Characteristics of the OBE Model. Clearly Defined Learning Objectives: Each course and educational activity must precisely outline the knowledge and skills students are expected to acquire. These objectives encompass not only subject-specific knowledge but also abilities, attitudes, and practical competencies. Hence, educators must ensure that each activity has a distinct purpose and that students attain specified outcomes upon course completion.Alignment of Instruction with Learning Objectives: The planning of educational activities must be tailored to achieve the stated learning objectives. Course content, teaching methodologies, and resources should be closely aligned with these predefined objectives. Educators must organize content, select suitable teaching methods, and employ effective resources based on the learning objectives to guarantee that the instructional process effectively supports student achievement [2].

Ongoing Assessment and Feedback: In the Outcomes-Based Education (OBE) framework, assessment is an ongoing practice throughout the instructional period, rather than solely at term's end. Educators should provide frequent feedback to students through diverse assessment methods, such as class participation, group discussions, assignments, project presentations, and peer evaluations. This continuous assessment verifies students' attainment of the expected learning objectives, aiming to provide timely insights to assist students in adjusting their learning strategies, refining their methods, and ultimately enhancing their learning effectiveness.

The OBE model emphasizes a student-centered approach, where teachers shift from knowledge transmitters to facilitators. By creating interactive activities, providing support, and guiding problem-solving, educators inspire students' interest and initiative, helping them explore, reflect, and apply what they've learned.

2.3 Global Development of the OBE Model. The OBE model, developed in the United States in the 1960s, gained global traction through educational reforms and became central to higher education worldwide in the 21st century, driven by globalization and informatization. Both developed countries in Europe and North America and developing nations in Asia have integrated OBE across various fields with significant success. Introduced by Spady and colleagues in 1981, OBE laid the foundation for professional accreditation in engineering education. Its philosophy emphasizes designing courses around students' learning outcomes, using a reverse-engineering approach to define training goals, which then shape the curriculum and teaching plans.

3. Application of the OBE Model in Computer Basics Teaching

As society's demand for talent continues to grow, the traditional rigid, injection-style teaching methods have become inadequate for meeting contemporary societal requirements. Currently, society expects graduates not only to possess strong practical application skills and innovative capabilities but also to excel in certain proficiency tests, such as the CET-4, CET-6, and National Computer Rank Examination (NCRE) Level 2. In response to this evolving demand, the OBE concept has emerged. The OBE concept prioritizes students as the central focus, tailoring teaching goals to their needs and using them as the starting point. It adheres to the principle of backward design, which entails setting training objectives based on societal demands to ensure alignment between educational goals and outcomes. Guided by the OBE educational philosophy, the teaching of university computer fundamentals courses can be better aligned with societal and professional requirements. Through thoughtful course design and teaching implementation, students can not only acquire fundamental computer skills but also develop practical application abilities and innovative thinking. Specifically, in proficiency tests like the NCRE, course instruction can be centered around the exam content to bolster students' test-taking abilities and ensure their successful completion of these certification exams, thereby equipping them with relevant professional qualifications.

3.1 University Computer Basics Course and Its Importance. The University Computer Basics

course plays a vital role in students' academic and career growth, providing essential computer knowledge for all fields, particularly for non-computer majors. Taken in the first year, it covers fundamental concepts, computational thinking, and problem-solving, laying the foundation for future research and technological advancements.

The course emphasizes practical skills, incorporating competition projects and multimedia modules such as digital image processing, audio/video processing, animation design, and micro-course creation. These modules align with students' interests, encouraging creativity and preparation for competitions. For teacher education students, the focus is on "micro-course design" to address career needs.

In the second semester, computer programming is introduced to enhance coding abilities and computational thinking. Educational reforms aim to improve theoretical instruction, practical experience, and assessment methods, fostering active learning and boosting career readiness. Ongoing innovation in content and teaching approaches is essential for achieving these objectives.

3.2 University Computer Basics Course Design Based on OBE Thinking. When designing the University Computer Basics course, aligning with the four core principles of Outcome-Based Education (OBE) is crucial for clear goals and effective teaching. First, teaching objectives should define the skills students need to acquire, focusing on computer knowledge, computational thinking, innovation, and practical application [3]. These objectives should be challenging yet achievable, guiding students toward continuous improvement.The course content should meet students' needs by highlighting its relevance to future studies and careers. As students from different majors have varied demands, the course should be flexible, tailoring content for engineering, management, or liberal arts students to support their professional development.

Successful course implementation requires diverse teaching methods that blend theory and practice. Project-based learning, experiments, and competitions encourage students to apply knowledge and develop practical skills, fostering independent thinking and problem-solving.Effective evaluation is key to enhancing teaching quality. A mix of assessments written tests, practical evaluations, and peer feedback tracks both academic performance and practical skills, while focusing on overall qualities like teamwork, communication, and critical thinking to prepare students for the workforce.

3.3 Hierarchical teaching system structure. A hierarchical teaching system is established based on students' needs and training goals, as shown in Fig. 1. It consists of basic, multimedia, and applied courses [4]. Basic courses focus on computer theory and practical skills to develop students' computational thinking and literacy. Multimedia courses, centered around competition content, allow students to choose based on their interests, stimulating enthusiasm and enhancing practical application. Through competition participation, students progress from understanding to mastery, achieving a leap in skill level.Applied courses are electives tailored to the needs of various majors, such as data analysis, computer-aided teaching design, and e-commerce. Their goal is to serve specific disciplines.

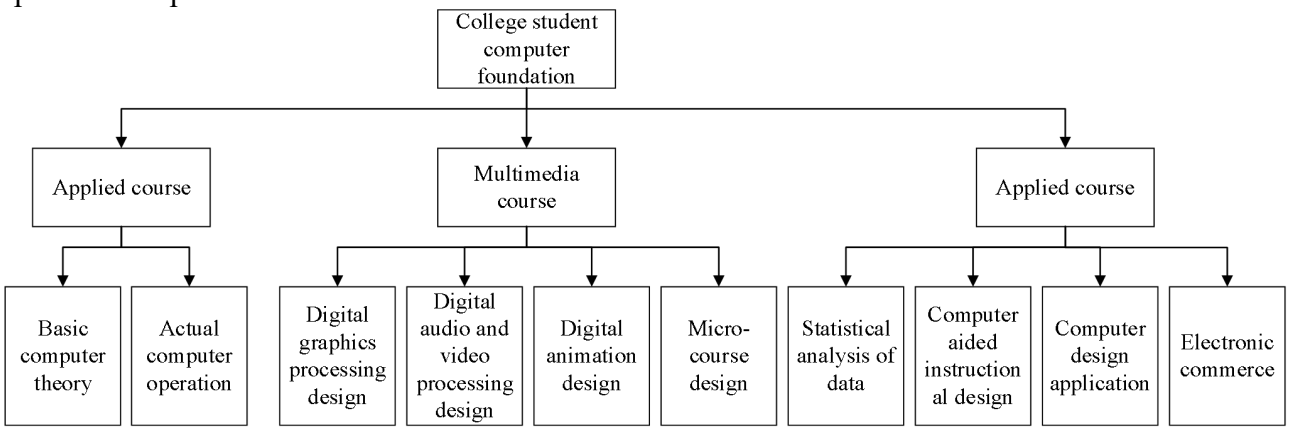

Figure 1. Hierarchical teaching system

3.4 Differentiated teaching according to students. High school students often face significant

academic burdens and considerable stress, coupled with limited computer course hours, resulting in many students having a weak grasp of computer skills. Consequently, these students may struggle with computer learning during their college years, perceive computers as difficult to master, and gradually lose their confidence and interest in studying them. To address this issue, when introducing the OBE (Outcome-Based Education) teaching concept into the teaching of computer basics courses in colleges and universities, educators can classify students into distinct groups based on their individual circumstances and skill levels. For instance, universities can conduct a computer proficiency test upon the arrival of freshmen and subsequently divide them into three classes: A, B, and C, according to their scores, for differentiated instruction. As illustrated in Fig. 2, students with excellent scores or strong computer foundations can be placed in Class A, for which a customized syllabus and teaching plan are devised, and small-class management is implemented. Students with average scores are assigned to Class B, while those with weaker computer skills are grouped into Class C. Appropriate teaching activities are conducted for each class according to the regular teaching plan, and distinct teaching achievement exhibition activities are established for them. This targeted and differentiated teaching approach not only effectively stimulates students' learning motivation and enthusiasm but also significantly enhances the course's teaching effectiveness.

