STUDY ON SUPERIMPOSED TEACHING MODE OF MECHANICAL MANUFACTURING COURSE --TAKE SHANDONG ENGINEERING VOCATIONAL AND TECHNICAL UNIVERSITY AS AN EXAMPLE

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Title: Study on Superimposed Teaching Mode of Mechanical Manufacturing Course - Take Shandong Engineering Vocational and Technical University as an example

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ABSTRACT

This study is based on constructivist learning theory and behaviorist learning theory. In the CDIO(Conceive, Design, Implement and Operate) mode, the superimposed teaching is applied to the intelligent manufacturing professional machinery manufacturing course of Shandong Engineering Vocational and Technical University, and a new teaching mode of intelligent manufacturing professional machinery manufacturing practice teaching is constructed, which combines the advantages of Internet learning while retaining the advantages of the traditional mechanical manufacturing practice teaching mode, so as to improve the teaching effect of intelligent manufacturing professional machinery manufacturing classroom and improve the teaching structure of intelligent manufacturing professional machinery manufacturing course. Under the background of "Internet+", the superimposed teaching mode is adopted, that is, the online teaching mode such as micro-course and MOOC(massive open online courses) is combined with the on-site practical operation teaching mode to reconstruct the traditional teaching process and the relationship between teachers and students.

The objectives of this paper were: 1) To verify the feasibility of applying the superposition teaching mode based on CDIO mode to the teaching of intelligent manufacturing major machinery manufacturing courses in Shandong Engineering Vocational and Technical University; 2) To explore whether the superimposed teaching mode based on CDIO mode can optimize the teaching structure and enrich the teaching content of mechanical manufacturing courses of Shandong Engineering Vocational and Technical University; 3) Through the application of the superimposed teaching mode based on the CDIO mode, to promote the communication and exchange between teachers and students, and improve the teaching level of the mechanical manufacturing course of Shandong Engineering Vocational and Technical University.

In this study, a mixed research method was adopted to combine quantitative and qualitative methods to conduct superimposed teaching of mechanical manufacturing courses based on CDIO mode for 300 students majoring in intelligent manufacturing in 2021 of Shandong Engineering Vocational and Technical University. After 16 weeks of superimposed teaching practice of machinery manufacturing under CDIO mode, this paper found that: 1) It is effective and operable to apply the superimposed teaching mode of machinery manufacturing courses based on CDIO mode to the internal mechanism and external conditions of intelligent manufacturing professional machinery manufacturing courses of Shandong Engineering Vocational and Technical University; 2) Based on the superimposed teaching of mechanical manufacturing under the CDIO mode, combined with the advantages of offline classroom teaching and online platform teaching, online resources are used to make up for the shortcomings of offline classroom teaching, and improve the state and efficiency of student learning; 3) Teachers and students have a positive attitude towards the teaching effect of the mechanical manufacturing superposition teaching mode based on the CDIO mode, which can effectively feedback the key and difficult points in the learning process of students, so that teachers can solve problems in a timely and targeted manner and stimulate students' interest in exploratory learning.

Keywords: CDIO mode, pedagogical theory, superimposed teaching, hands-on teaching mode

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Declaration

I, Xu Jipeng, hereby certify that the work embodied in this independent study entitled " Study on Superimposed Teaching Mode of Mechanical Manufacturing Class-Take Shandong Engineering Vocational and Technical University as an example*" is result of original research and has not been submitted for a higher degree to any other university or institution.*

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Chapter 1 Introduction

1.1 Research Background

The practical teaching model has become increasingly important in Chinese education in recent years. The hands-on teaching model aims to foster creativity and teamwork in students through practice and participation, enabling them to learn by doing rather than relying on teacher chatter. The practical teaching mode helps to improve teaching efficiency, cultivate students' hands-on ability and innovative thinking, as well as improve students' understanding and cognitive ability to learn content, stimulate students' interest in learning, and promote students' initiative in learning (Teng, 2023).

As one of the essential ways to cultivate professional and technical talents, China has introduced corresponding policies to support its development against the strong demand for applied technical skills in China. 2017 "Guidance of the Ministry of Education on Further Promoting the Development of Vocational Education Informatization" proposed to improve the fundamental capacity of vocational and technical informatization, deepen the innovation mode of education and teaching, and enhance the information of teachers, students, and managers literacy (Ministry of Education of the People's Republic of China, 2017).

In 2018, the "Opinions of the Ministry of Education on the Implementation of the Excellent Teacher Training Program 2.0" mentioned that the construction of Chinese-level high-quality online open courses, the promotion of new teaching models such as flipped classrooms and superimposed teaching, and the formation of an independent, cooperative and inquiry learning model that organically combines and deeply integrates online and offline teaching (Ministry of Education of the People's Republic of China, 2018).

In 2019, the Implementation Plan of China's Vocational Education Reform clearly stated that "vocational education and general education are two different types, and they have equal importance" (General Office of the State Council of the People's Republic of China, 2019).

Traditional practical teaching model. The traditional practical teaching mode is manifested as the on-site teaching mode under examination-oriented education. In the classroom of mechanical professional teaching, most of them adopt this single teaching mode, instilling the knowledge in the books to students. Teaching content and methods lack characteristics, cookie-cutter, and other defects. It is challenging to teach according to aptitude, resulting in many students having difficulty to accept and mastering part of the course content.

The traditional teaching method is based on the mode of "teachers speak, students listen, and follow", with the acquisition of knowledge as the main purpose, the teaching content is uniformly arranged, and the difference in students' knowledge starting point and ability is ignored; the classroom lacks experience and practice, and students' learning initiative is not high; the course evaluation method is single, focusing on the final exam and ignoring the learning process, which is difficult to stimulate students' lasting learning motivation and learning participation. However, at present, the on-site teaching mode is one of the most common methods in practical teaching, and it is also an effective means to achieve the goal of application-oriented talent training (Zhang, 2016).

"Theory and reality" teaching mode. The teaching task is jointly designed by both the school and the enterprise, and the boring and abstract professional basic knowledge is scientifically and effectively integrated into the vivid and interesting enterprise practice case teaching, and the course performance pays attention to the process assessment and other means, the assessment method is flexible, and the personalized and flexible teaching, learning and doing integration teaching mode is implemented (Pai, 2022).

The practical teaching mode of "platform + module ."Explore the realization of "zero distance" between school and enterprise in the comprehensive practice of students' graduation, strengthen in-depth cooperation between school and enterprise, and adopt the "platform + module" combination of engineering and learning practice teaching mode to improve students' interest in learning and employability (Luo, 2018).

The German dual model. Students receive professional education in vocational schools for "one yuan," and vocational skills training in enterprises is for "two yuan ."They have to receive two types of training, mainly theoretical teaching in school and learning vocational theoretical knowledge: in enterprises, mainly skills training, learning practical courses (Wang, 2020).

Australian TAFE model. The TAFE model is a vocational education and training system with Australian characteristics, which achieves the purpose of deep integration of occupational categories and vocational access systems, which requires employees in higher vocational skills departments to have corresponding vocational qualification certificates to enter, thereby standardizing the operation standards of the job market (Li, 2017).

British "sandwich" practical training model. The main feature of the "sandwich" practical training mode is that students first learn theoretical

knowledge and then go to the factory enterprise to carry out production labor, verify the theory, and then carry out theoretical study, practice, and so on until they can master the knowledge they have learned and can pass the exam to get a graduation certificate (Qiu, 2015).

It is worth noting that although the teaching mode of mechanical professional practice in domestic and foreign vocational colleges is different in different countries and regions, its common point is that they all focus on cultivating students' practical ability and problem-solving abilities. Whether it is domestic or foreign vocational education, it is committed to breaking the traditional teaching mode and improving students' practical operation ability and innovation ability so as to meet the needs of modern industrial development. In terms of the research of mechanical professional practice teaching mode, each college basically adopts the practical teaching mode of combining engineering and learning, but the phenomenon of teaching and learning of vocational education is still relatively common, and students lack real experience in actual production and solving production technology problems in school (Shi, 2019).

Some people believe that the teaching method of mechanical manufacturing courses is mainly based on skill training and theoretical knowledge expression, and its characteristics determine that face-to-face teaching is inseparable, and once separated from the physical classroom, the quality and effect of mechanical manufacturing teaching cannot be guaranteed. Others argue that digital technology allows different voices to enter some of the more specialized fields, which may reduce its own discussion of hierarchy, characterized by arbitrariness and unprofessionalism (Wang, 2020). However, with the development of online mechanical manufacturing course teaching during the pandemic, more and more educators have found that network teaching has indeed brought new enlightenment and development paths to the teaching of traditional mechanical manufacturing courses, which can improve the phenomenon of single teaching of traditional mechanical manufacturing courses, monotonous learning paths of students, weak sense of innovation and thinking to a certain extent, broaden the teaching channels of mechanical manufacturing courses, and improve the teaching quality of teachers and the learning effect of students. Traditional offline classrooms can no longer meet the needs of students, and the way to obtain knowledge and information is very different from before. In the past, students could only listen to the teacher's teaching and knowledge transfer when entering the classroom, and now students can also access various learning resources at home through the Internet and major applications.

Therefore, the Internet and information teaching are naturally introduced into student learning, and students' learning channels and learning methods are enriched through a combination of online and offline teaching so that students can not only receive face-to-face guidance from teachers but also conduct more independent learning through the Internet, online teaching platforms and other information means, so as to cultivate their independent learning ability and lifelong learning habits. Integrating superimposed teaching into the teaching of mechanical manufacturing courses in vocational colleges has become an urgent need for teaching reform and development, which can not only enrich teachers' teaching methods and curriculum construction but also broaden students' diversified learning paths, cultivate innovative awareness and teamwork ability, and promote the diversified development of modern vocational education.

1.2 Problems of the study

Traditional mechanical manufacturing teaching refers to offline teaching as the main teaching form, "on-site teaching" as the main teaching method and skill training as the main teaching goal. Since mechanical manufacturing is an important compulsory course for colleges and universities to cultivate students' excellent technical strength, innovation, and teamwork ability, its essence lies in the development and use of skills, so this teaching method has been inherited since the establishment of the discipline of mechanical manufacturing, teachers through face-to-face oral narration and physical demonstration, the formation of offline "demonstration-imitation-practice" The advantage of this teaching mode is that students can observe the teacher's language expression and technical operation up close, which gives them a stronger intuitive learning experience. However, with the development of the times, the traditional mechanical manufacturing teaching method also has certain drawbacks, such as the teaching mode is old-fashioned, single, students' learning initiative is not high, the sense of exploration and innovation is weak, the vocational education "dual teacher quality" teachers are insufficient, and the school teaching equipment is insufficient. At present, the teaching of mechanical manufacturing in colleges and universities is still in the process of development.

At present, the rigidity of the teaching procedures of mechanical manufacturing in colleges and universities and the stereotyped teaching methods of intelligent manufacturing majors make students lack enthusiasm for learning and find it difficult to meet their individual needs. In the teaching of mechanical engineering, even students in the same class will be different due to different learning experiences and differences in professional level and learning ability. In this case, teachers need to spend more time and energy to understand the learning situation of each student, unable to provide targeted guidance or help

to students, and the difficulty of learning will increase, resulting in weakened students' interest in learning. The learning source of mechanical manufacturing courses for intelligent manufacturing students in colleges and universities mainly relies on the teaching of intelligent manufacturing professional machinery manufacturing in colleges and universities and expanding students' knowledge sources and learning paths to improve the teaching status of intelligent manufacturing professional mechanical manufacturing courses in colleges and universities.

1. The superimposed teaching mode of machinery manufacturing based on the CDIO model can be applied to the teaching of intelligent manufacturing professional machinery manufacturing courses at Shandong Engineering Vocational and Technical University or not?

2. The superimposed teaching mode of mechanical manufacturing based on the CDIO model can optimize the teaching structure and enrich the teaching content of the mechanical manufacturing course of Shandong Engineering Vocational and Technical University or not?

3. Through the application of the superimposed teaching mode of mechanical manufacturing based on the CDIO model, can it promote the communication and exchange between teachers and students and improve the teaching level of mechanical manufacturing courses at Shandong Engineering Vocational and Technical University?

