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Ability - Oriented Teaching Innovation Design of Mechanical Drawing Course

Guijian Xiao*
Chongqing University
Chongqing, China

Yuanxin Luo
Chongqing University
Chongqing, China

Qimin Li
Chongqing University
Chongqing, China

Xianxiong Ning
Chongqing University
Chongqing, China

***Abstract*-Mechanical drawing course is an important basic course of both theory and practice for mechanical majors. Its basic goal is to cultivate students' spatial thinking ability, cultivate students' basic ability of drawing and reading engineering drawings, and master the skills of drawing with ruler and gauge, freehand drawing and computer drawing. However, the key ability of training students to adapt to the development of times is the new requirement of deepening the reform of educational system and mechanism, and the key ability of training engineering talents is the final destination of "new engineering" talent training. Taking mechanical drawing course as an example, this paper explores several innovative and creative education and teaching methods from the aspects of teaching goal design, teaching implementation and teaching evaluation with the aim of improving students' ability, so as to stimulate students' potential to the greatest extent, improve students' comprehensive ability and cultivate innovative and creative talents with comprehensive development of engineering ability.**

Keywords-mechanical drawing, ability orientation, curriculum design, evaluation system, innovation

I. INTRODUCTION

Ability-oriented teaching is student-centered and aims to comprehensively improve learners' abilities, not just the transmission of knowledge under the traditional education mode. The connotation of ability-oriented teaching should include the following two aspects: first, the arrangement of teaching content must be reflected in the improvement and development of ability, rather than simply completing the study of textbook knowledge; Second, ability-oriented teaching should not only cultivate students' ability, but also rely on students' ability to understand, master and innovate knowledge by giving play to students' ability in practical projects. In fact, these two are complementary processes, and the ability can only be exercised and improved in the process of needing the ability [1].

Mechanical drawing course mainly studies the basic principle of mechanical design drawings, the method and drawing related national standards system, the goal is to cultivate students' basic ability of drawing and reading engineering drawing, master the application ruler gauge drawing, freehand drawing and computer drawing skills, improve the students' ability of space imagination and space thinking ability and innovative thinking ability. As a compulsory course for science and engineering undergraduate students in colleges and universities, mechanical drawing is the first course that students come into contact with. The organization and arrangement of teaching activities not only have a direct impact on students' learning effect of this course, but also have an important impact on their interest in subsequent professional knowledge learning [2]. Aiming at the course of mechanical drawing, aiming at improving students' ability, this paper explores several innovative and creative teaching methods from the aspects of teaching target design, teaching implementation and teaching evaluation, so as to stimulate students' potential to the greatest extent, improve students' comprehensive ability and cultivate innovative and creative talents with comprehensive development of engineering ability.

II. PROBLEMS IN THE COURSE OF MECHANICAL DRAWING TEACHING

In recent years, the teaching method and content had the very big change, from the traditional blackboard freehand drawing teaching to give priority to with multimedia teaching blackboard writing as the auxiliary teaching, the teaching effect had the very big enhancement [3], but the teaching pattern is still not changed, give priority to with the teacher to teach, students passively accept knowledge cramming education mode, to master the knowledge to stay on the surface, ignore the cultivation of innovation ability and practice of the application of knowledge, there are still a lot of problems. For example, mechanical students finish the course with excellent performance, but when they finish the graduation design or participate in the competition, they will still face many problems and mistakes in the design and expression of machine parts, drawing of parts drawing and assembly drawing, as well as dimension and tolerance marking.

The emphasis on theory teaching overlooks the importance of practice teaching. In the actual course schedule of mechanical drawing, the time of theoretical teaching takes up the majority, while the proportion of practical teaching is often very small. However, in fact, the

classroom theory teaching can only let the student passively study to the knowledge spot, but really must grasp the knowledge, use the knowledge in the practical question, only then can study in the practice teaching link. Therefore, in the teaching process of mechanical drawing course, we should strengthen the cultivation of application ability and innovative thinking ability.

Lack of practical case system training, teaching material knowledge of each chapter is relatively independent. The content of each chapter in the textbook of mechanical principles is relatively independent, and there is a lack of corresponding practical cases. Students can only learn basic knowledge points, and they lack the opportunity to solve practical engineering problems with what they have learned.

Lack of effective and comprehensive teaching evaluation system. In terms of teaching effect evaluation, the system is not perfect and lacks comprehensive and quantitative assessment indicators for the learning process. At present, the main assessment indicators are class attendance, homework and final examination, which to some extent leads students to only pursue the final score and ignore the importance of process learning. In addition, in the assessment of students' ability to improve the lack of corresponding learning modules and assessment indicators.

