Analysis of Intelligent Experimental Teaching in Applied Higher - Education Undergraduate Institutions

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Abstract—*This paper focuses on applied higher - education undergraduate institutions and aims to deeply explore intelligent experimental teaching by means of multi - dimensional analysis methods. By combing through the literature in academic databases such as Web of Science and CNKI, the research trends in this field are grasped. Multiple representative institutions are selected to carry out case studies and empirical investigations, and SPSS software is used to quantitatively analyze the data. The research reveals that currently, intelligent experimental teaching faces issues such as insufficient teaching resources, deficient teacher capabilities, poor student adaptability, and imperfect teaching management. However, intelligent experimental teaching is of great significance for improving the quality of talent cultivation, promoting the development of disciplines and specialties, and enhancing the competitiveness of institutions. To address the challenges at the technical, teaching, management, and guarantee levels, strategies such as strengthening technical support and innovation, promoting the innovation of teaching models and methods, strengthening the construction of the teaching staff, and improving the management and guarantee mechanisms need to be adopted. Future research should expand the sample scope, pay attention to the application of emerging technologies, and improve development strategies.*

Keywords—*Applied higher-education undergraduate institutions, intelligent experimental teaching, talent cultivation, teaching model innovation, development dtrategies.*

I. INTRODUCTION

A. Research Background

In the framework of the higher - education system, applied higher - education undergraduate institutions play an indispensable and crucial role. Their core mission is to continuously supply the society with applied professionals who possess strong practical abilities and innovative spirits. In recent years, with the rapid development of cutting - edge intelligent technologies such as Artificial Intelligence, Big Data, and the Internet of Things, the education field is undergoing profound changes. As a product of the deep integration of education and technology, intelligent experimental teaching has become a key path to improve teaching quality and meet the society's demand for high - quality talents, and it has far - reaching significance for the innovation of talent - cultivation models and the improvement of education quality in applied higher - education undergraduate institutions [1]-[9].

B. Research Objectives and Significance

This research aims to use multi - dimensional analysis methods to deeply and systematically analyze the current situation of intelligent experimental teaching in applied higher - education undergraduate institutions, accurately identify the existing problems, and propose practical and forward - looking development strategies from the perspective of the combination of theory and practice. By deeply promoting intelligent experimental teaching, it can not only effectively enhance students' practical operation skills, innovative thinking abilities, and the ability to solve complex practical problems, but also strongly promote the interdisciplinary integration and innovative development of disciplines and specialties, and significantly enhance the core competitiveness of institutions in the higher - education field. This not only helps to meet the urgent demand of the society for innovative applied talents, but also provides theoretical support and practical guidance for the sustainable development of applied higher - education undergraduate institutions.

C. Research Methods and Ideas

This research comprehensively uses a variety of research methods to strive for a comprehensive and in - depth exploration of issues related to intelligent experimental teaching in applied higher - education undergraduate institutions. In terms of literature research, by relying on academic databases such as Web of Science and CNKI, it extensively combs through the cutting - edge research achievements on intelligent experimental teaching at home and abroad, and comprehensively grasps the research trends and development trends in this field. At the same time, through designing a scientific and rigorous questionnaire, empirical investigations are carried out on dimensions such as the application of intelligent experimental teaching, the construction of teaching resources and platforms, and the attitudes and experiences of teachers and students in multiple institutions. Statistical analysis software such as SPSS is used to quantitatively analyze the collected data to ensure the scientificity and reliability of research conclusions. Through the coordinated application of multiple methods, the essence of the problem is comprehensively and deeply revealed, and then targeted and practical development strategies are proposed.

II. RELEVANT THEORIES OF INTELLIGENT EXPERIMENTAL TEACHING IN APPLIED HIGHER - EDUCATION UNDERGRADUATE INSTITUTIONS

A. Concept and Connotation of Intelligent Experimental Teaching

Intelligent experimental teaching refers to the systematic optimization and innovative transformation of the entire process of experimental teaching relying on advanced intelligent technologies such as artificial intelligence, Virtual Reality (VR), Augmented Reality (AR), and big - data analysis. This process not only covers the extensive application of intelligent experimental equipment to achieve the automation, precision, and intelligence of experimental operations, but also includes the construction of intelligent experimental teaching platforms. By integrating various teaching resources, it provides teachers and students with a convenient and efficient teaching interaction environment. At the same time, the innovation of teaching methods and models based on intelligent technologies, such as adaptive learning and intelligent tutoring systems, aims to meet the personalized and diversified learning needs of students and build a more efficient and interactive experimental learning ecosystem.