1.3 Objective of the study

Based on the CDIO model, this study envisages the application of mechanical manufacturing superimposed teaching in the intelligent manufacturing major mechanical manufacturing course of Shandong Engineering Vocational and Technical University and envisages that the teaching of online learning platform and communication and interactive platform can make up for the shortcomings of offline teaching, supplement the advantages of face-to-face classroom teaching with online teaching, so as to carry out detailed design and planning on how to better realize the docking of online and offline teaching activities and give full play to its immediacy and sharing, giving students more learning space and time. Students have more learning space and time, strive to achieve the teacher's concentration in imparting knowledge in the physical classroom, and more effective supplementary learning content outside the classroom, and the teacher's accompaniment will run through the teaching activities. The study can solve the problem of insufficient teachers and insufficient school teaching equipment in

vocational education and has extraordinary significance for the reform of practical internship teaching, the effectiveness of practical internship with students as the main body and the school itself, which is the need to comprehensively promote quality education and cultivate high-quality application-oriented talents that meet the requirements of the times, and will also enhance the school's teachers and promote the improvement and improvement of teaching hardware conditions. In the reform of practical teaching, it is necessary to strengthen the construction of teachers. Only with a high-quality, practical teaching team is it possible to take practical teaching to a higher level, on the basis of sufficient equipment conditions provided by the school, shorten the time of students' top internship and the adaptation cycle of enterprise employment, improve production efficiency, and improve product quality.

1. To verify the feasibility of applying the superposition teaching mode based on CDIO mode to the teaching of intelligent manufacturing major machinery manufacturing courses at Shandong Engineering Vocational and Technical University.

2. To explore whether the superimposed teaching mode based on CDIO mode can optimize the teaching structure and enrich the teaching content of mechanical manufacturing courses of Shandong Engineering Vocational and Technical University.

3. Through the application of the superimposed teaching mode based on the CDIO mode, to promote the communication and exchange between teachers and students and improve the teaching level of the mechanical manufacturing course of Shandong Engineering Vocational and Technical University.

1.4 Scope of the study

There are many studies on practical teaching, and the author found a total of 40 results in the keyword "superposition teaching" on CNKI, including 25 academic journals, four academic papers, one conference article, and two yearbooks; the author searched for the keyword "practical teaching mode" on CNKI and obtained a total of 18,900 results, including 15,700 academic journals, 186 academic papers, 358 conference articles, 41 yearbooks, and 22 newspapers. Through reading the literature, it was found that constructivist learning theory and behaviorist learning theory were more applied and consistent with the research of this paper, so these two theories were finally chosen as the most theoretical basis of the research paper.

This paper selects 300 students of the 2021 intelligent manufacturing major of Shandong Engineering Vocational and Technical University and teachers of machinery manufacturing courses in Shandong Province as research objects, analyzes the teaching situation of mechanical manufacturing and the application of superimposed teaching in mechanical manufacturing teaching, and carries out superimposed teaching practice of mechanical manufacturing courses in 10 lessons per week (45 minutes each, a total of 450 minutes), a total of 16 weeks and 160 lessons, according to the recommended length of time, the superimposed teaching practice of mechanical manufacturing courses is carried out, and the overall changes of students after 16 weeks are compared. The effectiveness of superimposed teaching is examined by comparing students' overall changes after 16 weeks.

1.5 Research Significance

In recent years, the rapid development of information technology has continuously promoted the innovation of educational reform practice models. Online and offline have always been closely connected, and the inherent teaching mode is difficult to apply in different teaching content and teaching environments. The superimposed teaching of mechanical manufacturing courses based on CDIO mode can make full use of the form of online and offline integration, improve students' cognitive effects, explore new teaching methods, enrich students' after-school life, enhance the relationship between teachers and students, and provide new ideas for the current reform of mechanical manufacturing teaching.

Successfully carrying out the research of superimposed teaching mode of mechanical manufacturing can guide students' learning from shallow to deep learning so that students have more ways and methods to put more energy into the study of mechanical manufacturing practice courses, urge students to develop independent learning behaviors, and improve the teaching level of mechanical manufacturing practice courses.

Successfully carrying out the research and practice of mechanical manufacturing superimposed teaching mode can improve the teaching quality of "vocational, undergraduate mechanical manufacturing practical teaching ."According to the characteristics of vocational, undergraduate mechanical engineering students, through the integration of more advanced teaching concepts such as project teaching method, CDIO engineering education, task-driven method, hierarchical teaching method, independent learning, online learning, and active practice, the systematic reform has been

carried out from the aspects of project design topics, teaching content, teaching methods, design methods, and evaluation systems.

The use of superimposed teaching based on CDIO mode in the intelligent manufacturing professional machinery manufacturing course in colleges and universities is a new attempt, which can effectively combine online teaching with traditional classrooms to achieve cross-border cooperation between online and offline. This study comprehensively and systematically discusses and analyzes the superimposed teaching mode of mechanical manufacturing, and with the help of CDIO mode, it can enrich the relevant research of mechanical manufacturing courses in colleges and universities to a certain extent and broaden the depth and breadth of the applied research vision of superimposed teaching in mechanical manufacturing education.

Chapter 2 pieces of literature Review

Shandong Engineering Vocational and Technical University is an undergraduate-level vocational and technical university approved by the Ministry of Education with independent degree awarding qualifications and is one of the first 15 undergraduate-level vocational education pilot institutions in China. Shandong Engineering Vocational and Technical University has ten full-time teachers of intelligent manufacturing professional mechanical manufacturing courses with rich teaching experience who have been engaged in mechanical manufacturing courses and taught for more than eight years. There are 300 students majoring in intelligent manufacturing in 2021, and the students generally have good learning acceptance ability, interest, ability to try and understand new things, and ability to use information technology tools such as electronic devices. Since students have never been exposed to mechanical manufacturing courses, their understanding of automated manufacturing and personal basic abilities are generally weak; most are in a zero-based state, and their learning autonomy and creativity are still weak. Students are accustomed to passive acceptance of learning, and in the learning process, it is often easy to attach importance to theoretical learning and neglect practical operation. At present, the teaching of mechanical manufacturing courses is still mainly based on offline classroom practical training, supplemented by theoretical knowledge learning.

2.1 Theoretical basis

2.1.1 Constructivist learning theory

Constructivism believes that knowledge is acquired not from direct transmission by teachers but through the active construction of meaning in a certain teaching context with the help of others and the use of necessary learning resources, emphasizing the learner-centered teaching process, the creation of teaching situations, cooperation, communication, and the importance of resources for the construction of meaning (He & Li, 2009)

According to constructivist learning theory, blended teaching is precisely the process of facilitating effective learning by creating authentic and complex contexts for learners to collaboratively explore and construct meaning in a combination of online and offline instruction (Feng et al., 2019).

The constructivist theory differs from the traditional concept of learning and teaching in that it emphasizes that learners can participate in the process of learning autonomously in the social environment of communication and that

learning is the production and construction of understanding by learners based on prior knowledge and experience (Zhang, Zhang, & L, 2019).

Under constructivist theory, the teacher is the facilitator of the learning process, and students can take the initiative in acquiring knowledge, using learning resources and materials that can enhance their skills, and forming a chain of knowledge in their brains with the help of the teacher or others. Constructivist learning theory also considers "context," "collaboration," "conversation," and "meaning making" as the four main attributes of a learning environment. In order to design teaching in a constructivist learning environment, it is important to consider creating an environment that is conducive to student learning, designing a "place" where students can express their individuality, echoing the current trends and relating to the actual situation, so that students' individuality can be released in a relaxed and natural atmosphere (Ji, 2016).

Understanding the nature of things and how they are connected is what constructs are all about. Teachers should try their best to help students accumulate knowledge in the learning process; that is, teachers need to help students understand the nature of things and the inner laws of things more deeply in the process of teaching activities.

In Shandong Engineering Vocational and Technical University intelligent manufacturing professional machinery manufacturing class superposition teaching, teachers to clearly position for the tutor, build a centered realistic learning environment, provide rich practical teaching resources, use online teaching platform and communication software to strengthen communication between teachers and students, pay attention to interaction, guide and cultivate the students' habit of autonomous learning, realize the students initiative purpose of construction significance. Based on the constructivist learning theory, the superimposed teaching research of college mechanical manufacturing courses based on the CDIO model needs to emphasize students' active learning of mechanical manufacturing courses in the teaching design and, at the same time, create rich and colorful media teaching situations for students to help them make meaningful and valuable construction.

2.1.2 Behaviorist Learning Theories

Behaviorist learning theories, as one of the mainstreams of today's learning theories, believe that the external environment in which a person is placed drives behavior patterns; that is, human theories of mind are the result of interaction

with the outside world, and both normal and abnormal behaviors are acquired by humans through learning and can also be corrected, increased, or eliminated through learning (Jin, 2019).

The behaviorism learning theory applied to the mechanical manufacturing course of Shandong Engineering Vocational and Technical University is simply summarized as requiring teachers to master the methods of shaping and correcting students' behavior. When learning skills, it is appropriate to correct aspects of students' technical movements that are not standardized, to reinforce students to develop appropriate behaviors, and to eliminate inappropriate behaviors, which means that teachers should actively guide students to form good independent learning behaviors in the superimposed teaching activities of preschool in colleges and universities based on the CDIO model. , some students in the physical Classroom take technology action more seriously, but they don't work hard, not often practice in class, so the teacher to urge students on the effect of correct student behavior can check more in the entity try to do homework in the Classroom, let the students dare not slack in the process of practice, to cultivate students to explore and active learning skills, and therefore improve their mechanical manufacturing skills.

2.1.3 CDIO model

The CDIO(Conceive, Design, Implement, and Operate) engineering education model is the latest achievement of the reform of international engineering education in recent years. Since 2000, the transnational research of four universities, including the Massachusetts Institute of Technology and the Royal Swedish Institute of Technology, has received a huge grant of nearly 20 million US dollars from the Knut and Alice Wallenberg Foundation, and after four years of exploration and research, the CDIO engineering education concept was established, and an international cooperation organization named after CDIO was established (Baidu Encyclopedia, 2023).

CDIO stands for Conceive, Design, Implement, and Operate, which takes the life cycle from product development to product operation as the carrier, allowing students to learn engineering in an active, practical, and organic way between courses. The CDIO training program divides the ability of engineering graduates into four levels: basic engineering knowledge, individual ability, interpersonal team ability, and engineering system ability, and the program requires students to achieve the predetermined goals at these four levels in a comprehensive training way.

In 2005, under the guidance of Professor Gu Peihua, Executive President of the School of Engineering of Shantou University, the CDIO engineering

education model began to be studied and implemented, and obvious results were achieved. In 2006, Shantou University became the first CDIO member of a Chinese university. In 2008, the Department of Higher Education of the Ministry of Education issued a document to establish the "CDIO Engineering Education Model Research and Practice Research Group"; in 2016, the "CDIO Engineering Education Alliance" was established on the basis of the original "CDIO Engineering Education Reform Pilot Working Group" of the Ministry of Education (Baidu Encyclopedia, 2023).

The concept of CDIO not only inherits and develops the concept of engineering education reform in Europe and the United States for more than 20 years, but more importantly, it systematically puts forward 12 standards for operable ability training, comprehensive implementation, and inspection and assessment. The Swedish National Agency for Higher Educa2tion, which used these 12 standards in 2005 to evaluate 100 engineering degree programs in the country, showed that the new standards are more widely adapted than the original standards, more conducive to improving quality, and most importantly, the new standards provide the basis for the systematic development of engineering education. As of 2013, dozens of world-renowned universities have joined the CDIO organization, and its Department of Mechanical Engineering and Aerospace has fully adopted the CDIO engineering education concept and syllabus and achieved good results and the students trained according to the CDIO model are well received by society and enterprises.

The CDIO consists of three core documents: a vision, an outline, and 12 standards. Its vision provides students with an emphasis on engineering-based, real-world products and systems based on the Conceive-Design-Implement - Operate (CDIO) process (Baidu Encyclopedia, 2023).