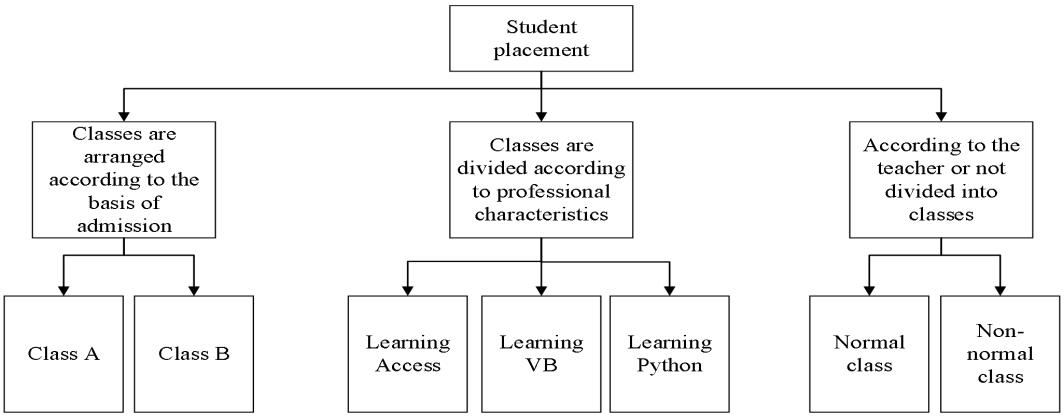

Figure 2. Students are divided into classes

3.5 Personalized teaching according to major. The college computer basics course is a key component of general education, essential for both non-computer and computer majors. However, due to varying needs across disciplines, the teaching focus must be differentiated. In implementing the OBE (Outcomes-Based Education) concept, teachers should tailor their approach to the specific learning requirements of each major, ensuring that the course supports students' professional learning and career development.

For example, finance majors require strong Excel skills for financial data analysis. Teachers should focus on building students' data analysis abilities, starting with basic Excel functions and gradually introducing more complex ones, such as financial, logical functions, and data analysis tools. By using real-world financial case studies, students can apply Excel to solve professional problems, deepening their knowledge and skills.

Additionally, universities can offer computer language courses like Visual Basic, Access, Python, and C, based on students' professional needs. For liberal arts majors, such as business administration and business English, Access courses can be offered to teach database management and simple programming. For engineering, computer science, and related fields, Python courses can be introduced to develop programming skills in data processing and engineering applications.

Through such differentiated curriculum design, students can acquire relevant knowledge and skills tailored to their major, meeting their learning needs and laying a solid foundation for their future careers. The OBE-based teaching approach ensures a student-centered, achievement-oriented education that supports both academic growth and professional development.

3.6 Case-based operation instruction teaching. In teaching fundamental computer courses, case-based instruction plays a key role in enhancing students' understanding of core concepts.

Within the OBE (Outcomes-Based Education) framework, incorporating real-world cases can improve teaching efficiency, education quality, and students' hands-on skills. For example, when teaching Office software, instructors can use graduate thesis examples to demonstrate Word formatting techniques, such as font settings, table of contents creation, and page design. This allows students to directly engage with the software and gain practical experience in formatting their own thesis, reinforcing both Word skills and operational competence.

Similarly, PPT creation is a crucial skill, especially for thesis defenses. Instructors can use professional defense PPTs as case studies to teach design templates, animation effects, and custom fonts. These practical cases help students create polished presentations and acquire the necessary skills for future academic and professional use [5]. This case-based approach aligns with the OBE philosophy, focusing on practical tasks to help students achieve their learning goals and effectively apply their knowledge in real-world situations.

4. Challenges and countermeasures of OBE teaching mode

4.1 OBE challenge of OBE teaching mode. Under the OBE (Outcomes-Based Education) model, the role of teachers shifts from "knowledge imparting" to that of "learning guide" and "supporter." Teachers must design clear learning objectives and adjust their methods to encourage active learning and independent exploration. However, for teachers accustomed to traditional methods, this transition can be challenging. They may struggle with one-way knowledge transfer, lack awareness of students' individual needs, and find it difficult to engage students through inquiry and interaction.

Curriculum design under the OBE model focuses on clear, measurable learning outcomes. However, traditional courses often emphasize theoretical knowledge over practical skills, making it hard to connect content with specific learning achievements[6]. Objectives are typically vague, and the curriculum does not adequately address students' practical application needs, limiting the development of critical skills like practical operations and innovation.

The evaluation system also needs to evolve. OBE requires assessments based on students' learning outcomes, yet traditional methods like exams fail to fully measure students' abilities, particularly in areas like critical thinking and innovation. Traditional systems often over-rely on final exams, neglecting continuous evaluation and a comprehensive assessment of students' abilities. OBE requires more diverse evaluation methods, such as project presentations, group work, and peer reviews, to assess students' achievements more comprehensively.

A key challenge in OBE implementation is the lack of resources and technological support, particularly in underserved areas. Many schools face outdated infrastructure and limited access to educational technology, hindering full adoption of the OBE model. Blended learning, which combines online and offline methods, requires strong tech support, but many institutions lack the necessary resources, and both teachers and students may have limited tech skills.

In conclusion, OBE implementation faces obstacles in transforming teaching roles, redesigning curricula, revamping evaluation systems, and securing necessary resources. To overcome these challenges, schools and educators must continuously adapt teaching methods, refine curricula, and improve technological resources to better meet OBE demands.

4.2 countermeasures of OBE teaching mode. Provide teachers with ongoing training on the OBE concept, curriculum design, and assessment methods to deepen their understanding and improve teaching strategies. Encourage active involvement in teaching research, innovation, and interdisciplinary collaboration to enhance their skills and adaptability. Additionally, offer support systems like instructional templates, online platforms, and feedback mechanisms to help teachers refine their methods and boost effectiveness.

Innovate curriculum design and teaching methodologies: Clearly articulate learning objectives in curriculum design, integrating practical applications and skills training seamlessly. By aligning course goals, content, and activities, ensure students attain the requisite core competencies upon course completion. Implement project-based learning (PBL), case studies, experiments, and practical exercises to bolster students' practical skills and problem-solving abilities. Furthermore,

promote Blended Learning, leveraging online resources for independent study and online classrooms for discussions, teamwork, and performance assessments, thereby seamlessly blending online and offline learning experiences [7].

Develop a diversified assessment framework: Within the OBE paradigm, the assessment system should holistically encompass students' abilities, spanning knowledge retention, skill application, critical thinking, and innovation. Employ diverse assessment techniques, such as daily assignments, group discussions, project presentations, peer evaluations, and self-assessments, to ensure a comprehensive and varied assessment process [8]. Establish clear evaluation criteria and quantify learning outcomes to uphold assessment objectivity and fairness. Merge process and outcome assessments to comprehensively reflect students' learning efficacy, emphasizing feedback for sustainable development. Timely provide feedback on students' learning progress through regular quizzes, homework, and project evaluations, enabling them to adjust their learning approaches and strategies.

Reinforce technical support and educational resource development: Schools should augment investments and optimizations in educational technology infrastructure, furnishing efficient online learning platforms and resource repositories to cater to students' personalized learning trajectories. Leverage big data and artificial intelligence for learning progress tracking and personalized recommendations, assisting students in tailoring their learning to individual needs. Offer an array of digital learning resources, including online courses, virtual labs, and e-textbooks, to enhance learning flexibility and interaction. Furthermore, conduct information technology training to elevate teachers' and students' digital literacy, empowering them to proficiently utilize various instructional tools and platforms, thereby optimizing the overall learning outcome.

5. Summary

The incorporation of the OBE (Outcome-Based Education) concept into college computer basics courses not only disrupts the traditional teaching paradigm but also fosters students' learning enthusiasm by establishing clear learning objectives and achievement-oriented goals. Unlike traditional teaching methods, OBE emphasizes the tangible demonstration of students' learning outcomes and prioritizes the cultivation of practical skills and comprehensive qualities. Hence, after adopting the OBE concept, the focus of computer basics courses shifts from teacher-centered knowledge transmission to student-centered ability enhancement and practical skill development [9]. In computer basics courses, the OBE concept ignites students' interest in computer science and encourages more active learning. This transformation significantly enhances students' mastery of course content, aids in acquiring core computer science skills, and ultimately fulfills the intended teaching objectives.

To achieve the ability-oriented and achievement-oriented goals within the OBE framework in computer courses, teachers must attend to the thoughtful design of course content and the refinement of teaching methods. Specifically, they should organize course content in a modular and hierarchical fashion, catering to students' diverse backgrounds and needs. This enables personalized and targeted instruction tailored to students' knowledge levels, learning capabilities, and interests. For instance, students with weaker foundations can commence with fundamental computer operations and programming languages, while those with stronger backgrounds can delve into more intricate topics such as computer system principles, data structures, and algorithms, ensuring that each student experiences maximum growth based on their individual standing.

Furthermore, teachers should tailor the emphasis of teaching content to the peculiarities of different majors. For example, computer science and technology majors should concentrate on technical knowledge like programming and computer system architecture, whereas information management and information system majors should prioritize more applied content such as database management and network security [10]. Through this personalized and specialized teaching arrangement, students' learning needs are better met, and more targeted support is provided for their future career advancement.