III. MECHANICAL DRAWING COURSE ABILITY-ORIENTED TEACHING INNOVATION DESIGN

A. Course Goal Design

Mechanical drawing courses are an important basic course for both mechanical theory and practice. Its main goal is to develop students' spatial thinking ability, develop students' basic ability to draw and read engineering drawings, and master the application of ruler drawing, freehand drawing and computer drawing skills. In this paper, the ability-oriented inquiry course teaching is implemented, and the ability of students to be trained in this course is divided into three levels: the first level is the professional basic ability, the second level is the professional key ability, the third level is engineering innovation ability [4]. Abandon the traditional cramming teaching mode, pay attention to the combination of theory and engineering project practice in the teaching process, emphasizing the subjectivity of students in the learning process, and exerting students' autonomy, initiative and creativity in learning. It not only cultivates students' professional basic ability and professional key ability, but also cultivates students' practical ability to solve engineering problems and cultivate students' innovative consciousness and innovative ability. Based on the above training objectives, the overall framework of the ability-oriented mechanical drawing teaching innovation design is formed, as shown in Figure 1:

B. Curriculum Organization and Implementation

In the implementation of the ability-oriented mechanical drawing curriculum innovation teaching curriculum design, the learning process is divided into two important processes. The first important process is based on the online learning of flipping the classroom mode. Through the "self-learning + flipping practice + self-inquiry" approach, students' professional basic ability and professional key ability are cultivated. The second important process is to participate in the engineering practice problems and carry out offline learning, comprehensively apply the professional basic knowledge to analyze and solve practical problems, so as to cultivate students' engineering innovation ability. The specific implementation process is shown in Figure 2.

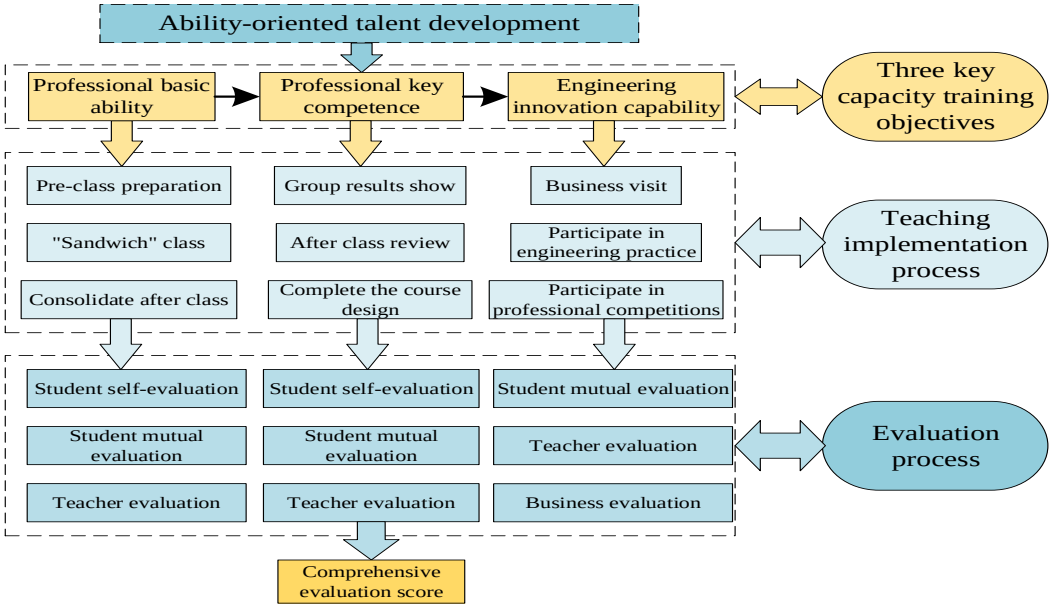

Figure 1. The overall framework of the teaching innovation design of the ability-oriented mechanical drawing course

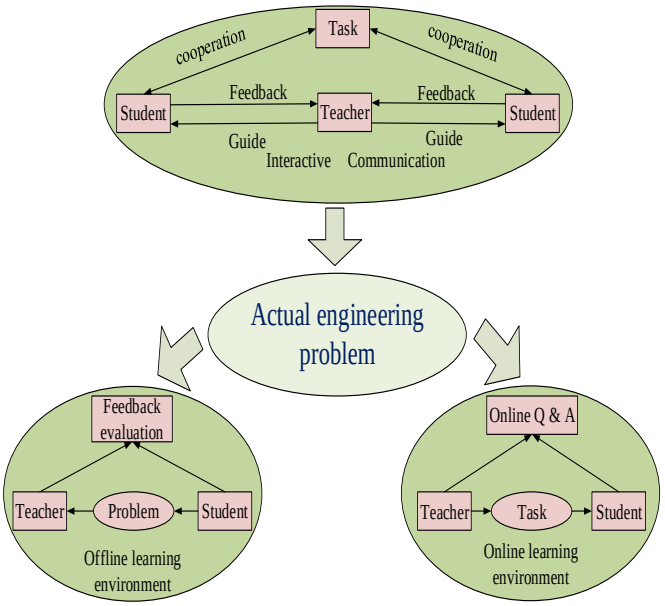

Figure 2. Capacity-Oriented online and offline education design

1) Online Teaching Method of "Self-Learning + Flipping Practice + Self-Inquiry"