Guided by the new ideas of engineering education, the ideas of CDIO engineering education are introduced into the practical teaching course of mechanical manufacturing, and the teaching reform of the course is explored. The CDIO model is student-centered, ability cultivation is the lead, CDIO is the design concept, and the curriculum teaching reform is explored from the aspects of curriculum objectives, course content, teaching design, assessment and evaluation methods, and ideological and political construction. Through the teaching reform, the students' learning initiative has been fully mobilized, the students' professional quality and comprehensive project development ability have been cultivated, the quality of new engineering talent training has been improved, and the requirements of modern society for software talents have been improved (Bai, 2022).

Through research on the problems of current engineering majors in CDIO engineering education, the improvement and reconstruction of the professional curriculum system are proposed. Improvement of teaching evaluation system; Research measures for the allocation and improvement of practical teaching links and internship conditions, in order to cultivate the innovative spirit and comprehensive practical ability of teachers and students in engineering education concepts, and cultivate engineering and technical professionals who are more in line with the needs of society and enterprises (Ye, 2021).

2.2 Superimposed teaching

The first official advocate of the superimposed teaching model in China was Professor He Kekang of Beijing Normal University. He believes that the superimposed teaching mode combines the advantages of traditional teaching methods with the advantages of networked teaching, which not only plays the leading role of teachers in guiding, inspiring, and monitoring the teaching process but also fully reflects the initiative, enthusiasm, and creativity of students as the main body of the learning process. The superposition teaching here is the superposition learning.

In recent years, with the rise of MOOC(massive open online courses), the superimposed teaching model has taken on a new connotation. Flipped Classroom is used as a powerful means to enhance the MOOC learning effect, combining online learning with offline discussion; that is, students first learn online video materials pre-recorded or designated by the teacher to obtain preliminary knowledge and then discuss with the teacher in the Classroom on questions they do not understand or have doubts, aiming to maximize the learning effect of students. In short, superimposed teaching is a combination and supplement of online learning and traditional classroom teaching, which not only plays the leading role of teachers but also reflects the subjectivity of students so as to achieve better teaching results (Baidu Encyclopedia, 2023).

Online and offline superimposed teaching based on SPOC is a new teaching mode that organically integrates online teaching and offline teaching with the help of a small-scale restrictive online course platform. Pre-class teaching activities are mainly for teachers to complete the preparation and introduction of curriculum resources and for students to preview; in classroom teaching, teachers use rich teaching forms according to teaching needs, strengthen interaction with students and between students, highlight students' subjectivity in the learning process, cultivate students' teamwork, communication, and expression comprehensive literacy; after-school teaching activities can be used for students to review and test their own learning. The practical results show that students' enthusiasm and motivation for learning can

be effectively stimulated under the hybrid teaching mode of online and offline, and the learning effect is better (Chen, 2023).

The online and offline superimposed teaching mode combines the advantages of online teaching and offline teaching. Although widely used, because its teaching effect is difficult to evaluate, it is necessary to establish a teaching effect evaluation system. On the basis of fully understanding the development status of the blended teaching mode and referring to the traditional classroom teaching effect evaluation index system, the teaching effect evaluation index system in the online and offline superimposed teaching mode is determined by the expert evaluation method to include four first-level indicators of teaching content, online teaching, offline teaching, assessment design, and including online and offline content correlation, operation interface layout, classroom order, etc. according to the characteristics of the hybrid teaching mode such as rich teaching mode, high student learning autonomy, and enhanced teacher-student and student-student interaction 20 secondary indicators such as after-class exercises (Chu, 2023).

In the research on practical teaching methods in vocational colleges under the background of informatization, it is proposed that the informatization teaching method has penetrated into all aspects of teaching, and there are corresponding information-based teaching methods such as simulation training software for practical courses in the Classroom, but the simulation training software for real work skills experience and skill training effect is not strong, there are certain limitations, the informatization of practical course teaching needs in-depth research, and it is necessary to continue to explore the practical skills teaching method. Online courses and other information teaching methods have also developed rapidly in recent years, which are of great help to knowledge learning and skill demonstration in practical courses, improve the intuitiveness of skill operation, have little time restrictions for student-oriented learners, have strong integration of theory and practice, and can also improve the effect of practical teaching through the rational use of teaching resources (Wen, 2022).

The state vigorously builds a new education and teaching model, an education service supply model, and a new education governance model based on information technology, promotes the deep integration of information technology and education and teaching, and supports colleges and universities to make full use of information technology to carry out the reform of talent training models and teaching methods, and gradually realize the informatization of teaching and learning. Continuously innovate new models of education governance in the information age, carry out actions to optimize education

governance capabilities supported by big data, and promote the use of the Internet and other information means to serve the whole process of education and teaching. Universities have built a large number of online courses (Li, 2023).

In order to effectively promote the reform of experimental teaching in military academies, explore online and offline hybrid experimental teaching models, build an online experimental platform for information and communication, and practice online and offline hybrid experimental teaching models in the teaching process of communication principles, signals, and systems, the construction scheme of the online experimental platform is given, and the advantages and disadvantages of offline experiments and online experiments are compared with typical experimental cases, and through the comparative analysis of experimental data, it is found that the hybrid experimental mode has significantly improved and improved in terms of experimental completion, reducing class transfer and make-up classes, improving learning enthusiasm, learning depth and focusing on teachers' energy (Li, 2022).

The application of online and offline hybrid teaching modes promotes not only the construction of education informatization and deepens the reform of teaching content but also the healthy development of higher vocational education teaching. This model can effectively meet the learning needs of contemporary students so that students can complete course tasks according to their own learning plans and effectively improve the teaching effect. In this context, this paper takes higher vocational education as an example to analyze the application of online and offline hybrid teaching modes, hoping to integrate this teaching mode into classroom teaching from multiple angles so as to comprehensively promote the development of higher vocational education (Zhang, 2022).

In order to better build the path of online and offline integrated teaching mode and truly improve the teaching effect, we must first conduct an in-depth discussion on the traditional cognition of online and offline integrated teaching mode, that is, clarify the fundamental purpose of the reform of online and offline integrated teaching mode, clarify its connotation and characteristics, and grasp its advantages and disadvantages. The fundamental purpose of online and offline integrated teaching is to improve the quality of teaching, which has the characteristics of systematic, information-based, and open. It is not advisable to exaggerate the advantages of online teaching and ignore the positive role of offline teaching, and it is necessary to correctly understand the shortcomings of offline teaching and give full play to people's subjective initiative (Tang, 2022).

In summary, nowadays, the country's science and technology continue to develop, and the demand for high-level talent in engineering is increasing. China's colleges and universities have a large number of graduates every year, but the work effect of graduates in the post is not ideal, and the quality of graduates needs to be improved. Taking the practical teaching of intelligent manufacturing professional machinery manufacturing production practical training in the School of Intelligent Manufacturing of Shandong Engineering Vocational and Technical University as an example, this paper proposes that students should have internship experience and corresponding skills in enterprises before graduation, based on the empirical analysis of domestic and foreign research and experimental colleges that carry out teaching practice reform, so online-offline superimposed practical teaching is an important part of the school's training of students.

2.3 Combining theory and practice in teaching mode

A very important feature of higher vocational education is to highlight the teaching of practical links and cultivate students' professional practical ability. This paper analyzes the theoretical basis of the combination of theoretical teaching and practical teaching, compares several modes of combining theoretical teaching and practical teaching, points out the basic principles of combining the two, and puts forward specific suggestions for the construction of practical courses in higher vocational education in our institute (Li, 2001).

Machining majors have strong applications and technology, mainly for society to train the need for comprehensive professionals; with the development of economic construction, the demand for comprehensive professionals is also increasing, so the quality of machining professional teaching has also been greatly valued, while the combination of theory and practice of the teaching mode of the status has also been significantly improved, fully reflect the importance of practical teaching, to the school practical teaching, off-campus practical training teaching, teacher team construction and assessment system and other aspects, The status and importance of the teaching mode combining theory and practice in the teaching of machining professional are analyzed and discussed (Liu, 2020).

Mechanical basic course has a strong theory, the traditional teaching mode, students' learning enthusiasm and interest can't be mobilized, thus not conducive to the training of social professionals, affecting the quality of school training, so in the teaching of mechanical basic courses, to innovate and reform for traditional teaching methods, the use of integrated teaching mode, mobilize students' interest in learning, improve teaching efficiency and quality. The

integrated teaching mode is actually a teaching method combining theory and practice, focusing on the cultivation of students' professional and technical ability, paying more attention to the cultivation of practical operation, and can implement relevant knowledge and practical training for students to keep up with social development according to the current situation of social technology innovation so that students can understand the development trend of social technology, meet the requirements of society for mechanical talents, and facilitate students' future personal development (Hu, 2019).

In the exploration of the practical teaching system based on "school-enterprise collaboration" in the context of "1+X", it is proposed that with the gradual implementation of the "1+X" certificate system, the original practical teaching system has problems such as inapplicable, incomplete, and difficult to meet the teaching requirements of "1+X" certificate. Therefore, vocational colleges must change the current practical teaching system to ensure the smooth implementation of the "1+X" system (Shi, 2022).

In the analysis of the application of virtualization technology in the practical teaching of vocational colleges, it is mentioned that higher vocational education must pay attention to students' hands-on practical ability and require students to apply what they have learned. With the increasing number of students in vocational colleges, teaching resources are gradually unable to meet the practical learning needs of all students. In this context, in order to effectively ensure the quality of practical teaching, vocational colleges and universities should integrate traditional teaching practice resources and allow students to complete relevant practical operations with the support of virtualization technology to better complete education and teaching goals (Fu, 2022).

In the construction of engineering practice teaching systems in colleges and universities from the perspective of engineering education professional certification, it is mentioned that in order to build a practical teaching system from the perspective of engineering education professional certification, colleges and universities should pay attention to the direction guidance of the Engineering Education Certification Standards, pay attention to cultivating the innovative awareness of talents, strengthen the construction of teachers, and promote the efficient development of practical teaching. Through the continuous deepening of school-enterprise cooperation, the continuous optimization of the practical teaching platform, and the continuous improvement of the evaluation mechanism, the existing problems are solved, and the engineering major is truly led to realize the high-quality construction of the practical teaching system from the perspective of engineering education professional certification (Xia, 2022).

2.4 Hands-on teaching mode

The practical teaching mode is a teaching method that takes practice as the main method, supplemented by auxiliary methods such as explanation, questioning, and discussion, to achieve educational goals. It focuses on cultivating students' autonomy and comprehensive ability so as to improve students' learning ability and improve the effectiveness and efficiency of learning. The research, implementation, and development of the practical teaching model are conducive to improving the quality of basic education, cultivating students' overall quality, shaping students' independent survival ability and innovation and development ability, establishing a learning mechanism, and improving learning results (Li, 2023).

In the context of education informatization, the mainstream hybrid teaching model of "platform + education" has been widely used. Through the analysis of the current situation of practical teaching in ordinary colleges and universities, a new model of "unbounded mixed" practical teaching using the multi-dimensional combination of "virtual and reality, offline and online, in-class and extracurricular, school and industry" is proposed, and it is proved in practice that the "unbounded mixed" practical teaching mode can not only consolidate theoretical knowledge, exercise students' ability to solve practical problems but also help cultivate students' innovative thinking and practical ability(Li, 2023).

New technologies and new models to promote the practical teaching of machinery manufacturing to strengthen the ability training of first-class undergraduate construction proposed to take first-class disciplines and new engineering construction as the guide, take the ability structure requirements of the 2.0 version of the excellent engineer training plan for talents as the goal, start from the cultivation of students' "basic ability", reform the concept and mode of practical teaching of mechanical manufacturing disciplines, combine the application of new technologies such as CAI/VR and 3D printing, and combine the teaching of manufacturing technology theory courses and experimental teaching, The organic combination of practical teaching such as internship and curriculum design to improve students' knowledge acquisition ability, strengthen knowledge application ability, and then realize the cultivation of innovation and creativity ability, so as to meet the needs of the basic ability of talents for the construction of an innovative country (Wang, 2022).