In teaching design, teachers can integrate theory with practice by introducing real-world cases,

allowing students to improve computer skills through programming projects or software development tasks. Case-based teaching deepens understanding and fosters innovation and problem-solving abilities. Teachers can also use experiments and teamwork assignments to enhance collaboration and practical skills.Guided by the OBE concept, students' comprehensive abilities are improved, and teaching effectiveness is enhanced, better preparing them for future careers and societal demands.

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Research on computer teaching reform strategy under the background of Internet era

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Abstract. Under the profound influence of the Internet era, computer technology has become an important driving force to promote social and economic transformation, industrial upgrading and scientific and technological innovation. Facing the global competition and the demand of digital economy development, computer education in colleges and universities must be reformed constantly in order to cultivate high-quality, compound and innovative talents. This paper first discusses the connotation of the Internet era and its impact on university education, and analyzes the basic content and development direction of the current computer teaching reform, including teacher construction, textbook selection and student demand. However, computer teaching is facing many challenges at present, such as the weak construction of teachers, the lack of subject reform in the curriculum system, and the lack of integration of theory and practice. To solve these problems, this paper puts forward a series of optimization countermeasures, including building professional teachers, promoting the disciplinary development of computer education, and building a teaching model that deeply integrates theory and practice, so as to improve the quality of computer education and the level of talent training. This paper can provide reference and guidance for the reform of computer teaching in colleges and universities, so as to better adapt to the needs of the Internet age and promote the high-quality development of computer education in our country.

Keywords: Internet Era; Computer Education; Educational Reform

1. Introduction

In the era of accelerating economic globalization and rapid development of Internet technology, international competition is becoming increasingly fierce, industrial structure is constantly optimized and adjusted, and countries have formulated innovation-driven development strategies to seize the commanding heights of future economic growth [1]. As the core support of modern scientific and technological change, computer technology not only promotes the upgrading and transformation of traditional industries, but also profoundly affects the reshaping of business model, production mode and social operation mechanism. Relying on computer technology to drive industrial innovation, it can not only help our country to tap new economic growth points, but also provide solid support for the high-quality development of digital economy [2-5].

Therefore, deepening the reform of computer education and training high-quality compound talents with interdisciplinary ability are not only vital to the transformation and upgrading of China's economy, but also play a key role in the process of social intelligence. However, in the process of promoting the reform of computer teaching, we need to deeply study the characteristics of the Internet era and its impact on higher education, systematically sort out the main challenges faced by computer teaching at present, so as to build a more scientific, efficient and meet the needs of The Times talent training system [6-10].

2. Connotation of Internet age and university education

The Internet is a global information interaction system built by remote communication and computer technology. It is not only a technical concept, but also a broad social phenomenon covering many fields such as culture, economy and education. Through the integration of communication technology and computer technology, the Internet has provided a powerful information infrastructure for the development of modern society, and formed a new set of value

systems, institutional structures and technical systems, which have profoundly influenced and reshaped human values and lifestyles.

Under the background of the new era, computer network is not only a tool for people to obtain information, but also plays an important role in social and economic development and higher education reform. The popularization of the Internet has blurred the regional characteristics of university education, and gradually realized the interconnection of educational resources, which has promoted the liberalization, individuation, diversification and ubiquity of learning methods. According to the website of China Internet Network Information Center, as of June 2024, the number of Internet users in China has reached 1.09967 million [12], and the Internet penetration rate is as high as 78%, as shown in Fig. 1. At the same time, many colleges and universities have basically realized the full coverage of campus network, and the information technology is widely used in teaching practice. Although the Internet has greatly promoted the modernization of education, university education still faces many practical challenges.

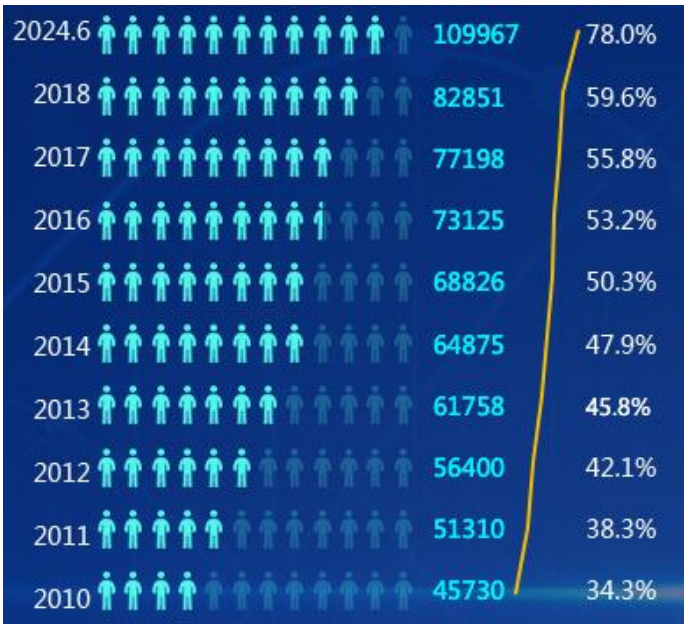

Figure 1. The scale of Internet users and the trend of Internet penetration

First, the role of the teacher is undergoing profound change. In the network era, education has broken through the physical boundary of traditional classroom, and the concept of "network is teacher" and "network is school" has gradually formed, which makes university education show stronger socialization characteristics. Students can not only acquire knowledge through classroom learning, but also use the Internet to study independently and explore deeply. Teachers have gradually changed from traditional "knowledge indoctrinators" to "learning guides" and "knowledge service providers", and the teaching mode has gradually changed from teacher-centered "spoon-feeding" to student-centered "inquiry" learning. This change requires college teachers to improve information literacy and adjust teaching strategies to better adapt to the digital learning environment.

Secondly, the way students learn is also evolving. The deep integration of the Internet and education has made learning methods more flexible and diversified, breaking the restrictions of time and space, and students can study independently anytime and anywhere. At the same time, the popularization of the Internet also provides more abundant teaching resources for college teachers, making the teaching content more diversified and interactive, and alleviating the problem of uneven distribution of educational resources to a certain extent. However, the change of learning methods and media also puts forward higher requirements for the teaching environment and teacher construction in colleges and universities. Modern colleges and universities need to speed up the construction of high-level information-based teaching teams, and improve the hardware and software facilities to adapt to the profound change of education mode in the Internet era.

The rapid development of the Internet is reshaping the form of university education, providing new opportunities for the reform of computer teaching, but also bringing many challenges. How to integrate the network resources effectively, optimize the teaching mode, and improve the information literacy of teachers and students will become the key direction of the future college education reform.

3. The basic content and direction of computer teaching reform

With the rapid development of information technology and the increasing demand for high-quality computer professionals, the reform of computer teaching has become an important issue in current higher education. In order to meet the challenges and requirements of the new era, computer education must keep up with the pace of The Times, improve the teaching quality in an all-round way, and cultivate compound talents who meet the needs of society. This chapter will discuss the basic content and direction of computer teaching reform, starting from teacher construction, textbook selection and student needs, as shown in Fig. 2. Comprehensively analyze how to promote the in-depth implementation of teaching reform to ensure that the improvement of education quality and the cultivation of students' ability can develop simultaneously.

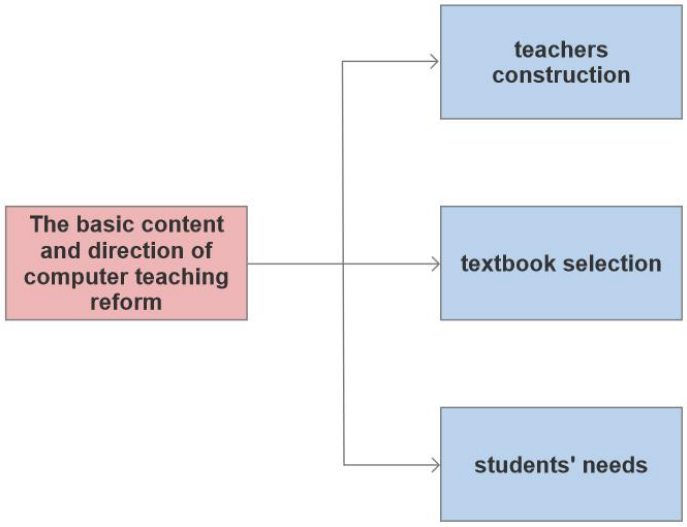

Figure 2. The basic content and direction diagram of computer teaching reform

3.1 Teacher construction. Computer courses are usually offered as elective courses in colleges and universities. However, with the ever-changing educational needs, how to ensure that teachers with rich practical experience can effectively lead the teaching reform has become a key issue that colleges and universities need to solve urgently. Teachers are the core force of teaching reform, therefore, teachers' professional ability and reform consciousness directly affect the improvement of teaching effect and the realization of reform objectives. Before carrying out the teaching reform, schools should make full preparations and supporting measures to ensure that the reform can be smoothly promoted and achieve the expected results.

