

Design and Application of Group Teaching in Blended Learning Classrooms: A Case Study of "Building Equipment Engineering"

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Abstract: In most university departments in our country, the number of students is high, so group learning has become one of the most important methods in higher education. This article takes the course "Construction Equipment Engineering" as an example and, based on a hybrid teaching model, designs the in – class application of this approach so that students can make the most of the interaction time between teachers and students during face – to – face sessions.

Keywords: group teaching; hybrid model; construction engineering teams; classroom teaching

0. Introduction

With the accelerating pace of the information age, teaching methods and tools are also being progressively renewed. Faced with the contradiction between the continuous reduction of class hours for specialized subjects in universities and the steady increase in the volume of knowledge, for teachers with extensive classroom teaching experience, optimizing the efficiency of classroom time has become a central and highly relevant issue. We not only actively promote the blended teaching method, but also appropriately and effectively configure teaching tools, enabling different educational approaches to complement each other, making classes more dynamic and engaging, and helping students more easily understand and master key and complex content. The author believes that group learning is indispensable in both traditional teaching models and current blended models; its perfect integration with information technology further highlights the advantages of this pedagogical approach.

1. Common Pedagogical Strategies and Methods

Based on Based on the teaching content of "Construction Equipment Engineering" and the identification of its key points and difficulties, it is proposed to select and design several effective teaching methods and strategies to be applied throughout the instructional process.

1.1 Project-Based Teaching Method

Definition of the Project-Based Teaching Method: In higher education^[1], this method consists of academic institutions designing and guiding projects and plans with practical value, organizing students to autonomously formulate their implementation plans, carry out self-directed learning, practical application, and operational activities, with the aim of fostering students' learning abilities, study methods, social competencies, and improving their overall quality.

Analyze the educational content and define the project tasks, then preparation period for project-based teaching:

(1)Teacher preparation: analyze and study the project, consult relevant information, gather knowledge and practical cases, understand the situation and context of the selected enterprise; prepare guiding documents such as the project work plan and the activity evaluation table; finally, conduct a brief presentation to motivate students, explain the importance and value of the project, and stimulate their interest in completing it.

(2)Student preparation:Faced with an open, student-centered teaching approach, students must

take the initiative seriously, preview the relevant teaching materials in advance, acquire the necessary knowledge, adequately prepare for the corresponding subjects, and collect relevant information about the enterprises, in order to make a proper preliminary preparation before joining them.

(3)Project Implementation Phase: The first step is to divide the students in the class into groups to create cooperative learning teams, i.e., project development teams^[2]. The second step is to complete the project according to the plan.

(4)Presentation and Evaluation of Project Results: In accordance with the principles of fairness, impartiality, and transparency, student self-assessment, peer assessment, and overall teacher evaluation will be used. The evaluation should also take into account the specific characteristics of each project and organically integrate project evaluation with individual student evaluation from three perspectives: "knowledge and skills," "processes and methods," and "emotional attitudes and values." (as shown in the Fig.1).

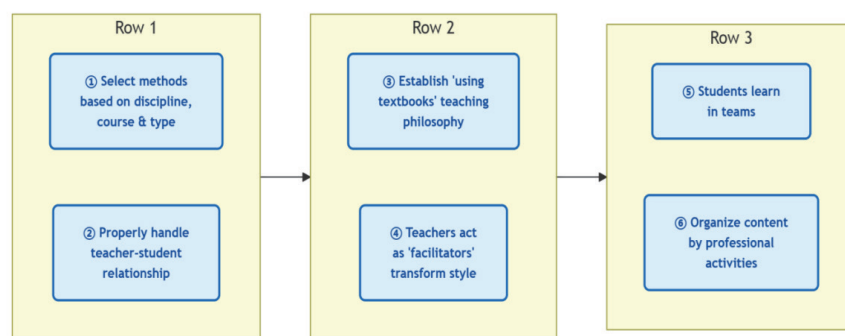


Fig.1.

1.2 Case-Based Teaching Method

Definition of the Case-Based Teaching Method:Case-based teaching consists of using real-life examples to integrate everyday life into the learning process, "simulating real-world professional situations" and developing "narrative guides" that allow for detailed review, analysis, and in-depth understanding, in order to help students think and act like professionals(as shown in the Fig.2).