The Australian TAFE (Technical and Further Education) model is the vocational education and training part of the Australian education system, with the main goal of providing technical and vocational training and providing

students with practical skills and theoretical knowledge. It has a flexible curriculum with a focus on practical teaching and employment training to equip students with practical skills and career competitiveness. The Australian TAFE model originated from technical colleges in the 20th century and was first established to meet the demand for skilled workers in the local labor market. With the changes of the times and the development of the economy, the TAFE model has gradually been integrated into the Australian vocational education system and developed into an important training institution in the Australian education system. TAFE colleges mainly provide vocational skills training diploma and certificate courses, and their curriculum and teaching modes are clearly different from Australian universities (Zhang, 2018).

As the largest component of the Australian education system, Australia's TAFE system has always combined vocational and technical education and continuing education, providing vocational education and training from high school, college, and undergraduate to postgraduate level, which is a unique education system in Australia. The teaching diversity and quality-oriented teaching of TAFE colleges in Australia provide a reference for the development of vocational education in China (Zhang, 2018).

The UK has a long history of higher education, the quality of education has been recognized by the world, and its "sandwich" education model has distinctive characteristics, which has become a model of industry-university-research cooperation. This paper reviews the development of the "sandwich" education model and explains its curriculum structure, characteristics, and effectiveness. Taking this as a guide, the "Excellent Engineer Education and Training Program" being implemented at this stage should focus on solving several problems: creating a new mechanism for universities and enterprises to jointly cultivate talents; Reconstruct the curriculum system and teaching content; Strengthen practical engineering education; Increase funding; creating a sound institutional environment; Coordinate multiple resources (Peng, 2013).

Based on the German "dual system" model, the exploration of higher vocational education practical training and teaching reform mentioned that the "dual system" vocational education model is the core way to carry out vocational education in Germany, and Germany has used this method to cultivate a large number of high-quality vocational and skilled talents. China's higher vocational education practical training and teaching reform draws on Germany's advanced education experience, which will have very strong practical advantages which are conducive to schools and enterprises jointly cultivating excellent skilled talents. The connotation of the German "dual system" vocational education model, the role and feasibility of applying the "dual system" model in China's

higher vocational education were discussed, and some suggestions for improvement were put forward in view of the shortcomings of vocational education concepts and practical training conditions (Wang, 2022).

2.5 Theoretical framework

The literature research method is used to sort out the existing relevant research, the research background, research review, relevant concepts, and theoretical basis of this research are summarized and analyzed, and the constructivism learning theory and behaviorism learning theory are flexibly applied to the superposition teaching design of intelligent manufacturing professional machinery manufacturing course in universities under the CDIO mode. The questionnaire survey method and experimental comparison method are used to investigate the teaching status of the mechanical manufacturing practice course, and the existing problems are obtained and analyzed. According to the facts, the necessity and feasibility of the "superimposed teaching mode of mechanical manufacturing course" in the course are explored so as to improve students' professional quality.

The research idea of this paper is "literature analysis-statistical survey-data analysis-practice effect analysis formation of the conclusion", through the literature research, in Shandong Engineering Vocational and Technical University machinery manufacturing teaching intelligent manufacturing professional machinery manufacturing class superposition teaching problems analysis, through the analysis of intelligent manufacturing professional machinery manufacturing teaching situation, from the teaching front, constructivism learning theory and behavior learning theory, applied to the CDIO mode of mechanical manufacturing course superposition teaching design. Through the analysis of students' mechanical manufacturing course superposition teaching situation, from the front-end teaching analysis, teaching goal design, teaching resources design, teaching time design, teaching content design, teaching activity design, teaching evaluation design, teaching practice case study, build the CDIO mode of mechanical manufacturing course superposition teaching design, and analyzes the practice effect, to draw conclusions and Suggestions. The research roadmap of this paper:

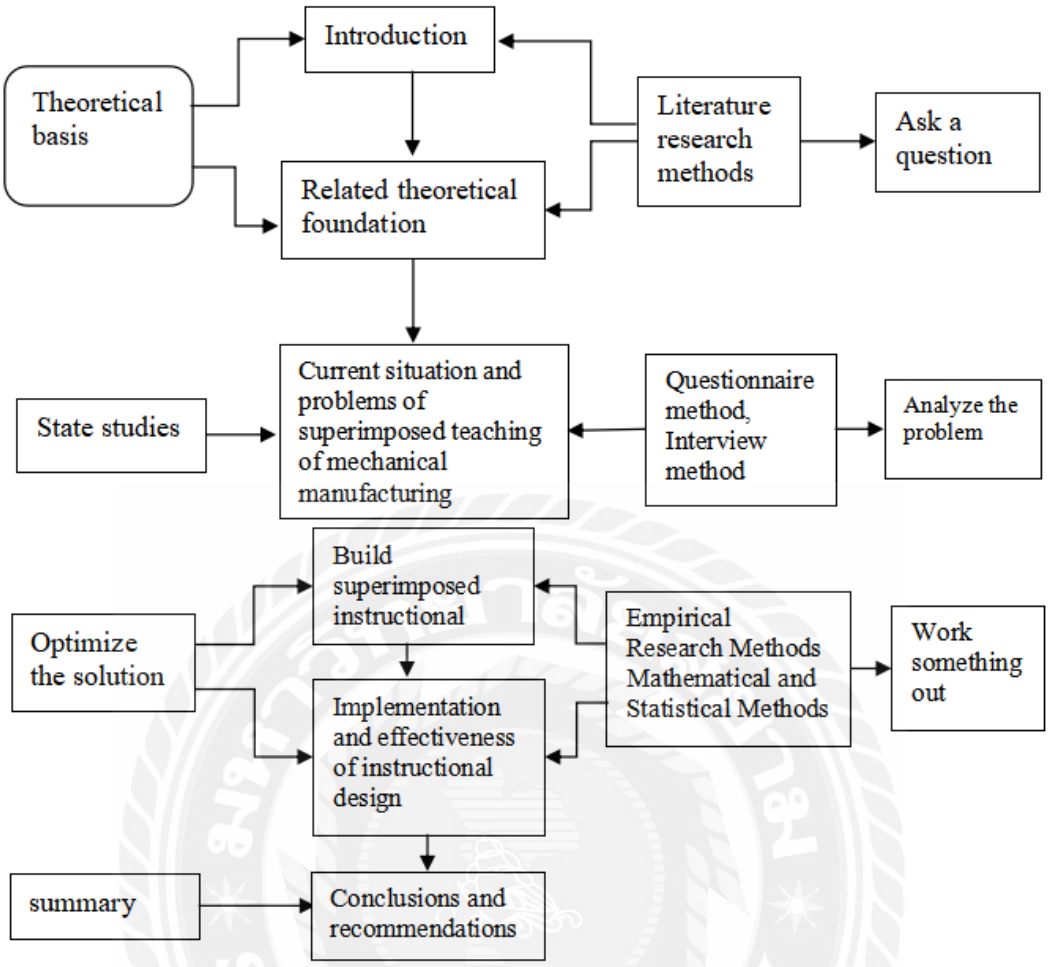

Figure 2.1 Stacked teaching and research framework for mechanical manufacturing courses based on CDIO concept

Chapter 3 Research Methodology

3.1 Introduction

On the basis of collecting a large amount of literature and preliminary research, this paper adopts the mixed research method of quantitative and qualitative combination, using the questionnaire survey method and the interview method, to compare the mechanical manufacturing line superposition teaching method and the traditional decomposition teaching method, and achieves more comprehensive and accurate research results. According to the interview information and first-hand data, the preliminary designed questionnaire items were modified and improved, and the formal questionnaire was issued so as to fully understand the current situation and potential problems of the superimposed teaching mode in higher vocational colleges.

Qualitative research. First of all, the literature research method is adopted to collect relevant resources such as domestic and foreign books, journal papers, conference papers, mixed teaching policies, and opinions through library access and network platform retrieval, and summarize and analyze the literature so as to consolidate the theoretical foundation and provide ideas for the research of this paper. Taking the education goal, education process, and education evaluation as the survey questionnaire dimension, starting from the five indicators of course evaluation, enterprise production status, teaching implementation, students' hands-on operation time, and job work experience of the implementation of the "superimposed teaching mode," the relevant topics are designed, and the corresponding interviews are conducted, through the experts of Shandong Engineering Vocational and Technical University who have studied the teaching design of the course for many years, as well as the front-line teachers engaged in the teaching of mechanical manufacturing courses, there are five front-line teachers and ten front-line teachers participating in the interview. Through inquiry, we understood the current situation of mechanical manufacturing course teaching, solicited opinions on the problems encountered in the teaching of mechanical manufacturing courses, and the feasibility of applying CDIO mode superimposed teaching to mechanical manufacturing course teaching; we listened carefully to the opinions of experts and discussed a series of problems that may occur in the teaching process, so as to respond to emergencies in time in the follow-up teaching implementation.

Quantitative research aspects. Controlled experiments, questionnaires, and mathematical statistics were used. It is clear that the research objects are mainly intelligent manufacturing students of Shandong Engineering Vocational and Technical University, and the questionnaire is compiled, distributed, and recycled. By designing questionnaires, including pre-and post-instruction, and

using SPSS software to analyze and process the data, the reliability and validity of the overall sample data were analyzed, and the effect of traditional teaching and superimposed teaching was compared. The data shows that students' satisfaction with the superimposed teaching activities and evaluation methods of mechanical manufacturing courses is more than 95%, and the superimposed teaching and research of mechanical manufacturing courses carried out in Shandong Engineering Vocational and Technical University is outstanding, and the effect is remarkable in improving students' independent learning ability, innovative inquiry ability, professional literacy ability, comprehensive expression ability, etc., and the learning effect and teaching quality of students are significantly improved. The results show that the "superimposed" teaching mode has a good effect on completing the teaching objectives of mechanical manufacturing courses, which is in line with the development trend of modern intelligent manufacturing technology.

3.2 Design and implementation of the questionnaire

3.2.1 Population and Sampling Size

The research objects of this survey are mainly selected students and teachers majoring in mechanical manufacturing at Shandong Engineering Vocational and Technical University, and the superimposed teaching mode of mechanical manufacturing itself has the characteristics of students, so from the perspective of students, the implementation status of the superimposed teaching mode of mechanical manufacturing is studied. After preliminary visits and investigations, it was learned that first-year students have not participated in mechanical manufacturing practical training and related professional knowledge learning and rarely participate in vocational and technical skills competitions in professional fields, which has an impact on the integrity of grasping the implementation status of the superimposed teaching mode.

3.2.2 Data Collection

Two questionnaires were designed for this study.

The first questionnaire, "Questionnaire for Teaching Before Teaching in Mechanical Manufacturing Course" (Appendix 2), was distributed to students before the start of the mechanical manufacturing course, and the opinions and suggestions of teachers and students of the mechanical manufacturing course of Shandong Engineering Vocational and Technical University before carrying out superimposed teaching were investigated, and a total of 310 questionnaires were distributed, and 300 valid questionnaires were retrieved, with an effective rate of 97%.

The second questionnaire, "Student Feedback Questionnaire after Superimposed Teaching in Mechanical Manufacturing Course" (Appendix 3), was distributed to students after the course, and 300 questionnaires were distributed to investigate the changes and views of students after receiving superimposed teaching in mechanical manufacturing courses, and 294 valid questionnaires were retrieved, with an effective rate of 98%.

The main purpose of this survey is to find out the current difficulties and the use of "online-offline superimposed teaching" in mechanical manufacturing training and students' understanding of network resources so as to better carry out experiments. This survey was conducted in the form of a questionnaire, and the author designed a questionnaire based on the existing teachers' and students' mastery of knowledge. Real-time research and statistical analysis of the results of the questionnaire as a standard to explore the current students' difficulties in course learning and the teaching status of teachers, understand students' requirements for mechanical manufacturing productive practical training skills operation, explore new learning methods to cultivate students' operational ability in mechanical manufacturing practical training, and explore a new way of practical operation suitable for the characteristics of vocational college students, so that each student can maximize participation, thinking, hands-on, cooperation, communication and completion of all practical projects; Have the courage to do it, successfully complete the purpose of practical training, and lay the foundation for follow-up teaching and post-graduation work.