The online teaching method of “self-learning + flipping practice + independent inquiry” is adopted. Online learning develops self-learning ability, through classroom situation setting, group discussion, results display and other inversion practice learning, internalizing the fragmentation knowledge of the curriculum, forming a structured knowledge body, and guiding students to effective learning and deep learning. In addition, based on the dual-class and teaching reform construction needs, the online course resources construction promotes the integration of experimental information technology and education teaching in mechanical drawing courses, and compiles and optimizes electronic courseware. Design and produce the teaching dynamic PPT and video that students like, build micro-course video, micro-class discussion area, set up online preparation, online operation and online testing, so that students become the ultimate beneficiaries of modern information technology.

- Course introduction is carried out in the form of “learning task structure diagram”. First, the teacher constructs a suitable learning situation according to the characteristics of the teaching content in the field of study. Then, based on the learning situation, design appropriate learning tasks according to the requirements of the teaching objectives. Finally, following the internal relationship between learning tasks, in the form of a network diagram, the learning tasks are connected in series to form a structural diagram with a certain logical relationship. Such instructional introduction can enable students to understand the knowledge and ability structure of the subject unit at the beginning of the course, and can stimulate the motivation of learning, establish the connection between old and new knowledge, and make the students' thinking become the main part of the classroom.

- The teaching method of online classroom teaching was implemented using the "sandwich structure" teaching method [5]. The teaching implementation process mainly adopts the "sandwich structure" teaching method, which is mainly divided into four parts: the teaching preparation stage, the self-learning stage, the cooperative discussion learning stage, and the results presentation and the student mutual evaluation stage (the specific process is shown in Figure 3 below).

2) Introducing Offline Practice Teaching Method Based on "Enterprise Engineering Project"

Combining theory teaching with engineering practice closely, studying the relationship between theory learning and practice in the course content, exploring a new way of engineering practice teaching based on enterprise actual project system, and strengthening the ability of transforming theoretical knowledge into practical innovative achievements.

In order to cultivate students' innovative consciousness and ability, some new achievements in scientific research work and some main points in scientific research papers are introduced to the students. As concrete examples, students are explained. In this way, teaching and scientific research permeate each other, so as to make students clear the purpose of learning, stimulate their interest in learning, inspire them to think independently and initiate students' creation. New inspiration. When the students' scientific research consciousness and innovative thinking are established, they should be given the opportunity of practical engineering project practice in enterprises, encourage students to participate in it, and help the implementation of the project and complete the innovative design with the professional ability of the mechanical drawing course they have learned.