First of all, schools need to provide systematic "skill training" and "theoretical training" for computer teachers to help teachers master the latest teaching concepts, technical tools and industry development trends. This can not only enhance the professional quality of teachers, but also improve their ability to cope with various challenges in the teaching reform, and ensure that teachers can cope with changes and challenges in the reform process, so as to improve the quality and effectiveness of teaching. At the same time, through training, teachers can timely understand the application of emerging technologies and teaching methods, and avoid teaching content lagging behind the development of The Times.

However, many computer professional teachers have accumulated rich practical experience in the teaching process for many years, and gradually formed their own unique teaching methods. Although these experiences provide valuable resources for teachers in daily teaching, with the

continuous advancement of teaching reform, teachers' traditional teaching methods and teaching habits may be impacted, especially with the introduction of new technological tools and teaching concepts. How to balance traditional teaching methods and reform requirements, help teachers to make a smooth transition, and avoid resistance and adaptation difficulties in the process of reform, is an issue that universities need to focus on when promoting teaching reform.

Therefore, schools should promote teachers' understanding and acceptance of the reform through various ways, and provide more flexible and diversified support measures. For example, we organize teachers to participate in teaching seminars and sharing meetings, invite industry experts to give lectures and guidance, and encourage the exchange of experience and teaching innovation among teachers. These measures can not only enhance teachers' sense of identity for the reform, but also stimulate their enthusiasm to actively participate in reform and innovative teaching, so as to ensure that teaching reform can be smoothly promoted among teachers.

Teachers are the leading force of computer teaching reform. How to improve their professional level, help them adapt to the reform and promote their active participation is the key to ensure the smooth implementation of the reform.

3.2 Selection of teaching materials. An intelligent and deeply thinking individual's actions and decisions are often guided by internal values and systems of thought. Although these thoughts are latent and intangible, they have a profound impact on individual behavior and life choices. The situation is similar in the process of teaching reform. When the reform enters the implementation stage, it is difficult to ensure that every computer professional teacher can fully understand the deep connotation of the teaching reform, especially in the Internet era, the new educational needs and teaching methods are constantly changing, and teachers are often difficult to clarify the specific requirements of these changes. Teaching reform is not only a change of knowledge, but also a change of thought, which requires teachers to adapt flexibly in the ever-changing environment.

In order to solve this problem, it is particularly important to convey the ideas and thoughts of teaching reform through effective media. In the process of teaching reform, teaching materials, as the carrier of ideas and concepts, have played a vital role. Teaching materials are not only a tool for knowledge transmission, but also an important way for teachers to understand and implement reform ideas. Through carefully written and designed textbooks, teachers can have a deeper understanding of the connotation of teaching reform, and guide and adjust teaching practice through the educational ideas conveyed by the textbooks.

Since higher education is directly related to the future development of the country and the revitalization of the nation, and affects the construction of the social market economy and technological innovation, the compilation of teaching materials should be closely combined with the development of The Times and the change of students' needs. It should not only reflect the latest academic development results, but also pay attention to students' learning interests and needs, so as to enhance the sense of The Times and practicability of the textbooks. Through the content of the textbook that is in line with the development of The Times, it can effectively reduce the confusion and difficulty of teachers in the teaching process, and help them better adapt to the pace of reform.

At the same time, the updating and innovation of teaching materials can make the teaching reform more deeply integrated into the training process of computer interdisciplinary talents. Teaching materials not only impart knowledge, but also promote the in-depth development of teaching reform. Through forward-looking and systematic textbook content, teachers can implement reforms more smoothly in the process of teaching and educating people, ensuring that students can obtain practical and cutting-edge knowledge in a challenging and changing technological environment, so as to cultivate more composite talents for social development and technological progress in line with the needs of the new era.

3.3 Student demand. Change often results from the failure of existing systems to meet the changing needs of society. Every change is accompanied by a challenge to the status quo, and it is this challenge that drives people to seek new paths of development. However, if the reform is too advanced, ignoring the basis of reality and the limitations of existing resources, it may lead to people's ability and adaptability not keeping up, thus making it difficult for the reform to take root.

On the contrary, if the reform is delayed and the old model is copied, it will not be able to effectively respond to the needs of the new situation, and ultimately hinder the advancement of change. Therefore, adapting to the development of The Times and ensuring that the reform can effectively meet the actual needs are the basic prerequisites for the success of the change.

In the course of computer teaching reform, students are the core object of reform. The ultimate goal of the reform is to improve students' knowledge level, innovation ability and practical operation ability. Therefore, teaching reform should not exceed students' existing capacity to accept knowledge, otherwise it may cause students to have self-doubt and think that they can not keep up with the teaching progress, thus affecting their learning motivation and confidence. However, if the reform is too late and fails to meet the latest requirements of society and the industry for talents, students may have resistance to the existing teaching model, and then it is difficult to actively support the reform, and even form a distance from the teaching content and methods. Therefore, before carrying out the teaching reform, it is necessary to fully understand the students' knowledge base and acceptance ability to ensure that the reform measures meet the actual needs of students.

Only when the teaching reform is closely combined with the needs of students and the development of The Times can the teaching quality and efficiency be effectively improved. The reform should aim to provide students with educational content that is more in line with their actual needs and help them improve their ability to adapt to future social development. Through reform, the process of curriculum teaching and personnel training can truly become the key force to promote national technological progress and social construction. Education reform is not only the transfer of knowledge, but also the training of high-quality talents with innovative ability and practical ability, so as to inject a steady stream of power for social and economic development and technological innovation.

4. Problems existing in computer teaching in the Internet era

With the rapid development of information technology, especially the coming of the Internet era, computer teaching is facing unprecedented opportunities and challenges. In this context, computer education not only needs to update the teaching idea and method, but also needs to adjust the curriculum and teaching content to adapt to the rapid changes of society and industry. At present, there are still some problems in computer teaching in China in many aspects, including the weak construction of teachers, the lack of discipline in the curriculum system, and the disconnection between theory and practice [13].

4.1 The construction of computer professional teachers is weak. The core of computer teaching reform lies in the construction of teaching staff. With the advent of the Internet era, professional teachers are required not only to update the traditional teaching concepts, but also to continuously improve their information literacy, master and flexibly apply information technology, so as to promote the deep-level reform of teaching content, methods, models and systems. If the construction of teachers is not perfect enough, it will inevitably make the reform of computer teaching difficult to adapt to the rapid development of The Times, and may even fall behind. Therefore, strengthening the construction of teachers is the key to promote the reform of computer teaching.

According to the relevant survey results, there are several problems in the construction of teaching staff in modern colleges and universities in China:

First of all, there are some problems in the teacher appointment mechanism. Many colleges and universities pay too much attention to the evaluation of academic background and experience when recruiting teachers, and neglect the evaluation of information literacy and information technology application ability of computer teachers. Such recruitment standards have led to the difficulty for teachers to keep up with the pace of educational reform and achieve the expected teaching effect in the face of the rapid development of modern information technology.

Secondly, the lack of high-level and professional academic teams leads to the teaching reform of computer majors often out of touch with the needs of social development. This disconnection not only limits the frontier development of the discipline, but also affects the training of complex and

innovative computer talents, which is difficult to meet the social demand for high-quality technical talents.

Finally, there are obvious shortcomings in teacher training. The current teacher training focuses more on improving the basic teaching skills of teachers, but the guidance of teaching concepts and teaching methods is relatively lacking. This makes the reform of computer teaching still stay in the level of traditional theory indoctrination and knowledge cramming teaching, which is difficult to stimulate students' innovative thinking and practical ability, and is not conducive to the cultivation of students' comprehensive quality.

Therefore, strengthening the construction of teachers, improving teachers' information literacy and teaching ability, and promoting the updating of teaching concepts and methods are the keys to accelerate the reform of computer teaching and improve the quality of education.

4.2 Lack of subject-based curriculum reform. Whether a discipline can be called "discipline" depends not only on the construction of its discipline establishment and discipline system. The discipline establishment usually includes funding, administrative establishment, organizational structure, etc., aiming at enhancing the administrative legitimacy and academic organization of the discipline and ensuring the independence and effective operation of the discipline in the education system. The discipline system lays more emphasis on the internal norms and institutionalization of the discipline, covering the research paradigm, theoretical system, ideological tradition and other aspects, emphasizing the academic foundation and long-term development path of the discipline. Only under the joint action of the two, the discipline can obtain perfect system guarantee and practical support.

For the modernization of computer curriculum, the subject construction is of vital significance. Subjectification can not only provide a structured and systematic framework for computer education, but also promote the innovative development of the subject and ensure that the course content keeps pace with the development of The Times. Without subject construction, schools will face severe challenges in the construction of subject system, selection of teaching materials, curriculum design, teacher training and other aspects, which will affect the quality and effectiveness of computer teaching, especially in adapting to the teaching needs of the Internet era, and may not be able to meet the rapid changes of society and industry.