3.2.3 Data Analysis

Through the data statistics and analysis of the questionnaire research, we have a more objective and in-depth grasp of the research group and the research effect.

1. Questionnaire validity test

The effectiveness of the questionnaire is tested by the method of expert evaluation to improve its scientificity and effectiveness. According to the content of the questionnaire, the experts evaluated the overall effectiveness of the questionnaire and its structural design and content completeness, which were divided into five evaluation levels: very reasonable, reasonable, relatively reasonable, unreasonable, and unreasonable, and the results are shown in Table 3.1 and Table 3.2.

Table 3.1 About the validity test table of the "Questionnaire for Teaching Questionnaire before Teaching in Mechanical Manufacturing Course"

Evaluation level	Very reasonable	Plausible	Relatively reasonable	Not very reasonable	Unreasonable
Overall design	1	5	1	0	0
Structural design	2	5	1	0	0
The content is complete	1	7	0	0	0

Table 3.2 Validity test table on the "Student Feedback Questionnaire after Teaching with Superposition in Mechanical Manufacturing Class"

Evaluation level	Very reasonable	Plausible	Relatively reasonable	Not very reasonable	Unreasonable
Overall design	1	6	1	0	0
Structural design	2	5	1	0	0
The content is complete	1	6	1	0	0

2. Questionnaire reliability test

The Questionnaire Star platform was used to compile the questionnaire, and the questionnaire was distributed to the research subjects through the network. In view of the distribution of the questionnaire in the early stage, the questionnaire design was discussed with experts and adjusted to further clarify the scope of the research object. The survey subjects basically conform to the overall situation of students in the superimposed teaching mode of mechanical manufacturing majors without extreme deviation and meet the survey requirements. In order to ensure the authenticity and validity of the survey information, the reliability of the questionnaire was tested by the "retest method," and the questionnaire was distributed to all students and teachers 15 days after the questionnaire was issued and the results of the two questionnaires were statistically analyzed, and the SPSS version of the software was used for systematic analysis. The results showed that the correlation coefficients of the pre-teaching questionnaire and the mixed teaching practice effect questionnaire were 0.832 and 0.875, respectively, indicating that the difference between the two tests was not significant and the reliability was high. The results are shown in Tables 3.3 and 3.4.

Table 3.3 Reliability statistics on the "Questionnaire for Teaching Questionnaire Before Using Superposition in Mechanical Manufacturing Courses"

Cronbach's Alpha	Cronbach's Alpha based on the normalization term	number of items
0.832	0.832	10

Table 3.4 Reliability statistics on the "Student Feedback Questionnaire after Teaching in Mechanical Manufacturing Course."

Cronbach's Alpha	Cronbach's Alpha based on the normalization term	number of items
0.875	0.875	10

Relevant data show that the current mechanical manufacturing production practice training interested in 30%, not interested in 20%, bored accounted for 45%, must learn 5%. Productive practical training on mechanical manufacturing after using superimposed teaching: 85% are interested, 10% are not interested, 5% are bored, and 90% must be learned. 86% prefer the superimposed teaching method, 10% prefer the classroom teaching method, and the project-based teaching method accounts for 4%. 88% felt that they could meet their needs using the overlay teaching model, and 12% did not.

Table 3.5 Basic information of the research subjects

grade	gender	Number of people	percentage（%）
Second year of college	male	210	96.7
	female	90	
graduate	male	4	3.3
	female	6	

Table 3.6 Questionnaire data statistics

data	Number of cases	percentage %
effective	294	98
exclude	6	2
total	300	100

3.3 Practical research method

Combined with the teaching objectives, teaching resources, teaching practices, teaching content, teaching activities, and teaching evaluation of mechanical manufacturing courses, the superimposed teaching mode was applied to the 16-week mechanical manufacturing course carried out by 300 intelligent manufacturing students of Shandong Engineering Vocational and Technical University in 2021. Based on the CDIO model, the superimposed teaching design of the mechanical manufacturing course is as follows:

(1) Teaching goal design.

The new curriculum standard advocates explaining the teaching objectives from three dimensions, namely knowledge and skill objectives, process and method objectives, emotional attitudes and value objectives, and the superimposed teaching objectives of mechanical manufacturing courses under the CDIO model should be based on the teaching objectives of the new curriculum standards, integrate the core literacy of the subject, give full play to the unique advantages of online teaching and offline teaching, and design teaching objectives that meet the actual situation and comprehensive level of college students. The final teaching goal of the mechanical manufacturing course is to enable students to master the basic concepts, basic knowledge, and development of mechanical engineering, master the basic process and system knowledge of the whole process of mechanical industry production, guide students to correctly understand mechanical engineering majors, improve their professional interests, enable students to have the ability to formulate and program machine tool processing processes of medium-complexity parts, meet the requirements of independent operation of enterprise employees, have the basic ability of machine tool operators, and reach high-level technical skills.

(2) Resource design

The design of teaching resources in this study mainly includes two aspects: teaching platform and teaching materials.

At present, the widely used teaching platforms on the market include Tencent Classroom, DingTalk, Chaoxing Learning Pass, WeChat, Rain Classroom, Tencent Meeting, etc. (Table 3.10); through the evaluation and analysis of the functions used by major platforms can be found that the major teaching software basically has basic functions such as teacher live broadcast, interactive communication, screen sharing, and resource upload. In view of the teaching characteristics of mechanical manufacturing disciplines, combined with the functional advantages of major teaching platforms and students' proficiency in using the platform, the superimposed teaching online link of mechanical manufacturing courses designed and carried out by the college requires teachers to upload video resources to the teaching platform, use Superstar Learning Pass for theoretical course teaching, and use Tencent Meeting for skills training.

The teaching materials are mainly mechanical manufacturing textbooks, supplemented by national high-quality online open courses and excellent teaching resources of the online platform. Appropriately reduce the difficulty and make the teaching content of the revised design more in line with the needs of intelligent manufacturing professional development. National Excellent

Online Open Courses, also known as MOOCs, cover thousands of excellent online courses in various disciplines, and this study draws on course content suitable for inclusion in superimposed teaching. The excellent teaching resources of the online platform include excellent mechanical manufacturing practice videos, online forums and lectures on major websites and apps, etc., and this study puts the collected high-quality resources into the extension of online teaching resources to expand students' knowledge horizons and learning scope.

Table 3.7 Functional distribution table by teaching platform

	Tencent Classroom	DingTalk	Superstar Learning Pass	WeChat	Cloud Classroom	Tencent Meeting
Teacher livestreaming	Yes	Yes	Yes	Yes	Yes	Yes
Teacher-student interaction	Yes	Yes	Yes	Yes	Yes	Yes
Screen sharing	Yes	Yes	Yes	Yes	Yes	Yes
Asset upload	Yes	Yes	Yes	Yes	Yes	Yes
Course replay	Yes	Yes	Yes	Yes	Yes	Yes
sign in	Yes	Yes	Yes	Yes	Yes	Yes
Test feedback	Yes	Yes	Yes	Yes	Yes	Yes

(3) Teaching time design

The reasonable allocation of online teaching and offline teaching time ratio of mechanical manufacturing courses greatly affects the quality and effect of teaching. Therefore, in the time allocation of superimposed teaching design of mechanical manufacturing courses, the proportion of online teaching is greater than or equal to 30% and less than or equal to 49%, and since the teaching design of this study is supplemented by "online teaching as a supplement, offline teaching is the mainstay," the proportion of online teaching time should be less than the proportion of offline teaching, and by consulting the opinions of experts on the proportion of teaching time allocation, this study proposes that online teaching accounts for 35% of the total teaching time, and offline teaching accounts for 65% of the total teaching time. This study carried out the practice of superimposed teaching in mechanical manufacturing according to the recommended duration and examined the effectiveness of superimposed teaching by comparing the overall change of students after 16 weeks.

(4) Teaching content design

The superimposed teaching content of mechanical manufacturing courses should meet the actual level and development needs of students on the homepage of intelligent manufacturing, and the course design should cover a

wide range of knowledge and moderate difficulty, which should meet the requirements of intelligent manufacturing education.

First of all, the classification of teaching content is mainly divided into two major sections: online teaching and offline teaching. Online teaching is divided into two parts: "theoretical knowledge learning" and "skill basic practice," and offline teaching is divided into two parts: "comprehensive training of skills" and "practical skill application."

The "theoretical knowledge learning" in online teaching mainly includes the basic concepts and basic knowledge in mechanical engineering, combined with teaching methods such as group cooperation and problem exploration to enhance students' cultural knowledge and cultivate logical thinking and expression ability. "Skill basic exercise" mainly includes the basic process and system knowledge of the whole process of mechanical industry production, basic skills, basic training, etc., through online basic and segmented skills learning, improve students' independent learning ability, and lay a solid foundation for offline "comprehensive skill training." In the design of mechanical manufacturing online teaching content, this research mainly focuses on comprehensive learning combining theory and practice and integrates theoretical knowledge and skill practice into online teaching.

The "comprehensive training of skills" part of offline teaching mainly includes the formulation and programming of machine tool processing processes for medium-complexity parts, aiming to deeply train students' comprehensive ability and professional quality and better transform and apply the online learning content to the comprehensive training of mechanical manufacturing. The "application of practical skills" part mainly includes the overall parts processing through learning various skill operations so that students can try the practice of parts processing on the basis of mastering the essentials of machine tool operation, improve students' comprehensive application ability, and fully tap students' imagination and creativity. Offline teaching is mainly based on practical courses, integrating theoretical knowledge into practical learning, guiding the development of subsequent practice through practical learning and summarizing theory, forming a learning mode of "theory-practice-theory" circular development, and improving learning effect and application ability.

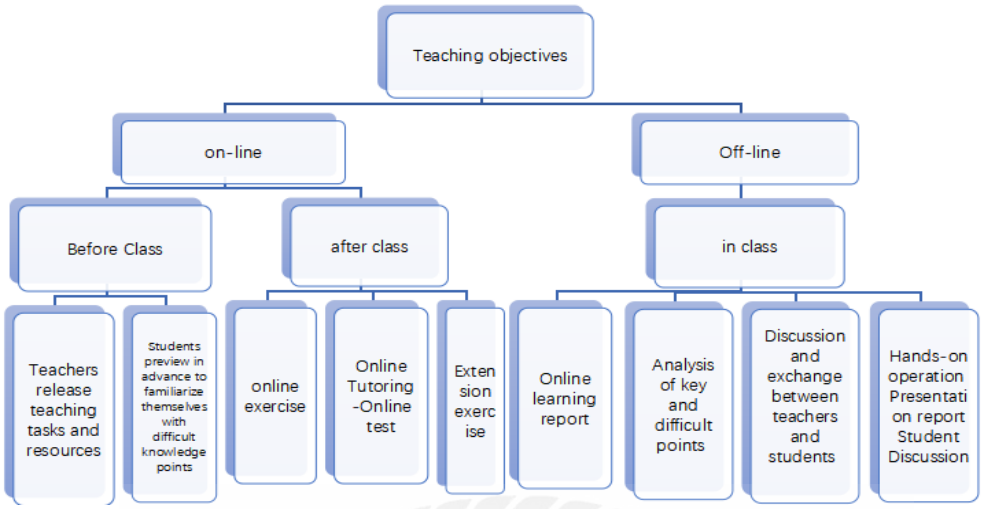

Figure 3.1 Classification chart of superimposed teaching content of mechanical manufacturing course based on CDIO model.

(5) Teaching process

The first part is the pre-course preparation phase of the online course. Pre-course preparation is the foundation of effective classroom teaching, and the specific teaching process design of the online pre-course preview stage and the teaching process design table of the online pre-course preview stage are detailed in Appendix 4.

The second part is the teaching phase of the offline classroom. Offline teaching is the core content of the entire teaching activity, through face-to-face teaching and guidance to enhance students' intuitive learning perception and improve physical flexibility and expression ability; the specific teaching process design table of the offline classroom teaching stage is detailed in Appendix 5.