B. Theoretical Basis

The theoretical basis of intelligent experimental teaching mainly stems from constructivist learning theory, cognitive load theory, and situated learning theory. Constructivist learning theory emphasizes that students acquire knowledge through active exploration, collaborative communication, and meaning construction in the experimental process. Teachers should play the roles of guides and facilitators, creating rich learning situations and interaction opportunities for students. Cognitive load theory focuses on the rationality of experimental task design, aiming to avoid low learning efficiency caused by excessive cognitive load on students. By optimizing the presentation of teaching content and reasonably arranging experimental steps, it ensures that students achieve efficient learning with limited cognitive resources. Situated learning theory advocates placing learning in a realistic experimental situation. By simulating real - world work scenarios and problem - solving processes, it cultivates students' practical abilities, problem - solving abilities, and professional qualities, enabling students to better understand and apply knowledge in a situated learning environment.

C. Necessity of Carrying out Intelligent Experimental Teaching in Applied Higher - Education Undergraduate Institutions

From the perspective of talent - cultivation goals, applied higher - education undergraduate institutions take the cultivation of applied talents with solid professional knowledge and strong practical abilities as their core tasks. Intelligent experimental teaching can create a highly simulated experimental environment, simulate complex real - world work scenarios, enable students to encounter real problems and challenges in the experimental process, and thus effectively improve their ability to solve practical problems, meeting the society's demand for the practical abilities of applied talents. With the rapid development of science and technology and the transformation and upgrading of industries, the market's demand for innovative talents is increasing day by day. Intelligent experimental teaching, by introducing cutting - edge technologies and innovative teaching methods, stimulates students' innovative thinking, cultivates their innovative abilities, provides students with opportunities to explore the unknown and solve complex problems, and helps students become leaders driven by innovation in their future careers. In addition, intelligent experimental teaching is also an inevitable choice for applied higher - education undergraduate institutions to adapt to the development trend of higher education, improve their own education quality and competitiveness, and is an important measure to realize the modernization of education and the innovation of talent - cultivation models.

III. ANALYSIS OF THE CURRENT SITUATION OF INTELLIGENT EXPERIMENTAL TEACHING IN APPLIED HIGHER - EDUCATION UNDERGRADUATE INSTITUTIONS

A. Design of the Current - Situation Survey

This survey selected ten applied higher - education undergraduate institutions of different regions and types across the country as research objects, aiming to ensure the representativeness and diversity of the samples. By drawing on relevant research results at home and abroad and combining the characteristics of applied higher - education undergraduate institutions, a set of questionnaires covering multiple dimensions such as the application of intelligent experimental teaching, the construction of teaching resources and platforms, and the attitudes and experiences of teachers and students was designed. The questionnaire adopts the Likert scale form to quantitatively measure the indicators of each dimension to improve the accuracy and comparability of the data. The data collection adopts a combination of online and offline methods. Online, questionnaires are distributed through the Wenjuanxing platform, and offline, in - depth understanding of some institutions is carried out through on - site research and interviews to ensure the comprehensiveness and reliability of the data.

B. Survey Results and Analysis

(i) Application of Intelligent Experimental Teaching

The survey data show that 80% of the institutions have carried out intelligent experimental teaching in some professional courses, but the overall application scope is still relatively limited, and the curriculum coverage is uneven. Among them, the application proportion in science and engineering majors is relatively high, reaching 100%, while the application proportion in liberal arts majors is only 60%. In terms of the depth of application, most institutions only apply intelligent technologies to the experimental demonstration and data collection links, and the application in experimental design, data analysis, and result feedback links is still insufficient.

(ii) Construction of Teaching Resources and Platforms

The intelligent experimental teaching resources are relatively scarce. 50% of the institutions have problems such

as aging experimental equipment and insufficient digital experimental resources. The functions of intelligent teaching platforms also need to be improved. Some platforms have problems such as complex operation and poor stability, and only 40% of the institutions are satisfied with the existing platforms. In terms of the sharing of teaching resources, there is a lack of effective cooperation mechanisms among institutions, and the degree of resource sharing is low, which restricts the overall development of intelligent experimental teaching.

(iii) Attitudes and Experiences of Teachers and Students towards Intelligent Experimental Teaching

Most teachers (98%) and students (95%) hold a positive attitude towards intelligent experimental teaching and believe that it helps to improve teaching effectiveness and learning experience. However, in actual teaching, some teachers (29%) have problems such as insufficient information literacy and teaching ability, and it is difficult for them to effectively use intelligent technologies to carry out teaching. On the student side, 34% of the students said that they have poor adaptability to the new teaching mode, their self - learning ability needs to be improved, and they lack effective solutions when encountering problems in the experimental process.