At present, some colleges and universities have not fully realized the importance of subject construction, resulting in the computer course system is difficult to closely connect with the "social reality", unable to introduce advanced computer technology and ideas in time. This not only makes the course content out of line with the advanced information technology, but also makes the training effect of computer professionals greatly reduced. In addition, due to the lack of high-level academic journals and professional academic institutions, many advanced computer technology in society is difficult to transform into teaching resources, which further restricts the updating of teaching content and the improvement of teaching quality.

Therefore, promoting the construction of computer science is the key to solve the above problems. By strengthening the discipline construction, it can promote the updating and optimization of the curriculum content, make it match the social demand and scientific and technological development, improve the quality of education, and lay a solid foundation for cultivating innovative computer talents.

4.3 It is difficult to integrate theory with practice. At present, the computer teaching in some colleges and universities in China is still mainly based on theory, but with the change of social needs, the practical problems that students face after entering the workplace are often more complex and diverse than what they learn in the classroom. Therefore, the reform of computer teaching urgently needs to fully consider the needs and perspectives of students in the course structure, and strive to set up more courses that fit with students' life, growth and future career development, organically combine practice and theory, and cultivate students' comprehensive quality and practical application ability.

Although some colleges and universities have put forward the suggestion of integrating theory teaching with practice teaching, but in the current network era, how to effectively achieve this goal,

especially for computer teachers, is still an important problem to be solved. First of all, the class schedule of practical courses is usually limited, and it is difficult for students to consolidate and deepen the theoretical knowledge they have learned in limited practical time, which has formed an obvious restriction on the professional development of students. However, if the proportion of practical courses is further increased, it will lead to the compression of theoretical courses, which may lead to the weakness of students' theoretical foundation, which will undoubtedly affect their subsequent academic research and work practice ability.

Secondly, students often do not pay enough attention to practical courses and lack initiative and autonomy. Even if teachers provide sufficient and high-quality practice opportunities, students may not be able to devote themselves to them and lack sufficient sense of participation and practical awareness. This makes the integration of theoretical knowledge and practical ability particularly difficult, students can not really apply what they learn in class to practical problems, and it is difficult to reverse feedback problems encountered in practice to theoretical learning, thus forming a virtuous circle.

In order to overcome these problems, the reform of computer teaching should be systematically improved from the aspects of curriculum design, teaching mode and teacher-student interaction. Teachers should pay attention to the innovation and diversification of practical courses, design projects and tasks in line with students' interests and actual needs, and stimulate students' enthusiasm for practice; At the same time, it is necessary to strengthen the cultivation of students' practical consciousness, encourage students to take the initiative to participate, and optimize the practice teaching process through the evaluation mechanism and feedback mechanism. Only the real integration of theory and practice can cultivate computer professionals with solid foundation, good practice ability and innovative thinking.

5. The main countermeasures of computer teaching in the Internet age

5.1 Build a professional team of teachers. Teacher construction is the core of computer teaching reform, especially in the Internet era, the quality of teachers directly determines the level of teaching quality. Only excellent teachers with high information literacy and solid technical ability can effectively promote the deep integration of modern information technology, network technology and communication technology with computer courses, and provide students with a rich and diversified learning platform. Therefore, in view of the problems existing in the construction of computer teachers, we need to improve and enhance from the following aspects, as shown in Fig. 3.

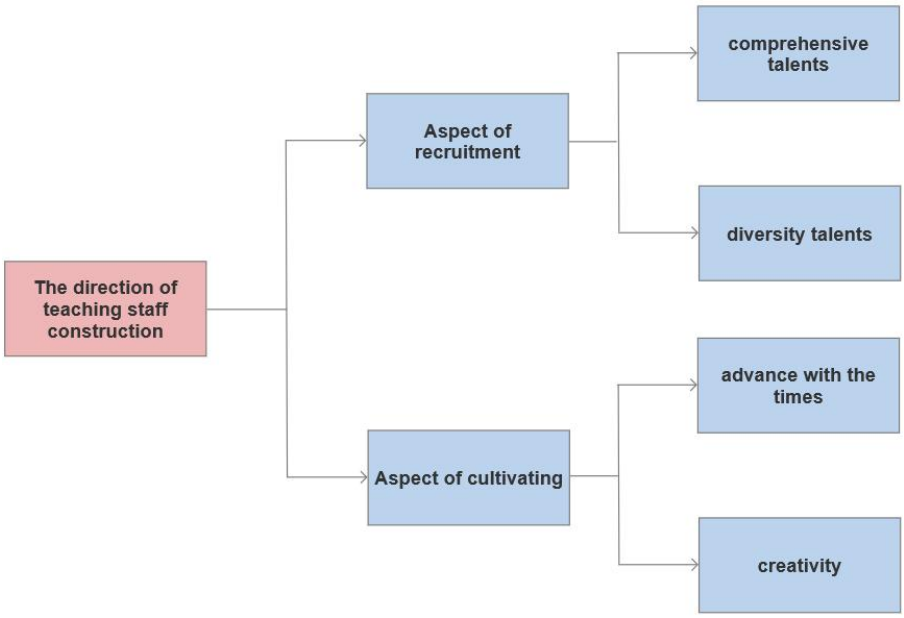

Figure 3. Teaching staff building direction diagram

First of all, when recruiting teachers, universities should give priority to teachers' information literacy, computer network application ability and innovation ability. Recruitment criteria should pay more attention to teachers' practical abilities rather than just academic qualifications and experience, ensuring that teachers have a strong professional background in the field of information technology. At the same time, it should be clear that the research direction of teachers is computer science, so as to ensure that the reform of computer teaching and curriculum construction can maintain a high degree of professionalism and cutting-edge.

Secondly, in the process of the construction of the faculty team, college leaders should focus on the recruitment of computer academic backbone and discipline leaders, and actively build a reasonable structure of the team. This team should not only have the professional ability of "fine", "sharp" and "specialized", but also realize the age structure of "young", "middle" and "old", so as to ensure that teachers of different levels and different experience backgrounds can complement each other and grow together. Through such team building, it can provide a solid teacher guarantee for the reform of computer teaching and promote the continuous innovation of disciplines and teaching.

Finally, regular teacher training activities are essential. In the process of training, schools should help teachers change the inherent teaching concept, deepen the role transformation of teachers, make them pay more attention to the main body status of students, pay attention to the growth and development of students, and guide students to actively participate in learning. At the same time, schools should encourage teachers to adopt guided and heuristic teaching methods, avoid traditional knowledge infusion methods, and stimulate students' thinking and innovation. In this way, teachers can not only adapt to the requirements of the development of The Times, but also effectively improve the comprehensive quality and practical ability of students, ensure that computer education can keep pace with The Times, and cultivate innovative technical talents that meet the needs of society.

Through these measures, schools will be able to build a team of high-quality computer teachers, promote the in-depth implementation of computer teaching reform, and provide students with better education services.

5.2 Realize the development of computer science. According to the research results of curriculum preparation theory and implementation orientation, teaching reform, as an important starting point of curriculum construction, must have a clear goal orientation and realize the sustainable development of disciplines. Only under the framework of discipline construction, the excellent and cutting-edge computer information technology resources in society can be effectively transformed into teaching content, so as to improve the teaching quality, enrich the knowledge structure of students, and cultivate high-quality talents with innovative spirit and practical ability. This paper puts forward two directions as shown in Fig. 4 to strengthen the construction of computer science.

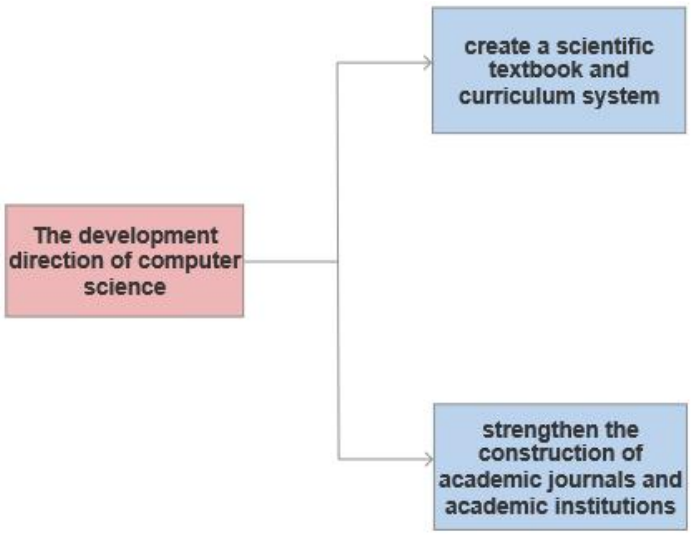

Figure 4. Computer science development direction diagram

First, build scientific teaching materials and curriculum system. Curriculum design is closely related to the development of computer science. We should build a complete and flexible curriculum system by drawing lessons from the successful experience of well-known universities at home and abroad, including professional courses, elective courses and compulsory courses. Such a curriculum system can not only explore the potential of computer science, but also help students learn deeply at different levels, broaden their horizons and improve their comprehensive quality. In the construction of teaching material system, the school should develop a dynamic teaching material system to adapt to the rapid development of information technology, and establish a linkage mechanism to integrate the resources of various departments, enterprises and institutions. Through Internet technology, schools can realize resource sharing and present it to students in the form of electronic textbooks, so that students' computer knowledge is always updated, and the content is more rich and cutting-edge.