(6) Design of teaching activities

Under the CDIO mode, the superimposed teaching activities of the intelligent manufacturing professional machinery manufacturing course are mainly designed from three stages: "online pre-class preparation," "offline classroom teaching," and "'online + offline' after-class consolidation." Through superimposed teaching, try to change the way of "teaching" and "learning," rely on the network information technology platform to create an online learning environment, and expand students' learning channels and resources so that teachers are no longer single knowledge transmitters, but become the builders of learning environments and guides of learning activities, break the inherent traditional offline teaching forms, integrate group inquiry, teamwork, innovative competition, ability display, simulation teaching and other forms to enrich students' learning methods.

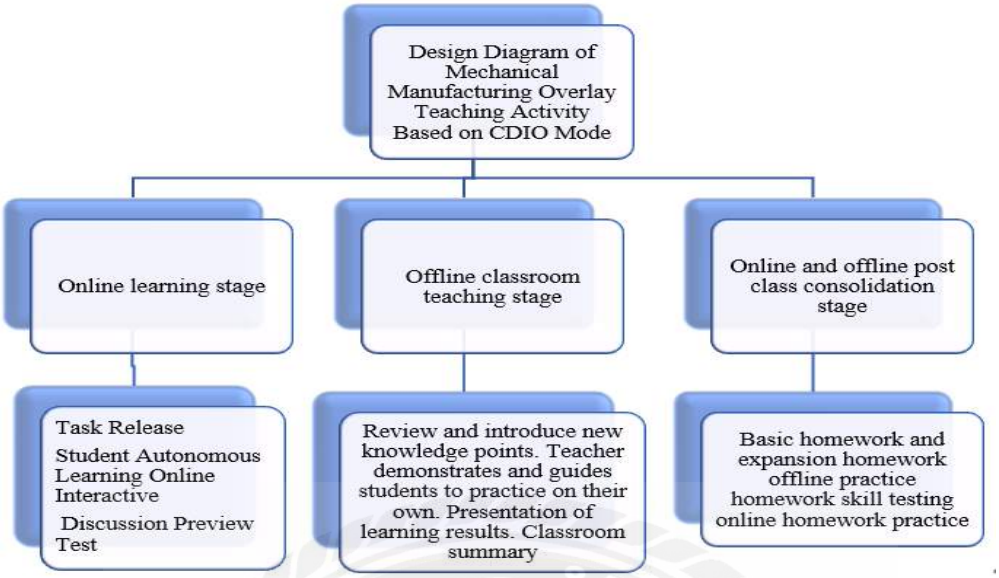

Figure 3.2 Design diagram of superimposed teaching activities of mechanical manufacturing based on CDIO mode

(7) Teaching evaluation design

According to the training objectives of the major and the people-oriented development concept, a corresponding professional evaluation system has been established. Based on teaching quality standards and evaluation standards, monitoring and evaluating the quality of all aspects of professional teaching and feedback on the evaluation results are important bases for revising the teaching quality assurance system, forming a cycle, dynamic, and constantly improving teaching evaluation system.

1. Diversified evaluation content. In addition to the understanding and mastery of basic theoretical knowledge, the content of the evaluation also adds in-class practice, concentrated practical training, and course design task books. Different teaching content reflects different students' intelligence so that students can be evaluated from many aspects.

2. Diversification of evaluation subjects. Change the past situation of teachers evaluating students alone, encourage students, classmates, and enterprise trainees to participate in the evaluation, and turn the evaluation into an activity with the participation of multiple subjects.

3. Diversification of evaluation methods. Change the traditional phenomenon of paper-based tests as the only or main means of evaluation and use a variety of evaluation methods to evaluate students. In addition to paper-based tests, there are also defenses, hands-on exercises, and research practices.

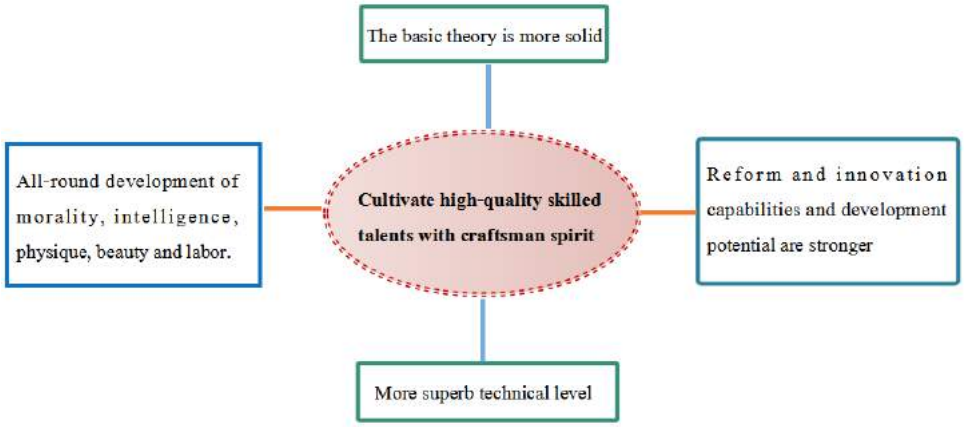

Figure 3.3 Mechanical manufacturing class superposition teaching mode of talent training objectives

In the superimposed teaching of mechanical manufacturing courses under the CDIO mode, the design of teaching evaluation is more comprehensive, integrating diagnostic evaluation, process evaluation, and final evaluation so as to promote the diversification of evaluation methods, the diversification of evaluation subjects, and the comprehensiveness of evaluation content.

Chapter 4 Finding

Based on the combing and summarizing of the survey results of questionnaires and interviews, combined with the literature collected in the previous research, the research results were explained by quantitative analysis. Combined with the intelligent manufacturing professional talent training program and the relevant text materials of the "superimposed teaching mode of mechanical manufacturing courses", firstly, focus on analyzing whether the education goals of the major are in line with the current employment needs and vocational skill standards of industry enterprises in the field of intelligent manufacturing technology: secondly, understand and further analyze the implementation status of the teaching process, grasp the teaching status of the superimposed teaching mode of mechanical manufacturing by analyzing the connection between the teaching objectives and the learning situation of students, and analyze the curriculum system and grasp the current situation of the integration of "coursework": Finally, this paper summarizes the current learning status and practical problems presented by the current teaching mode, analyzes the current situation of education evaluation, and summarizes the influencing factors of the implementation of the superimposed practical teaching mode of mechanical manufacturing.

4.1 Students are willing and expectant to receive superimposed instruction in mechanical engineering.

A comparative analysis of the pre-course and after-course questionnaires showed that the number of people willing to try superimposed teaching in mechanical engineering classes increased from 26.72% to 68.25%.

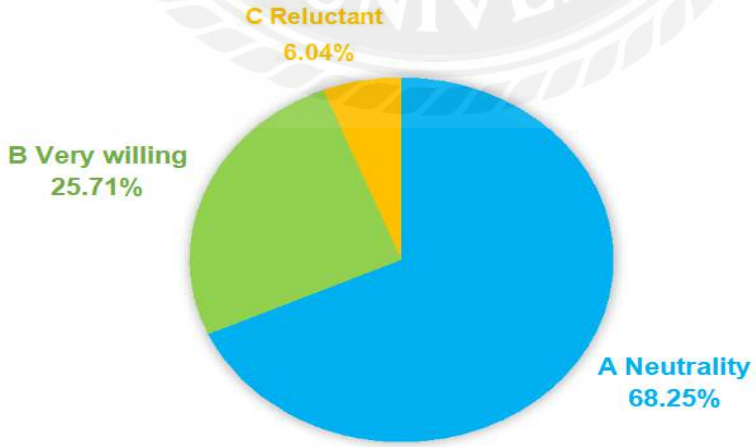

Figure 4.1 Pre-survey results of students' willingness to take a mechanical manufacturing class stacked instruction

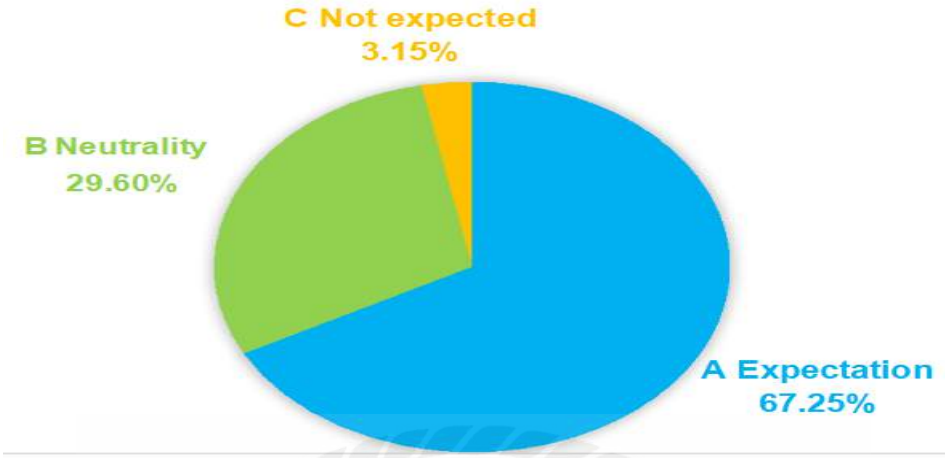

Figure 4.2 Survey results on whether students expect superimposed teaching in mechanical engineering classes.

4.2 Students like and adapt to the superimposed teaching of mechanical engineering classes.

According to the statistics of the questionnaire survey, 93.65% of the students liked and adapted to the superimposed teaching of the mechanical manufacturing course conducted this semester and believed that the superimposed teaching promoted their learning.

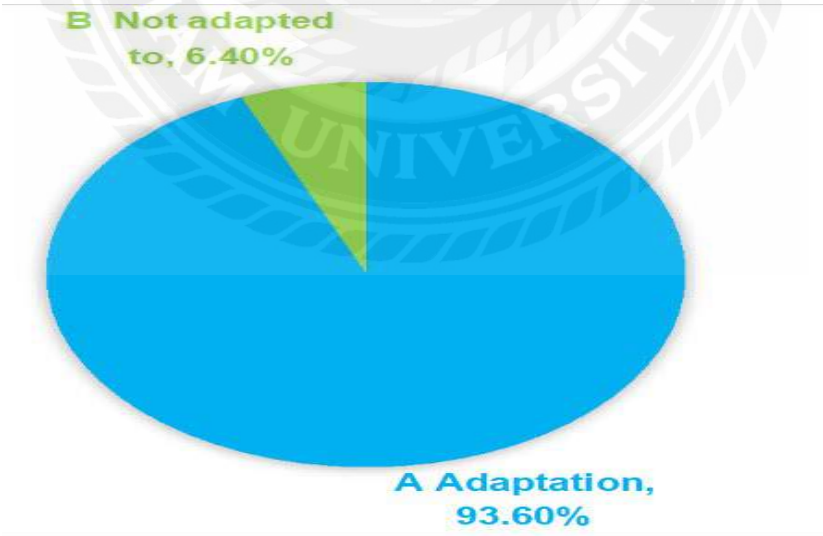

Figure 4.3 Whether students are comfortable with the superimposed teaching of mechanical manufacturing courses.

The superimposed teaching of mechanical manufacturing courses improves self-learning ability, promotes creative thinking and research, enriches

learning paths, expands knowledge, and improves learning efficiency and effectiveness.

In particular, it effectively enhances students' autonomy in learning. 92.6% of the students believe that the superimposed teaching of the mechanical manufacturing class this semester has dramatically improved their learning initiative, and the students are more willing to actively participate in classroom activities.