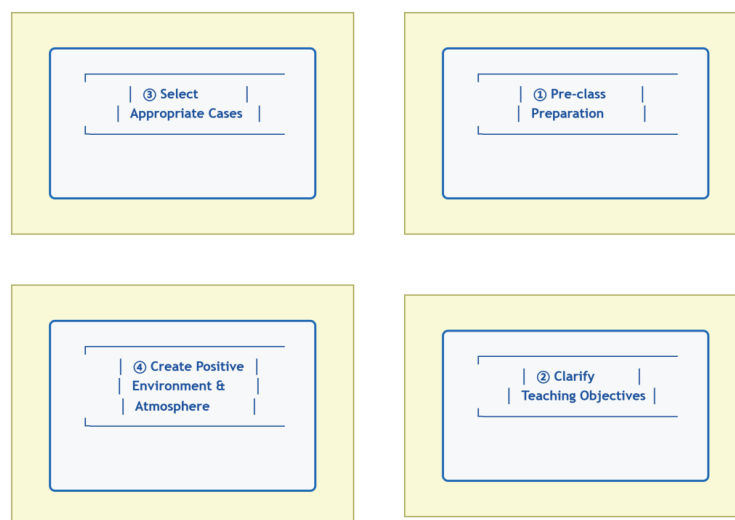


Fig.2

1.3 Task-driven Teaching Method

Definition of the Task-Based Teaching Method: The task-based teaching method is an educational methodology grounded in constructivist learning theory that transforms the traditional approach centered on knowledge transmission into an interactive, multidimensional model oriented toward solving problems and completing tasks. This approach replaces rote learning with inquiry-based learning, placing students in an active learning state: each student can, according to their understanding of the issue at hand, use common knowledge and personal experiences to propose solutions and solve problems.

Fundamental Elements of the Task-Based Teaching Method: (1) Create a context; (2) Define the problem or task; (3) Autonomous and collaborative learning; (4) Evaluation of results.

Requirements of the Task-Based Teaching Method: (1) Have a thorough understanding of the students. (2) The objectives of task design are clear and its structure is appropriate. (3) The task should be highly practical and presented in a realistic and natural manner. (4) Task design should be contextualized and brought close to everyday life. (5) Task design should focus on fostering students' innovative abilities. (6) Tasks should be organized in a tiered or graded manner. (as shown in the Figure 3).

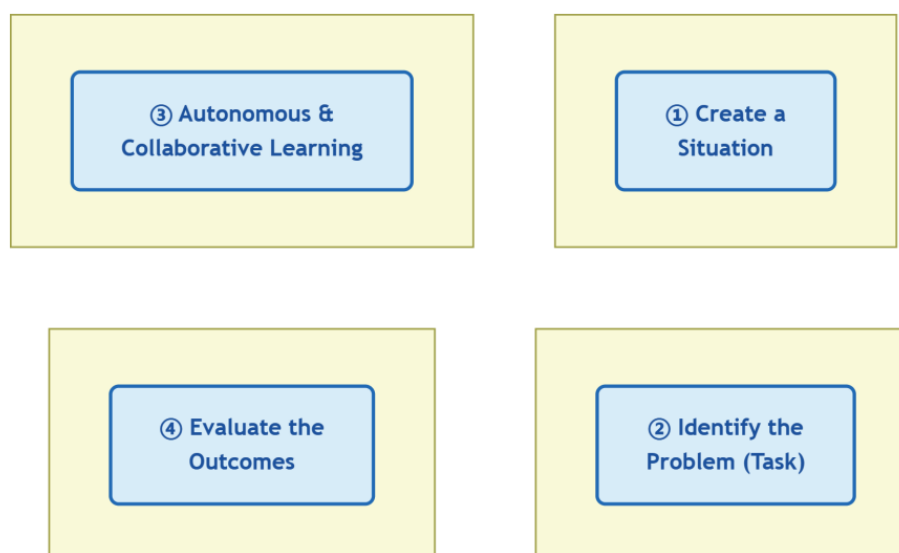


Fig.3

1.4 Cooperative Learning Teaching Method

Characteristics of the Cooperative Learning Teaching Method: Cooperative learning is a teaching modality that involves dividing students into groups of 2 to 6 people, who jointly carry out learning activities and complete the tasks assigned by the teacher.

Fundamental Elements of the Cooperative Learning Teaching Method: (1) Assignment of tasks (2) Grouping of students (3) Group learning activities (4) Group reporting and teacher-student discussion (5) Recognition and praise for the achievements attained in group learning

1.5 Situational Teaching Method

Definition of the Situational Teaching Method: The situational teaching method consists of recreating in the classroom the situations described in the textbooks and integrating them continuously throughout the entire learning process. It is a pedagogical approach in which, under the teacher's guidance, students immerse themselves in the environment depicted in the textbook, which stimulates their imagination, thinking ability, and sensitivity; moreover, through well-

designed questions posed by the teacher, the expected educational outcomes are achieved.

Fundamental Elements of the Situational Teaching Method:(1)Selection of cases(2)Extracurricular preparations(3)In-class exercises and question-and-answer sessions(4)Analysis and summary.

1.6 Goal-Oriented Teaching Methodology

1.6.1 Characteristics of the Goal-Oriented Teaching Method:

The goal-oriented teaching method consists of breaking down the process of a class into several stages: introduction to the topic, presentation of learning objectives, explanation of relevant knowledge in accordance with those objectives, and evaluation of results, thus organizing teaching according to these phases^[5].

1.6.2 The Basic Principles

(1) Goal-Centered Principle, Teaching objectives are the starting point and the ultimate end of the educational process; the class must be organized strictly around them. Particularly, when not all objectives are achieved, timely intervention is necessary to ensure that each academic session reaches its intended goals.