Secondly, schools should strengthen the construction of academic journals and academic institutions, deepen the connection with the social field, and introduce the most advanced computer technology into the teaching field. Although academic research results may be difficult to directly apply to classroom teaching in the short term, through the establishment of academic journals and professional academic institutions, students can continue to broaden their horizons and enable them to understand the actual needs of society and industry for computer technology in the process of learning computer courses. For example, schools can invite industry experts and scholars to share technology through collaborative research, academic lectures and other forms to help students understand the current technology trends and developments, and further enhance students' technology application ability and innovative thinking.

The construction of computer subject is the key to realize teaching reform and improve the quality of education. By optimizing the curriculum system, building dynamic teaching materials, and strengthening the integration and exchange of academic resources, schools can better connect with social needs and cultivate innovative computer talents who meet the requirements of modern technology development.

5.3 Promote the integration of practice and theory. The integration of practice and theory is the core requirement of computer teaching reform, the premise of meeting students' development needs, and the key to improving the quality of computer teaching. Especially in the Internet era, professional teachers need to explore and practice from many aspects to achieve this integration, in order to better train computer professionals with comprehensive abilities. Specifically, teachers should start from the following three aspects:

At the theoretical level, teachers should fully consider students' educational needs, career development and employment trend, carefully select theoretical knowledge closely related to practical work, and ensure the practicability and pertinancy of theoretical teaching content. From the perspective of students, teachers should combine the theoretical knowledge learned in class with the application scenarios in practical work, so that students can understand the theory and realize its importance and role in practical work. In addition, theoretical teaching should focus on cultivating students' critical thinking and innovative ability to help students better adapt to the rapidly developing information technology industry [14-16].

At the practical level, teachers should actively adopt modern teaching methods such as network teaching and network practice to provide students with diversified practical learning scenarios. Through the online practice platform, students can not only get rich practice opportunities, but also choose related projects for in-depth study according to their own interests and development direction [17]. Teachers should encourage students to combine the theoretical knowledge they have learned in practice to explore innovative solutions, so as to have a deeper understanding of knowledge and comprehensively improve the ability to apply computer technology and master professional skills. In addition, network practice can enable students to conduct experiments and simulation operations in a virtual environment, increase students' practical experience and improve their ability to solve practical problems.

In terms of assessment methods, teachers should change the traditional assessment mode,

incorporate practical teaching into the core content of students' evaluation, and strengthen students' attention to practical courses. In this process, teachers can evaluate whether students can apply computer knowledge to solve practical problems, whether they have the consciousness and ability of independent learning and cooperative learning through practical assessment. For example, it is possible to design project-driven tasks that allow students to solve practical problems in teamwork, and to comprehensively assess students' overall abilities through an assessment process. In this way, it can not only stimulate the enthusiasm of students to participate in computer learning, but also help students improve their problem-solving ability and innovative thinking in practical operation.

In short, in the deep integration of practice and theory, teachers should always adhere to student-centered teaching strategies and methods according to students' development needs and career planning. Through reasonable curriculum design, innovative teaching methods, and optimization of assessment mechanism, teachers can provide students with a richer and more comprehensive learning experience, ensure that students can improve their practical application ability on the basis of mastering theoretical knowledge, and comprehensively train high-quality computer talents who meet the needs of society and industry.

6. Summary

The reform of computer teaching should closely focus on the social development trend, the popularity of the network and the latest trend of computer application, and actively promote the deep integration of classroom teaching and social actual needs. With the continuous development of Internet technology and information society, computer professional education not only needs to impart a solid theoretical foundation, but also should pay attention to training students' practical operation ability and innovative thinking, so that the teaching content and the development of the industry synchronization, to ensure that students can master cutting-edge technology, adapt to the rapidly changing social environment.

The key of the reform is to closely combine the actual needs of students with the teaching content, and help students master the professional knowledge and skills of computer more effectively by updating the course system, innovating the teaching mode and optimizing the teaching method. Teaching reform should not only focus on the transfer of theoretical knowledge, but also pay attention to the cultivation of practical ability, especially in the current highly informationized background, students need to improve their ability to solve practical problems through a lot of practical learning and project experience. In this way, students can not only gain a profound knowledge reserve in the academic field, but also accumulate experience in practice, and cultivate innovative talents with comprehensive qualities.

The teaching reform should pay attention to the cultivation of students' independent learning and teamwork ability. Through the simulation of the enterprise environment and the introduction of actual project cases, students' learning interest and practical enthusiasm are stimulated, so as to enhance students' career competitiveness and social adaptability. In this process, teachers need to discuss with students the application of computer technology in various sectors of society, help students understand how technology can serve social development, promote economic prosperity and social construction, and further enhance students' sense of social responsibility and innovation.

Overall, the goal of computer teaching reform should be to cultivate compound talents with practical ability, innovative spirit, interdisciplinary knowledge and global vision. These talents will not only promote the development of China's information technology industry, but also provide strong talent support and technical guarantee for the intelligent transformation of society and the optimization and upgrading of economic structure. Through the continuous optimization and reform and innovation of the education system, students will consciously become an important force conducive to the country's economic development and social construction.

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Research and Practice of Teaching Reform for "Python Programming" under the New Engineering Background

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Abstract. With the rapid development of information technology, programming skills have become a fundamental requirement in modern society. As a foundational course for computer science, Python programming plays a critical role in cultivating students' coding skills and innovative thinking. However, traditional teaching models and content no longer meet current educational demands, making curriculum reform imperative. This paper analyzes the current state of Python programming courses and proposes a teaching reform plan. The reform focuses on updating course content by integrating the latest Python technologies and applications, such as data analysis and machine learning; adopting innovative teaching methods, including project-driven teaching and flipped classrooms, to enhance students' practical abilities and teamwork; and strengthening practical components through phased project tasks to improve problem-solving skills. Additionally, the course evaluation system has been optimized to use diversified assessment methods, emphasizing process-based performance and project outcomes. After the reform, students demonstrated significant improvements in programming skills, overall quality, class engagement, and interest in learning, as well as enhanced practical skills and innovative thinking. Teachers also improved their teaching capabilities through training and resource integration. In the future, Python programming courses will continue to optimize teaching content and methods, explore innovative teaching models and application scenarios, and better align with technological development needs to cultivate high-quality talent with innovation and practical abilities.

Keywords: Python programming；Teaching reform; project-driven； Flipped classroom； Innovative teaching models

1. Introduction

1.1 Research Background. Python is a free, open-source, cross-platform, high-level dynamic programming language known for its extensibility, readability, and simplicity. It has gradually become the preferred programming language in emerging industries such as artificial intelligence, big data, and cloud computing. In March 2018, the Ministry of Education included Python in the National Computer Rank Examination, and "Python Programming" became a subject for the Level II computer examination. Since 2021, Python has surpassed traditional compiled languages like C and Java to become the most popular language in the TIOBE programming language rankings. Currently, Python is widely used in web development [1], financial analysis [2], big data mining [3], web scraping[4], and many other fields. The demand for Python talent in the job market far exceeds supply under the new engineering background. Python programming courses not only provide non-computer science students with tools for data analysis in subsequent professional fields but also lay the foundation for computer science students to learn new technologies such as machine learning [5] and deep learning[6]. Therefore, universities must emphasize the innovative construction and practice of Python courses in computer science education, guiding students to leverage Python as a tool to solve various complex problems in learning and life.

To adapt to industry development needs and the trend of educational informatization, reforming the teaching of Python programming courses is essential. Updating course content, innovating teaching methods, and strengthening practical components can effectively improve students' programming skills, innovative thinking, and practical application abilities. Such reform not only nurtures more competitive computer science talent but also provides valuable experience for

building curriculum systems in higher education, promoting high-quality development in higher education.

1.2 Research Purpose and Significance. Python, as a programming language that is both simple to learn and powerful in functionality, has been widely adopted worldwide in recent years. Whether in data analysis, artificial intelligence, web development, or the Internet of Things, Python plays an indispensable role, making it one of the most important technologies in the IT industry. With Python's growing influence, incorporating it into programming course systems in universities has become a trend. However, traditional programming courses often fail to fully meet the demands of current technological developments and the need for cultivating interdisciplinary talent.

The construction of new engineering disciplines is a key focus of current higher education reform, emphasizing interdisciplinary integration and future-oriented innovation. Python, as a widely applicable cross-disciplinary programming language, holds unique advantages in new engineering education. Through teaching reform and exploring Python-based teaching models, this research aims to provide valuable experiences for constructing new engineering curricula.