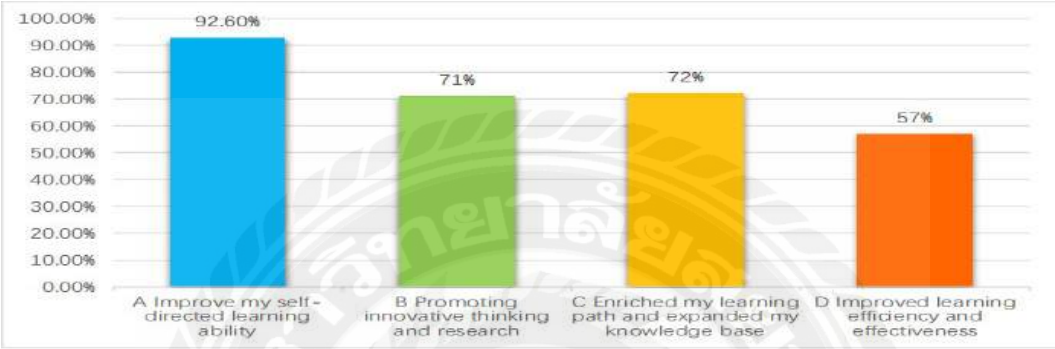

Figure 4.4 The difference brought to students by the superposition teaching of mechanical manufacturing courses.

Through the superimposed teaching of mechanical manufacturing courses, students' personal ability and comprehensive level have been improved to a certain extent.

Statistics show that 96.03% of students believe that their personal and comprehensive abilities have been greatly or somewhat improved after receiving the superimposed teaching of mechanical manufacturing courses.

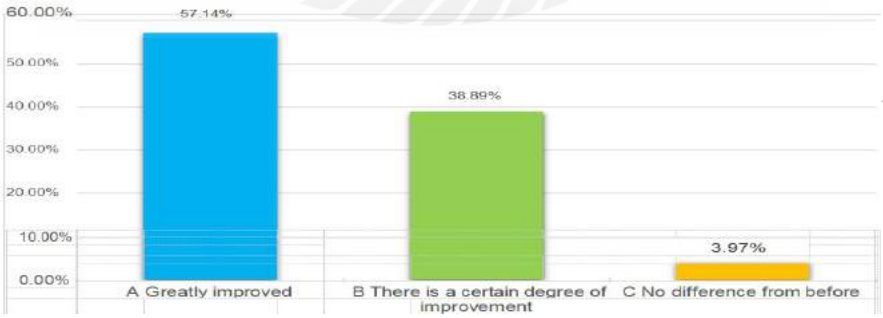

Figure 4.5 The influence of superposition of mechanical manufacturing course on students' individual ability and comprehensive level

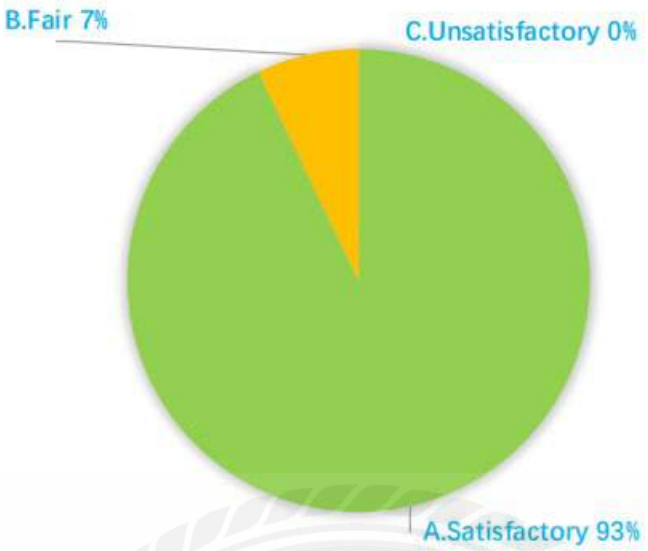

Figure 4.6 After the superimposed teaching of mechanical manufacturing class, students are satisfied with the teacher's teaching activities.

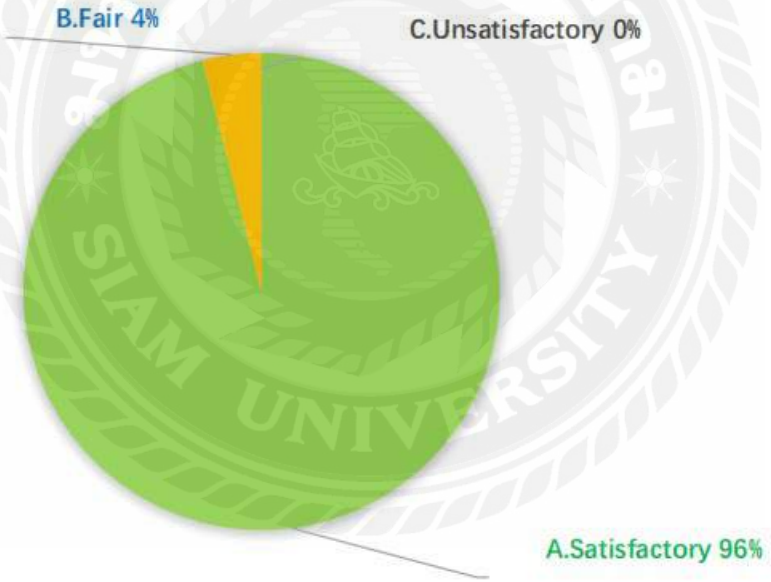

Figure 4.7 After the superimposed teaching of mechanical engineering class, students are satisfied with the evaluation method used by the teacher.

The data shows that students' satisfaction with teachers' superimposed teaching activities and evaluation methods is more than 95%, and the superimposed teaching effect of mechanical manufacturing courses based on CDIO mode of intelligent manufacturing major of Shandong Engineering Vocational and Technical University carried out in this study has outstanding teaching effects, strong operability, can effectively feedback students' key difficulties in the learning process, and is convenient for teachers to solve in a targeted and timely manner, in improving students' independent learning ability,

innovative inquiry ability, professionalism, Remarkable results have been achieved in comprehensive expression ability, and students' learning effect and teaching quality have been significantly improved.

The above experiments show that the "superimposed" teaching method is feasible in the practical teaching of mechanical manufacturing production, not only consistent with the development of modern intelligent manufacturing technology but also has a good impact on both students' achievement and technical evaluation. The teaching process is simplified.

90% of students are learning practical skills in mechanical manufacturing through online education platforms, and only 10% are following teachers in the classroom to master operational skills and achieve talent training goals. While acquiring professional knowledge and functional skills, students also hope to obtain the skills and literacy required for the position, the ability to choose and plan careers, relevant recruitment channels, and employment information through professional learning.

The training goal of mechanical manufacturing production training at Shandong Technical University is "to enable students to have the ability to formulate and program ordinary lathe processing process of medium-complexity parts through the actual operation of ordinary lathes, meet the requirements of independent operation of enterprise employees, and have the basic ability of ordinary lathe operators." This course is reflected in students' positions (groups) and vocational positions in the professional talent training program. Still, it lacks the design of relocation positions, which will impact the cultivation of students' professional, sustainable development ability emphasized in the educational goal.

Through the " mechanical manufacturing superimposed teaching mode," nearly 95% of the students have mastered the basic skills of mechanical manufacturing and met the requirements of talent training. 98% of students believe that the " mechanical manufacturing superimposed teaching mode" is in line with the needs of intelligent manufacturing professional compound talent training. It can be seen that although the intelligent manufacturing major of Shandong Engineering Vocational and Technical University still has room for adjustment and improvement in the positioning of mechanical manufacturing productive training courses, the education students as a whole agree with the "online-offline mechanical manufacturing superimposed teaching mode" formulated by the course.

The flexible educational opportunities provided by the Intelligent Manufacturing Institute after using superimposed teaching can meet the needs of students at different levels and promote social equity and social mobility. Through the overlay teaching model, students can change their career and life trajectories to achieve their development goals.

Through the research on the superimposed teaching mode based on mechanical manufacturing, the training goal of high-quality skilled talents in mechanical majors can be completed, and the overall quality of students' professional talents can be greatly improved. By cultivating the ability to adapt to career changes, we can greatly improve the vocational skill level of students, improve the gold content of graduates, shorten the adaptation cycle of enterprise employment, improve production efficiency, and improve product quality.

The research of superimposed teaching mode based on mechanical manufacturing provides strong support for the solution of problems related to the reform of vocational and technical education that have plagued for many years. For example, the teaching and learning of vocational education are separated from the production status of industry enterprises; students lack real experience in school learning and solving production technology problems, for the practical teaching mode based on job work experience, the teaching process, and the job production process are seamlessly docked, there are no relevant research and achievement problems in the pursuit of on-campus practical teaching job experience, work practice, etc., the teaching content is out of touch with the actual enterprise and the lack of connection between course content.

Through the research of superimposed teaching modes based on mechanical manufacturing, we can cooperate with enterprises to undertake some rough machining and manufacturing tasks and create conditions for the teaching reform and innovation of practical courses. On the one hand, we can take the real products of the enterprise as the carrier to formulate a set of practical cutting processing comprehensive training courses, integrate the existing practical practice of single work into turning, milling, grinding, and fitter assembly and other comprehensive training, and formulate scoring and assessment standards to score and summarize students' equipment mastery and completion of internship projects. On the other hand, you can also set up a professional skill level appraisal station in the school, organize students to conduct skill level tests after the course, and issue national professional skill level certificates; this reform in the internship teaching mode will greatly improve the employability of our graduates.

On the basis of sufficient equipment conditions provided by the school, based on the superimposed teaching mode of mechanical manufacturing,

research shortens the time of students' top internship and the adaptation cycle of enterprise employment, improves production efficiency, and improves product quality.

Through the research of superimposed teaching mode based on mechanical manufacturing, improve the teaching quality, according to the characteristics of mechanical manufacturing practice courses, through the integration of project teaching method, CDIO engineering education, task-driven method, hierarchical teaching method, independent learning, online learning and active practice and other more advanced teaching concepts, from the aspects of topic design topics, teaching content, teaching methods, design means, and evaluation system to carry out systematic reform.

The superimposed teaching mode mainly aims to provide an organic combination of practical skills and theoretical knowledge. It has the characteristics of a flexible curriculum, focusing on practical teaching and employment training, and an international education platform. The advantages of the superimposed teaching mode are mainly reflected in the close connection between education and employment, the cultivation of practical skills, the threshold of career development, and the combination of theoretical teaching and internship so that the training is closely combined with the actual needs of the enterprise; the trainees have more opportunities to participate, truly realize the application of what they have learned, and consolidate the mastery of the training content by the trainees. In China's vocational education system, the superimposed teaching model plays an important role in alleviating skills shortages, promoting economic development, and promoting social equity and social mobility.

Chapter 5 Conclusions and Recommendations

5.1 Conclusion

Based on the constructivism learning theory and behaviorism learning theory, this study of mixed research method (combining quantitative and qualitative methods) is adopted to teach mechanical manufacturing superposition for 300 students of Grade 2021 of Shandong Engineering Vocational and Technical University based on the CDIO mode. After 16 weeks based on the CDIO mode of mechanical manufacturing superposition teaching practice, in the intelligent manufacturing machinery manufacturing superposition of practice teaching mode and the implementation effect, about the mechanical manufacturing line superposition practice teaching mode does have substantial progress, students learning process and students learning success build up a complete mechanical manufacturing superposition practice teaching mode, and form the "accommodation" "schoolwork integration" accommodation "distinct characteristics of" teachers and students.

Therefore, this paper draws the following conclusions based on the current situation survey and implementation effectiveness analysis.

1. The internal mechanism and external conditions of applying the superimposed teaching mode of mechanical manufacturing course based on CDIO mode to the intelligent manufacturing course of Shandong Engineering Vocational and Technical University are more effective and operable. The superimposed teaching mode can be applied to the mechanical manufacturing course teaching of intelligent manufacturing major in Shandong Engineering Vocational and Technical University.

2. Based on the CDIO model, the superimposed teaching mode of mechanical manufacturing course can optimize the teaching structure and enrich the teaching content of the mechanical manufacturing course of Shandong Engineering Vocational and Technical University. The superimposed teaching divides the course into three parts: pre-class online independent learning, in-class theory and skill teaching, and after-class online consolidation. Using online resources to make up for the deficiency of offline face-to-face teaching, so as to optimize the teaching structure and enrich the teaching content.