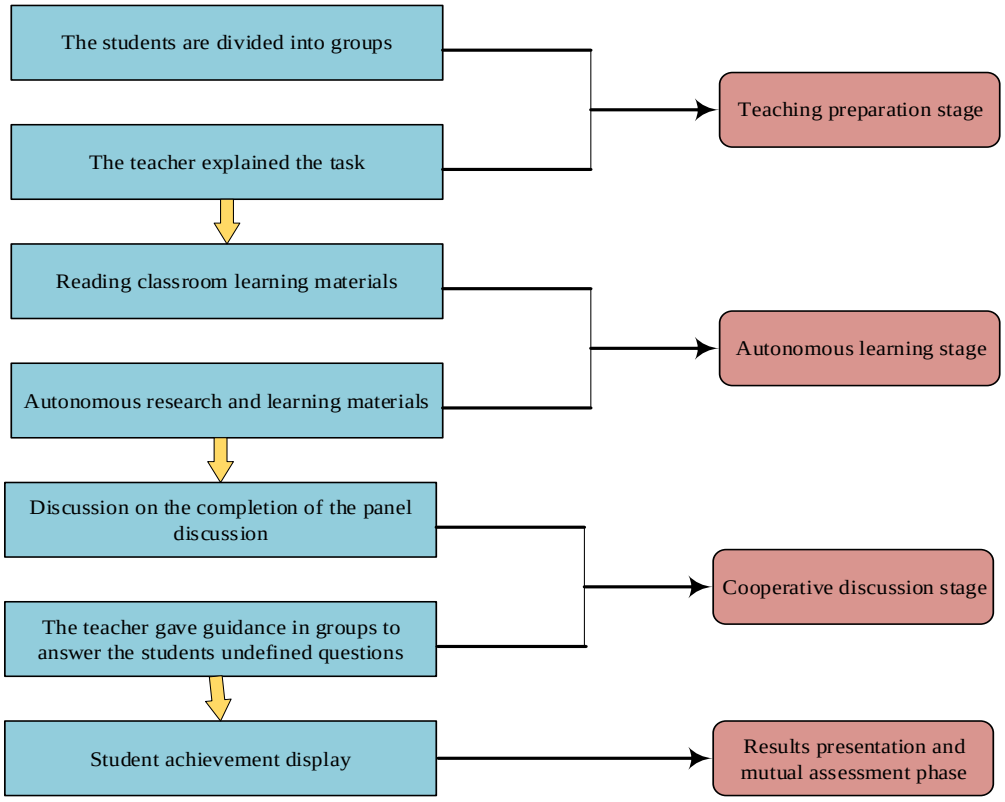

Figure 3 The implementation process of sandwich classroom teaching

TABLE1 CURRICULUM EVALUATION SYSTEM BASED ON OVERALL PROCESS

Evaluation items	Class A weight	Evaluation Index/Class B	Evaluator/Class B		Evaluation method
			Teacher	Students	
Attendance	5%	/	100%	0%	/
task	10%	(1) Normalization /40% (2) Correctness /60%	100%	0%	Σ(Single task) ÷Times×10%
Class discussion	10%	(1) Performance of panel discussions /40%; (2) Demonstration of Group Outcomes /40% (3) Participation degree /20%	70%	30%	Σ(Single discussion on teacher scoring ×70%+ Single discussion on student rating ×30%) ÷Task number ×10%
Enterprise Visit Practice	5%	(1) Internship attendance /20% (2) Internship report /80%	70%	30%	(Teacher scoring ×70%+ Student marking ×30%) ×5%
Discipline competition	5%	(1) Competition level /30% (2) Competition results /40% (3) Competition Division /30%	100%	0%	ΣScores in a single race÷Number of matches ×5%
engineering practice	10%	(1) Engineering Practice Works /40% (2) Evaluation of Enterprise Engineers /30% (3) Task division /30%	70%	30%	(Teacher scoring ×70%+ Student marking ×30%) ×10%
curriculum design	15%	(1) Course Design Works /40% (2) Course Design Defense /30% (3) Task division /30%	70%	30%	(Teacher scoring ×70%+ Student marking ×30%) ×15%
Examination results	40%	/	100%	0%	/

Students are encouraged and guided to participate in subject competitions, such as the National Machinery Innovation Design Competition, the National Smart Fish Engineering Innovation Competition and the National Robot Competition. Through the competition, not only can we consolidate the basic knowledge of the major we have learned, but also we can really exert our innovative consciousness to design the institutions that meet the requirements, cultivate our professional key ability and engineering innovation ability. More importantly, in the process of participating, we can cultivate our team cooperation consciousness and ability.

C. Course Evaluation System Based on Overall Process

Teaching evaluation plays an important role in teaching effect. Chen Xiaocen [6] and others analyzed the traditional assessment methods of mechanical principle course and put forward important reform measures.

In fact, the evaluation of students' learning effect of mechanical drawing course should not only pay attention to students' understanding and mastery of knowledge and skills, but also to their ability to participate in practical projects. It should also pay attention to the results of students' learning assessment, but also to their performance in the learning process. Therefore, the teaching evaluation system proposed in this paper adopts a variety of evaluation forms, combining process evaluation with result evaluation, combining qualitative and quantitative evaluation, dividing weight proportion according to different importance, and incorporating it into students' self-evaluation, giving students' final results comprehensively. Based on the above requirements, a teaching evaluation method based on the whole process is proposed, as shown in Table 1.

IV. SUMMARY

Aiming at the course of mechanical drawing, this paper completes the creative design of teaching based on ability, improves the tedious situation of the teaching contents of this kind of courses, and greatly improves the students interest in learning and the degree of participation in the class. It can not only learn the basic knowledge of curriculum, but also train students key professional ability and engineering innovation ability through interactive learning in class and participation in engineering practice in class, so as to lay a good foundation for participating in the work in the future. As far as mechanical field curriculum is concerned, its course nature and curriculum goal have great unity, and it has been widely used in practical teaching and implementation. In addition, it provides reference and experience for the change of educational concept and innovation of educational methods in other specialized courses in schools, and plays an important role in promoting the improvement of educational level in schools.

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