C. Summary of Existing Problems

Based on the comprehensive survey results, the current intelligent experimental teaching in applied higher - education undergraduate institutions has the following main problems: First, there is a shortage of teaching resources, including aging experimental equipment, scarce digital resources, and imperfect teaching platform functions. Second, the capabilities of teachers need to be improved. The information literacy and teaching abilities of some teachers are difficult to meet the requirements of intelligent teaching. Third, students have poor adaptability, and their acceptance of the new teaching mode and self - learning ability need to be improved. Fourth, the teaching management is imperfect, lacking effective teaching management mechanisms and evaluation systems, making it difficult to guarantee the quality and effectiveness of intelligent experimental teaching.

IV. THE SIGNIFICANCE OF INTELLIGENT EXPERIMENTAL TEACHING FOR APPLIED HIGHER - EDUCATION UNDERGRADUATE INSTITUTIONS

A. Improving the Quality of Talent Cultivation

Intelligent experimental teaching creates a learning environment that is closer to actual work for students by simulating real - world scenarios and providing rich experimental data. Students can use the knowledge they have learned to solve complex problems in the experimental process, effectively cultivating their practical abilities. At the same time, intelligent teaching tools such as data - analysis software and intelligent simulation systems can stimulate students' innovative thinking, guide students to think about problems from different perspectives, and enhance their innovative abilities. In the process of solving complex experimental problems, students' problem - solving abilities are exercised, thus comprehensively improving the quality of talent cultivation and enabling students to better meet the society's demand for applied talents.

B. Promoting the Development of Disciplines and Specialties

Intelligent experimental teaching promotes the deep interdisciplinary integration of disciplines and intelligent technologies, injecting new vitality into the development of disciplines. For example, in the field of engineering, the application of intelligent experimental equipment and data - analysis technology helps to carry out cutting - edge scientific research and promote the innovation and development of disciplinary theories. In the field of liberal arts, the introduction of big - data analysis and artificial - intelligence technology provides new methods and perspectives for humanities and social - science research, promoting the transformation of the disciplinary research paradigm. In addition, intelligent experimental teaching also promotes the optimization and update of the professional curriculum system, integrating cutting - edge technologies and industry demands into the curriculum content, and enhancing the competitiveness and adaptability of specialties.

C. Enhancing the Competitiveness of Institutions

The successful implementation of intelligent experimental teaching helps to enhance the teaching reputation of institutions, attract more high - quality students and excellent teachers. In the context of increasingly fierce competition in the higher - education market, institutions with advanced intelligent experimental teaching conditions can gain an advantage in enrollment and talent introduction. At the same time, intelligent experimental teaching also provides strong support for institutions to carry out industry - university - research cooperation, promotes the deep cooperation between institutions and enterprises and scientific research institutions, enhances the social influence of institutions and their ability to serve local economic development, and further enhances the competitiveness of institutions in the higher - education field.

V. CHALLENGES FACING INTELLIGENT EXPERIMENTAL TEACHING IN APPLIED HIGHER - EDUCATION UNDERGRADUATE INSTITUTIONS

A. Technical - Level Challenges

Intelligent technologies are updated extremely rapidly, and institutions face problems such as high equipment - renewal costs and poor technical compatibility. On the one hand, new intelligent experimental equipment is expensive, and institutions face great financial pressure in equipment procurement and renewal. On the other hand, there are compatibility problems between equipment and software from different manufacturers, resulting in difficulties in system integration and affecting teaching effectiveness. At the same time, network - security issues in experimental teaching cannot be ignored. Ensuring the security of experimental data and the stable operation of teaching platforms faces severe challenges. Security incidents such as data leakage and network attacks may cause serious threats to teaching order and students' information security.

B. Teaching - Level Challenges

It is difficult to integrate traditional teaching models with intelligent teaching models, and some teachers have difficulty adapting to new teaching concepts and methods. In an intelligent teaching environment, teachers need to transform from knowledge transmitters to learning guides and facilitators, which puts forward higher requirements for teachers' teaching abilities and information literacy. However, some teachers are bound by traditional teaching thinking and find it difficult to effectively use intelligent teaching tools to carry out teaching activities. In terms of curriculum design, the design of intelligent experimental courses lacks systematicness and scientificity, and the connection between practical links and theoretical teaching is not close enough, resulting in students' difficulty in forming a complete knowledge system and practical abilities in the learning process.