3. Through the application of the superimposed teaching mode of mechanical manufacturing course based on the CDIO model, it can promote the communication and exchange between teachers and students, and improve the teaching level of the mechanical manufacturing course of Shandong Engineering Vocational and Technical University. The superimposed teaching

combined with the advantages of online and offline teaching can effectively feedback the difficult problems in the learning process of students, so that teachers can solve problems targeted and timely to promote the communication between teachers and students, and stimulate students' interest in exploratory learning, so as to improve the teaching level of teachers.

5.2 Recommendation

In the implementation of the superimposed teaching mode, the following problems were found: the proportion of online and offline learning, the insufficient optimization of online teaching resources, and the decline of teachers' teaching ability Based on this, focus on the above problems and related causes and further put forward countermeasures and suggestions.

Focus on the problem and related causes and further put forward countermeasures and suggestions.

1. Integration and optimization of different elements

In the superimposed teaching mode, a series of elements such as learning environment, media, teachers, teaching strategies, and students are undoubtedly important, but more important is the reasonable integration of these elements, so as to bring students an overall learning experience, which is the core part of the entire teaching process.

2. Strengthen teachers' capabilities

Different from the previous "lesson preparation" teaching, the superimposed teaching content is not all included in the textbook, and online courses generally require students to preview in advance. The responsibility of teachers is to guide students to cooperate and discuss in groups, and answer questions in time. Therefore, compared with the past, teachers need to make more efforts to study the teaching content to deal with students' problems.

3. Effective teaching evaluation

Due to the diversity of teaching forms, the teaching evaluation of superimposed teaching mode has always been a hot topic of discussion. Some effective evaluation methods have been explored in recent years. In the process of sorting out knowledge points, students not only consolidate their knowledge, but also cultivate their own logical thinking and overall consciousness.

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Appendix

Appendix 1: Expert Interview Outline

Dear Experts：

Thank you very much for joining this academic interview. I am a graduate student in Educational Management. The theme of this interview is "Stacked Teaching and Research of Mechanical Manufacturing Course under the CDIO Mode of Intelligent Manufacturing in Colleges and Universities", the content of this interview is only for academic research, please answer questions objectively and truthfully according to your personal views and opinions. Your interview suggestions are critical to the validity and accuracy of your research results. Thank you for your support and cooperation!

1. Interview subjects: Teachers with rich teaching experience in mechanical manufacturing courses, as well as experts and scholars with in-depth research on intelligent manufacturing education and course teaching design in schools.

2. Purpose of the interview:

(1) Understand the feasibility of superimposed teaching of mechanical manufacturing courses based on CDIO mode.

(2) Understand the problems encountered when introducing mechanical manufacturing courses under the CDIO mode of superposition teaching, and the problems encountered when introducing professional mechanical manufacturing courses in intelligent manufacturing education.

(3) Listen to the suggestions of experts and scholars to build a reasonable and effective superimposed teaching design for mechanical manufacturing courses under the CDIO mode of intelligent manufacturing.

3. Interview outline:

(1) Do you know about additive learning?

(2) What problems do you think exist in the teaching of mechanical manufacturing in traditional intelligent manufacturing education?

(3) What advantages do you think the superposition teaching mode of CDIO mode has compared with the traditional teaching mode?

(4) What do you think is the difficulty of superimposed teaching in mechanical manufacturing courses in intelligent manufacturing education under the CDIO model, and how to solve it?

(5) What do you think is the focus of building a superimposed teaching design based on the CDIO mode in intelligent manufacturing, professional mechanical manufacturing?

(6) What other suggestions do you have for this study to build a superimposed teaching design based on the CDIO mode of intelligent manufacturing professional machinery manufacturing?

Appendix 2: "Questionnaire for Teaching Before Teaching in Mechanical Manufacturing Course" and statistical results

	question	answer	Number of votes	proportion	Significant number
1	Are you a teacher or student?	A. Teachers	10	3%	300
		B. Students	290	97%	
2	Do you know about superimposed teaching in mechanical engineering?	A. Don't know	180	60%	300
		B. Probably know	110	34%	
		C. Know very well	10	3%	
3	Have you used or been exposed to mechanical manufacturing superimposed teaching?	A. No	210	70%	300
		B. Yes	90	30%	
4	Have you used software or networking?	A. Can	230	76.7%	300
		B. Can't	70	23.3%	
5	What is your attitude towards applying superimposed teaching in mechanical engineering classes?	A. Very optimistic	50	16.7%	300
		B. Generally	60	20%	
		C. Not too optimistic	190	63.3%	
6	Would you like to try superimposed teaching?	A. Neutral	60	20%	300
		B. Very willing	80	26.7%	
		C. Not willing	160	53.3%	
7	If you are teaching mechanical engineering, which of the following are you interested in?	A. History of teaching	80	26.7%	300
		B. Specialized Course	60	20%	
		C. Appreciation	120	40%	
		D. Superimposed teaching	40	13.3%	
8	What do you think are the advantages of superimposed teaching in mechanical engineering?	A. Improve students' learning initiative and autonomy, and change "passive" to "active"	50	16.7%	300
		B. Improve the efficiency of teaching and learning	60	20%	
		C. Enrich the diversity of teaching/learning forms	40	13.3%	
		D. stimulate students' enthusiasm for learning	50	16.7%	
		E. Break the physical limitations of geography and time to expand the ways and scope of teaching/learning	50	16.7%	
		F. According to individual level, the knowledge learned can be repeatedly watched and paused	50	16.7%	
9	What do you think are the disadvantages of superimposed teaching in mechanical manufacturing?	A. The network is unstable	150	50%	300
		B. With a certain degree of virtual nature	50	16.7%	
		C. less intuitive	50	16.7%	
		D. Weakly supervised	50	16.7%	
10	What is your favorite way to teach mechanical engineering?	A. superimposed teaching	20	7%	300
		B.Traditional offline classroom	280	93%	

Appendix3: After "Mechanical Manufacturing Superimposed Teaching", students feedback questionnaire statistics and results

	Question	Answer	Number of votes	Proportion	Valid Number of votes
1	Did you like Mechanical manufacturing superimposed teaching offered this semester?	A. like	264	89.8%	294
		B. Don't like	30	10.2%	
2	Are you comfortable with Mechanical manufacturing superimposed teaching online and offline learning?	A. Adapt	264	89.8%	294
		B. Don't adapt	30	10.2%	
3	Did Mechanical manufacturing superimposed teaching help you?	A. played a certain role in promoting	234	78.2%	294
		B. did not play a role	60	20.4%	
		C. play a hindering role	0	0	
4	What do you think has helped you with Mechanical manufacturing superimposed teaching lesson?	A. improve my independent learning ability	71	24.1%	294
		B. Promote innovative thinking and research	71	24.1%	
		C. Enrich my learning path and expand my knowledge	81	27.7%	
		D. improve learning efficiency and learning effect	71	24.1%	
5	What do you think are the shortcomings of Mechanical manufacturing superimposed teaching?	A. Weak self-control, easily influenced by the entertainment function of the Internet	70	23.8%	294
		B. The network is unstable	70	23.8%	
		C. Weak face-to-face intuitive feeling teaching	80	27.2%	
		D. bias in the understanding of physical movements in the online learning process	74	25.2%	
6	Through Mechanical manufacturing superimposed teaching lessons, have your personal abilities and overall level improved?	A. get a lot of promotion	250	85%	294
		B. improved to some extent	34	11.6%	
		C. No difference compared with before	10	3.4%	
7	Do you prefer in- person Mechanical manufacturing superimposed teaching?	A. class offline learning	94	32%	294
		B. class blended learning	200	68%	
8	Do you expect to have blended teaching in classes in the future?	A. Expectation	230	78%	294
		B. Neutral attitude	54	18%	
		C. Not expecting	10	4%	
9	Are you satisfied with the teacher's teaching activities?	A. Satisfactory	220	74.8%	294
		B. Fair	54	18.4%	
		C. Dissatisfied	20	6.8%	
10	Are you satisfied with the way teachers evaluate lessons in education?	A. Satisfied	220	74.8%	294
		B. General	54	18.4%	
		C. Dissatisfied	20	6.8%	

Appendix 4：Design Table of Teaching Process in the Pre-Course Stage of Online Course

Teaching Activities	Teacher Behavior	Student Behavior	Design Intent
Task Release	1.Upload mechanical manufacturing textbooks (PPT, teaching plans, teaching objectives) and teaching videos to the Superstar Learning Pass platform. 2.Post the pre-study task notice on the teaching platform 3 days before the offline class, and the independent pre-study time ends at 20:00 pm the day before the class.	1.Check the pre-study content in the notification bar of Super Star Learning Platform. 2.Make your own study plan.	By posting pre-study tasks to make students clearer about what they are learning, it provides guidance for students to pre-study independently.
Student independent learning	1.Check the statistics of students' pre-study completion and number of students and remind students who have not yet started their independent study to complete their pre-study tasks before the time cut-off point. 2.Take care of students' questions and feedback on independent pre- study in a timely manner.	1.Browse the lesson in detail and take notes. 2.Watch video. 3.Summarize the problems in the pre-study process.	Through independent study before class, students can develop good learning. The students will develop good study habits and exercise their independent thinking and problem-solving skills through independent study before class.
Online interactive discussion	1.Set up a discussion forum on The discussion will be open and interactive, and the students who speak actively and perform well will be praised. 2.The topic of was discussed in the discussion forum and the students were given prizes. 3.Actively participated in the discussion of the topic posted by students. 4.Reply to some students' private messages and communicate with them one-on-one.	1.Participate in the discussion forum, actively think, and speak. 2.Post your thoughts or questions in the discussion forum. 3.You can communicate with he instructor individually by private message.	Through online discussion, teachers can better understand students' concerns, stimulate students' interest in learning, and develop students' thinking.
Preview test	1.Design the pre-test questions and upload them to the homework section of the platform. 2.Check the completion status of students' pre-study tests and make appropriate adjustments to the teaching content in the lecture phase of the class based on the results.	Actively complete the pre-study test questions within the specified time.	By setting test questions, improve students' mastery of knowledge, test the effect of students' pre-study, determine the teaching by learning, and point out the direction for the modification and improvement of the teaching content in the middle of the lesson.

Appendix 5: Design table of teaching process in the teaching stage of offline classes

Teaching Activities	Teacher Behavior	Student Behavior	Design Intent
Review and introduce new knowledge	Take a head count and greet students and teachers with a salute. Lead the students to review the online pre-reading together and explain the main issues that came up during the pre-reading.	Thinking closely with the teacher and recalling the content of the online pre-reading with the teacher.	By posting pre-study tasks to make students clearer about what they are learning, it provides guidance for students to pre-study independently.
Teacher demonstration and instruction	Sample check students' learning hand shapes and hand positions and explain them carefully again.	1.listen carefully to the lecture, imitate the teacher's movements, observe the body form through the mirror adjust and correct in time. 2.Learn the teacher's way and method of explaining the movements and try to teach imitation training in group practice.	Through independent study before class, students can develop good learning. The students will develop good study habits and exercise their independent thinking and problem-solving skills through independent study before class.
Students work independently Practice	1.Let students carry out independent practice within the specified time through individual practice and group practice. 2.The teacher makes rounds during the students' practice. The teacher will provide one-on- one guidance and correction for different students' problems.	1.Participate in the discussion forum, actively think, and speak. 2.Post your thoughts or questions in the discussion forum. 3.You can communicate with he instructor individually by private message.	Through online discussion, teachers can better understand students' concerns, stimulate students' interest in learning, and develop students' thinking.
Presentation of learning results	1.Students select high-frequency shapes or thematic movements and compete and demonstrate them individually or in small groups. 2.The teacher and other students will comment and score them, and the better individual or group will be awarded extra points by comparing the movement reproduction, movement beauty difficulty.	To show the content learned in the form of individual or group. Listen to the teacher's summary and self-reflection, organize the problems that are likely to occur during the practice, and communicate with the teacher and classmates in time.	By setting test questions, improve students' mastery of knowledge, test the effect of students' pre-study, determine the teaching by learning, and point out the direction for the modification and improvement of the teaching content in the middle of the lesson.