In terms of teaching models, introducing flipped classrooms, project-based learning (PBL), and blended teaching methods can build more flexible and efficient teaching systems that meet students' personalized learning needs [7]. Integrating real-world cases, interdisciplinary projects, and industry challenges into course teaching not only enhances students' ability to tackle complex engineering problems but also promotes the depth and sustainable development of new engineering education. Furthermore, optimizing the evaluation system to combine process-based and outcome-based assessments can comprehensively reflect students' overall abilities and innovative achievements, laying a solid foundation for cultivating high-quality engineering talent for the future .

This research aims to provide guidance for computer science curriculum reform in universities and contribute practical experiences to the development of new engineering education, offering both theoretical value and practical significance.

2. Current Situation Analysis of Python Programming Course

2.1 Survey on Student Learning. A survey revealed several common issues students face during learning that impact their effectiveness and programming skills development. Firstly, understanding challenges such as Python syntax rules, data structures, and algorithm logic are frequently mentioned. For example, some students struggle with foundational concepts like object-oriented programming and exception handling, which slow their progress. Secondly, a lack of practical ability is another major problem [8]. Although practical components are included in the course, these tasks are often limited to simple coding exercises, lacking training in real-world problem scenarios and project development. As a result, students lack systematic design and project management skills, unable to effectively apply theoretical knowledge to practice. These findings highlight the need for reform to improve students' interest in Python programming courses, address learning challenges, and strengthen practical skills.

2.2 Current State of Teaching Equipment, Materials, and Extracurricular Resources. At present, while most Python programming courses are equipped with basic computing equipment and programming software, there are still shortcomings. For example, some equipment experiences frequent failures due to delayed maintenance and updates, disrupting classes [9].

Regarding teaching materials, although many Python textbooks are available, most are too basic and lack in-depth coverage of Python's applications in fields like data science, artificial intelligence, and web development. These materials often focus on foundational knowledge and algorithms, failing to keep pace with technological advancements [10]. Additionally, many schools lack comprehensive resource repositories, making it difficult for students to access the latest practice tutorials and open-source projects.

2.3 Utilization of Online Learning Platforms. The proliferation of information technology has made online learning platforms vital supplementary tools for teaching Python programming. Many universities have started using platforms like MOOCs and Bilibili to provide extracurricular learning resources. However, some challenges remain.

While these platforms offer abundant learning materials, many students do not fully utilize them for independent learning. Furthermore, the content on these platforms often does not align well with classroom teaching, leaving students confused and unsupported when encountering difficulties. Finally, the interactive features and practical components of some platforms are underdeveloped, limiting students' ability to receive real-time feedback during exercises [11].

In summary, while teaching equipment, materials, and extracurricular resources support Python programming education to some extent, there is still room for improvement. The integration of online learning platforms into teaching requires optimization to better align with classroom instruction and enhance students' learning outcomes and autonomy.

2.4 Limitations of Traditional Teaching Content and Methods. Currently, most universities still adopt traditional teaching content and methods for Python programming courses, which have significant shortcomings. Firstly, the course content is overly basic, often limited to Python syntax rules, basic data structures, and simple algorithm explanations, lacking extensions to Python's applications in data analysis, artificial intelligence, web development, and other fields [12]. This limits students' interest in the course and the depth of their learning.

Secondly, the teaching method is singular, primarily focused on theoretical lectures and classroom demonstrations, with students passively absorbing knowledge and lacking opportunities for independent exploration and interactive participation. This approach leads to a monotonous classroom atmosphere, hindering students' enthusiasm and practical skills development. Furthermore, the design of practical components is often overly simplistic, with tasks disconnected from real-world applications, making it difficult for students to genuinely master programming skills and leaving them feeling unprepared when facing complex problems.

2.5 Gaps Between Students' Skill Needs and Course Design. The modern workplace demands diverse abilities from computer science students, including a solid programming foundation, interdisciplinary application capabilities, teamwork, and innovative problem-solving skills. However, the current design of Python courses fails to fully meet these demands.

Firstly, course content updates lag behind, lacking coverage of industry-leading technologies and real-world application scenarios, leaving students unaware of Python's critical role in fields like data science and artificial intelligence. Secondly, practical tasks are often small-scale, single-function programs, lacking comprehensive projects that could effectively cultivate students' system design abilities [13]. Additionally, assessment methods focus primarily on exams, neglecting to evaluate students' practical skills, teamwork, and learning process, thereby limiting their comprehensive development.

3. The specific measures of Python programming teaching reform

The following paper elaborates the specific measures of python programming teaching reform from four aspects: teaching content, teaching method, teaching practice, and evaluation system, as shown in Fig. 1.

3.1 Introduce the latest Python technology and application cases. In order for Python programming courses to keep up with the pace of technological developments, course content needs to introduce the latest Python technologies and application areas in a timely manner. In recent years, data analysis, machine learning and artificial intelligence have become important areas of Python application, and these technologies have a wide range of applications in academic research, industrial production, financial analysis and other industries. The curriculum should increase the content of these technologies, so that students not only learn the basics of programming, but also understand and master how to solve practical problems with Python.

For example, data analysis cases can be introduced to teach students how to use libraries such as Pandas and NumPy in Python for data cleaning, processing and visualization to help students understand the value behind the data [14]. Machine learning content can introduce basic methods of building models using tools such as Scikit-learn and TensorFlow to stimulate students' interest in AI technology. Through the design of simple application cases, students can gradually master these

popular technologies while learning Python, and improve their programming ability and practical ability.

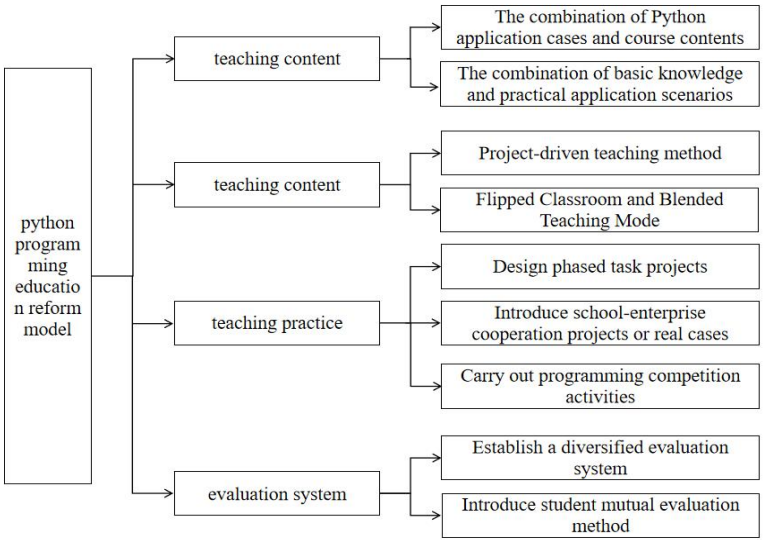

Figure 1. Content frame diagram

3.2 Combine basic knowledge with practical application scenarios. In order to improve students' practical programming ability, the course content should be changed from simple basic knowledge teaching to practical application scenarios. In the teaching process, we should not only pay attention to the basic knowledge of Python syntax, data structures and algorithms, but also let students master how to apply theoretical knowledge to practice through practical problem solving.

First, courses can set up project-driven learning models that combine the basics with practical problems. For example, after learning basic grammar, students can consolidate their knowledge and deepen their understanding by designing a simple automation tool or developing a small Web application. Through these projects, students can not only translate programming knowledge into the ability to solve practical problems, but also experience the practicality and fun of programming.

Secondly, the course can introduce interdisciplinary application scenarios, so that students can see the diversity and universality of Python in practical applications. For example, when learning data structures and algorithms, Python can be combined with practical applications in finance, medical care, education and other fields to explore how to solve practical problems in these industries with programming [15]. Through these application scenarios, students can deeply understand the advantages of Python and stimulate their interest in learning.

3.3 Project-driven teaching method. Project-Based Learning (PBL) is a teaching method with practical projects as the core, emphasizing that students can solve practical problems by participating in the development of real projects, so as to improve their programming ability, problem solving ability and teamwork ability [16]. In the Python programming course, PBL can enable students to understand the application of programming language in practice, and can deeply grasp the practical application of Python in data analysis, artificial intelligence, Web development and other fields.

In practical implementation, the course can design multiple phased project tasks, such as starting with a simple programming task and gradually transitioning to designing a small database application, developing a data analysis tool, or building a machine learning model. Through project-driven, students can not only learn the grammar and algorithm of programming language, but also experience the whole process of software development, such as requirement analysis, code implementation, testing and debugging, and enhance practical ability. In addition, PBL can stimulate students' interest in active learning, help them transform theoretical knowledge into practical abilities, and enhance their ability to solve complex problems.