C. Management and Guarantee - Level Challenges

The management system is imperfect, lacking effective management mechanisms and evaluation systems for intelligent experimental teaching. At present, most institutions still use traditional teaching management models to manage intelligent experimental teaching, which is difficult to meet the characteristics and needs of intelligent teaching. In terms of teaching - quality evaluation, there is a lack of scientific and reasonable evaluation indicators and methods, making it difficult to accurately evaluate the effectiveness of intelligent experimental teaching. The construction of the teaching - staff lags behind, and there is a shortage of teachers who are both proficient in professional knowledge and intelligent technologies. Institutions' investment in teacher training and talent introduction is insufficient, resulting in the overall quality of the teaching - staff being difficult to meet the requirements of intelligent teaching. Insufficient capital investment restricts the renewal of intelligent experimental teaching equipment and the development of teaching resources, becoming an important factor restricting the development of intelligent experimental teaching.

VI. DEVELOPMENT STRATEGIES FOR INTELLIGENT EXPERIMENTAL TEACHING IN APPLIED HIGHER - EDUCATION UNDERGRADUATE INSTITUTIONS

A. Technical Support and Innovation

Strengthen cooperation with scientific research institutions and enterprises, establish an industry - university - research collaborative innovation mechanism, and jointly develop intelligent technologies and equipment suitable for experimental teaching. Through cooperation, institutions can obtain cutting - edge technologies in a timely manner, reduce research and development costs, and improve the applicability and stability of equipment. Optimize the campus network environment, increase investment in network infrastructure, improve network bandwidth and stability, and ensure the smooth operation of intelligent experimental teaching. Strengthen network - security protection, establish and improve network - security management systems, and adopt advanced security technical means such as firewalls and encryption technologies to ensure the security of experimental data and the stability of the teaching platform.

B. Innovation of Teaching Models and Methods

Construct a student - centered personalized teaching model. With the help of learning - analysis technology, deeply understand the learning characteristics and needs of students, and provide customized experimental teaching plans for students. Innovate teaching methods, adopt teaching methods such as project - based learning, inquiry - based learning, and problem - based learning to stimulate students' learning interests and initiatives. Strengthen practical teaching, increase comprehensive and design - based experimental projects, and cultivate students' practical and innovative abilities. At the same time, pay attention to the organic integration of theoretical teaching and practical teaching. Through case - based teaching, on - site teaching, and other methods, enable students to deepen their understanding and application of theoretical knowledge in practice.

C. Construction of the Teaching Staff

Carry out teacher information - literacy training, regularly organize teachers to participate in intelligent teaching technology training and academic exchange activities, and enhance teachers' ability to use intelligent technologies for teaching. Encourage teachers to participate in scientific research projects, especially those related to intelligent experimental teaching, promote teaching through scientific research, broaden teachers' horizons, and improve teachers' professional levels. Introduce compound talents who are both proficient in professional knowledge and intelligent technologies to enrich the teaching staff and optimize the teacher structure. Establish a teacher - incentive mechanism, reward teachers who perform outstandingly in intelligent experimental teaching, and stimulate teachers' enthusiasm and creativity.

D. Improvement of Management and Guarantee Mechanisms

Establish and improve the management system for intelligent experimental teaching, clarify the responsibilities of various departments, and strengthen the management of the teaching process. Set up a special management institution for intelligent experimental teaching, responsible for the overall allocation of teaching resources, the monitoring and evaluation of teaching quality, and other work. Increase capital investment, set up special funds for the purchase of intelligent experimental teaching equipment, the development of teaching resources, and teacher training. Establish a scientific teaching - quality monitoring system, formulate scientific and reasonable evaluation indicators and methods, and regularly conduct comprehensive evaluations and feedback on the effectiveness of intelligent experimental teaching, and promptly discover and improve problems.

VII. CONCLUSION

This research, through multi - dimensional analysis, deeply analyzes the relevant theories, current situations, problems,

and development strategies of intelligent experimental teaching in applied higher - education undergraduate institutions. The research shows that intelligent experimental teaching is of great significance for improving the quality of talent cultivation, promoting the development of disciplines and specialties, and enhancing the competitiveness of institutions in applied higher - education undergraduate institutions. However, currently, there are still many challenges in terms of technology, teaching, and management. By adopting strategies such as technical support and innovation, innovation of teaching models and methods, construction of the teaching staff, and improvement of management and guarantee mechanisms, the development of intelligent experimental teaching can be effectively promoted, providing strong support for the education reform and talent cultivation of applied higher - education undergraduate institutions.

This research has certain limitations in case selection and data collection. Future research can further expand the sample scope, cover more applied higher - education undergraduate institutions of different regions and types, and deeply study the characteristics and laws of intelligent experimental teaching in different majors and regions. At the same time, with the continuous development of intelligent technologies, continuously pay attention to the application of new technologies in experimental teaching, such as block chain technology and quantum - computing technology, and continuously improve development strategies to provide more forward - looking theoretical guidance and practical suggestions for the development of intelligent experimental teaching in applied higher - education undergraduate institutions.

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