3.4 Flipped classroom and blended teaching mode. The combination of flipped classroom and blended teaching model provides students with more opportunities for independent learning and interactive communication. In this model, students learn basic concepts and fundamentals on their own through online learning platforms, instructional videos and reading materials before class, while class time focuses on discussions, problem solving, collaborative projects and hands-on activities.

Specifically, the course can use flipped classroom to let students preview Python syntax, algorithms, and basic applications before class, and provide after-class exercises and instant feedback through an online platform to ensure that students can master the basics. In class, teachers can organize students to have group discussions, solve problems encountered by students in the learning process, carry out programming practice, or let students deepen their understanding of Python in the real development process through project cooperation. In this way, students can not only master knowledge points more flexibly, but also enhance their self-study ability and teamwork spirit.

3.5 Problem-oriented instructional design. Problem-Based Learning (PBL) emphasizes promoting learning by guiding students to solve practical problems. In Python programming courses, students can learn programming knowledge while solving problems by designing real-world problem situations, and learn how to apply programming skills to real problems.

For example, teachers can set challenging programming problems or practical projects, and students can gradually master Python programming techniques by analyzing the problems, developing solutions, implementing code, and finally completing the project. PBL not only helps students deepen their understanding of Python syntax and tools in problem solving, but also exercises their critical thinking and creativity. In addition, PBL can promote students to think actively, cultivate their ability to solve problems independently, and lay a solid foundation for future work and scientific research.

Through the innovation of these three teaching methods, Python programming courses will pay more attention to the cultivation of practicality, interactivity and problem solving ability. In this teaching mode, students will not only master programming skills, but also enhance their innovative thinking and comprehensive abilities through the experience of collaboration, discussion and practical projects.

3.6 Increase the proportion of practical courses. In Python programming courses, the combination of theoretical learning and practical operation is crucial. In order to enhance students' practical ability, the curriculum should increase the proportion of practical courses, and design task projects in stages, so that students can improve their programming level in the process of gradual deepening. Tasks at each stage should have clear learning objectives and practical applications, covering all aspects of Python programming, from basic syntax applications to complex data analysis, machine learning, Web development and other practical projects.

For example, the early stages can help students consolidate their basic knowledge of Python through simple programming tasks (such as calculators, sorting algorithms, etc.); In the middle stage, students can design some more challenging projects (such as student management systems, data processing tools, etc.), so that students can start to contact with practical applications; Advanced stage can introduce complex projects, such as data analysis and visualization, machine learning model building, etc., to cultivate students' comprehensive ability. Each project should encourage students to think independently and solve problems, while encouraging students to code optimization and function expansion to further enhance their programming skills and innovative awareness.

3.7 Introducing school-enterprise cooperation projects. In order for students to better understand the needs of the industry and the application of technology, the course can introduce school-enterprise cooperation projects or real scenario cases. By working with companies to provide students with the opportunity to actually participate in projects, students can be exposed to the programming techniques and project needs actually used by enterprises, and develop the ability

to solve real problems. Companies can provide students with data sets, business requirements, and even guide students through project development to enhance students' hands-on experience.

For example, schools can work with technology companies to invite enterprise engineers to participate in teaching and provide common Python application scenarios in the industry, such as big data analysis, machine learning, automated script development, and so on. Students can develop projects based on these real questions, resulting in a better understanding of the links between theory and practice. In addition, enterprises can provide some open source projects or actual needs, and students can directly connect with the needs of enterprises when participating in them, and improve their employment competitiveness.

3.8 Carry out programming competitions. Programming competition is an effective way to stimulate students' interest in programming and innovative ability. By holding programming competitions (such as ACM and LeetCode competition), students can demonstrate their programming ability in fierce competitions and improve their ability of teamwork, problem solving and innovative thinking. Such activities can not only enhance students' practical programming experience, but also promote their interaction and communication, and enhance the spirit of collective cooperation.

The school can hold internal programming competitions regularly to encourage students to challenge programming problems of different difficulty and solve practical problems; At the same time, the school offers a wealth of project development opportunities, allowing students to work as a team within a limited time to complete a small project or solve a specific problem. Through these activities, students are not only able to exercise their programming skills, but also develop the ability to solve problems quickly under pressure, thereby enhancing their interest in programming and gaining confidence in their future careers.

3.9 Establish a diversified evaluation system. In order to comprehensively evaluate students' learning results in Python programming courses, a diversified evaluation system should be established, combining process evaluation and outcome evaluation. This comprehensive assessment focuses not only on the final outcome of the student, but also on the ability and progress demonstrated by the student during the learning process.

The process assessment focuses on the development of students' skills in the learning process, including class participation, assignment submission, laboratory operation, project progress, and group cooperation. Through regular feedback and guidance, teachers can find the weak points of students in the learning process in time and help them make targeted improvement. In addition, the process evaluation can also check the students' mastery of knowledge points through regular quizzes, homework and experiment reports, and encourage students to constantly improve themselves.

Results-based evaluation is mainly aimed at students' final completed projects or exam results. Students' mastery of Python language and application skills is assessed by scoring their final works, programming projects, final exams, etc. Through the review of student projects, teachers can gain insight into students' innovative thinking, code quality, problem-solving skills, etc., ensuring that students not only master basic programming skills, but also have the flexibility to apply these knowledge in real-world problems.

3.10 Introduction of student mutual evaluation. In order to enhance students' sense of active participation and teamwork spirit, evaluation methods such as student mutual evaluation and project results display can be introduced, which can promote students' self-reflection and improvement and stimulate students' learning interest.

Student evaluations can effectively improve students' critical thinking about their own and others' projects. During project development, students can check on each other's code quality, suggest improvements, and evaluate the work of other teams. This mutual evaluation not only motivates students to pay attention to detail and improve the quality of their projects, but also helps them understand the importance of teamwork and communication. In addition, by evaluating others' projects, students can learn different solutions from them and stimulate more creative thinking.

The presentation of project results is another effective way of evaluation, which can promote the presentation of students' own work and the building of self-confidence. At the end of the course, students can show their achievements in the project through reporting, demonstration and other forms, including code implementation, function display and project summary. Through this demonstration, students can get feedback from teachers and classmates, and at the same time further enhance their understanding of the project and self-confidence. The presentation session can also encourage students to demonstrate their innovative ideas and technology applications, further stimulating their interest and motivation.

4. Summary

4.1 Research Conclusion. Through the research and practice of the teaching reform of Python programming course, remarkable results have been achieved and valuable experience has been accumulated. First of all, the updating of course content and the innovation of teaching methods have effectively improved students' learning interest and programming ability. The introduction of project-driven teaching, flipped classroom and problem-oriented learning methods enables students to apply what they have learned in real scenarios, enhancing their practical ability and innovative thinking. Through the operation of practical projects, students not only learn programming skills, but also improve the ability of teamwork and problem solving.

Secondly, curriculum reform promotes the overall improvement of students' comprehensive quality. The reformed curriculum pays more attention to the combination of basic knowledge and practical application, and in the process of solving practical problems, students not only improve their programming ability, but also cultivate innovative thinking and independent problem-solving ability. The development of programming competitions, hackathons and other activities has stimulated students' enthusiasm for learning and enhanced their sense of competition and achievement.

In addition, the reform of teaching resources and teacher training has also achieved good results. Through the development of open learning platform and the integration of resources inside and outside the school, students can obtain rich learning materials at any time, and further improve the learning effect. Through regular training and exchange of teaching experience, teachers not only improve their teaching level, but also better adapt to the new teaching mode and the application of technical tools.

4.2 Future Outlook. Although the teaching reform of Python programming course has achieved remarkable results, there is still room for further optimization and development. In the future, we will continue to deepen the reform of teaching content and methods, and explore more innovative teaching models and application scenarios to adapt to changing educational needs and technological developments.

First of all, continuous optimization of teaching content and methods is the core direction of future reform. As Python technology continues to evolve, emerging areas such as data analytics, machine learning, artificial intelligence, and more will continue to be an important part of the course content. We plan to bring these cutting-edge technologies into the classroom to help students better master the latest programming skills and applied knowledge. At the same time, teaching methods should be constantly innovative. We will pay more attention to problem-based learning (PBL) and project-driven teaching model to stimulate students' learning interest, enhance their practical application ability and innovation ability.

Secondly, exploring more innovative teaching models and application scenarios will be an important topic of future reform. On the basis of existing models such as flipped classroom and blended teaching, we will try to integrate virtual reality (VR), augmented reality (AR) and other technologies into classroom teaching to create a more immersive and interactive learning experience for students. In addition, with the continuous development of artificial intelligence and big data technologies, the use of these technologies for personalized teaching, learning analysis and intelligent assessment will also become an effective way to improve the quality of education. Through these innovative models, it is possible to better adapt to the learning needs of different

students and help them grow in a more diverse and open environment.

In short, the future development of Python programming courses will continue to keep up with technological progress and educational innovation, promote the continuous improvement of teaching content, methods and evaluation systems, provide students with more challenging and creative learning opportunities, and lay a solid foundation for their future career development.

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