(2) The Principle of Teaching with "the Teacher as the Main Guide, the Student as the Central Subject, and Training as the Fundamental Axis." The teaching process is a process in which teachers and students participate together, and it must constantly place the student at the center of the process: the student acts as the protagonist, while the teacher plays the role of director.

(3) The Principle of Integrating Theory with Practice. Through stages such as discussion, detailed explanation, and evaluation, students are allowed to integrate the knowledge they have acquired with objective reality, thereby achieving the educational objectives.

(4) Principle of Optimization. From the beginning to the end of the class, and from the teacher's guidance to the student's learning, all aspects of the educational process should be appropriately combined to reflect harmony, naturalness, and optimization.

(5) Principle of Correction through Feedback. Gathering informative feedback and effectively correcting or supplementing incomplete knowledge constitutes an essential means of preventing the progressive accumulation of cognitive deficiencies and achieving the learning objectives set during the class, which reflects the initiative and effectiveness of interaction and communication in the educational process.

1.7 Lecture-Based Teaching Method

Characteristics of the Lecture-Based Teaching Method:The lecture method is a technique through which the teacher transmits knowledge, develops skills, and carries out ideological education to students through oral language; it constitutes the most widely used pedagogical approach within methods based primarily on verbal communication, and is frequently combined with other methods in practical application.

Basic Requirements of the Lecture-Based Teaching Method:

(1) Prepare lessons diligently, thoroughly master the content of the teaching materials, and have a clear, fluent, and comprehensive understanding of the key points of knowledge, their systematic structure, and interrelationships; only in this way can teaching be delivered with ease, energy, and confidence. At the same time, it is essential to take into account student feedback in order to appropriately adjust the development of teaching activities.

(2) The pedagogical language must be precise, rigorously scientific and logical; concise: without expressions unrelated to teaching, with brief vocabulary and using scientific geographical

language; clear: with accurate pronunciation, appropriate intonation, suitable speed, and correct emphasis; vivid and impact: with visual content and the ability to mobilize emotions, as well as deep teacher engagement.

(3) The principle of heuristic teaching should be fully applied: the content taught should correspond to the key points, difficulties, and essential aspects of the teaching materials, so that students actively reflect on problems throughout the teacher's explanation or presentation, with continuous guidance during the explanation and exercises integrated into it. The central role of the student is clearly manifested through their readiness to learn and reflect, which allows the teaching method to be dynamic and interactive, rather than an approach based on passive knowledge transmission.

(4) The content taught should be specific and illustrative; when relating it to prior knowledge to explain abstract concepts or principles, it should always be combined with other methods whenever possible to make it more visual and easier to understand. The content should be carefully organized so that it is clear, with a distinct distinction between primary and secondary points, and with key points highlighted.

(5) During teaching, board work should be combined with visual teaching aids; the latter can help highlight the key points of the content, show the development of the learning process, and make explanations clearer and more concrete. Intuitive teaching materials, such as maps, pictures, charts, and models, can be used to demonstrate the content while explaining it, in order to deepen understanding.

2. Concept of Group-Based Teaching

The so-called group teaching is a form of pedagogical organization in which the teacher, according to classroom needs and after analyzing the teaching materials and understanding the characteristics of the student group, combines available resources to divide them into several groups in a specific and clearly targeted manner. Group teaching takes various forms, such as cooperative grouping, random grouping, and homogeneous grouping; the choice of the most appropriate form in class is not fixed, but should be based on the characteristics of the teaching materials and the specific circumstances of the students. Regardless of the type of grouping used, it must be able to effectively stimulate students' motivation to practice, enhance the positive effects of the groups, and contribute to their progress in learning.

3. Design of Group Teaching

Course Positioning and Objectives: Taking the specialized course "Construction Equipment Engineering" as an example, this is a foundational core subject for majors such as civil engineering and project management. Through the study of this course, students will learn the basic theories, design principles, simple calculation methods, as well as the materials and equipment used; they will also understand the coordination relationships between construction equipment and structural engineering works in buildings. In addition, they will become aware of the trends and developments in new equipment, technologies, and materials used in engineering projects, and will acquire the fundamental abilities to conduct techno-economic analyses and provide decision-making advice on the selection of construction equipment based on functions, characteristics, project nature, and specific client requirements.

Main Course Content: This course is a professional subject of a pedagogical type that combines theory and practice. Given the nature of this course, teachers must not only clearly explain the fundamental theories, but also closely integrate teaching with practice, ensuring that the knowledge is both in-depth and up-to-date. The course mainly comprises four parts: building water supply and drainage, heating systems, ventilation systems, and building electrical engineering.

3.1 Course Content, Key Points, and Difficulties

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3.2 Having Mature Teaching Presentations

The PPT presentations used in teaching are the core element of the classroom. By carefully crafting multimedia materials tailored to the specific characteristics of each professional course and applying them appropriately in the educational process, the teaching content is transformed from static transmission into dynamic communication that combines text, images, audio, and video. Only by integrating these multimedia materials with other forms of teaching can their pedagogical advantages be fully leveraged and the effectiveness of classroom learning be significantly improved.

The Course Should Include Video Recordings Made by the Students Themselves On the basis of the school's existing physical studio facilities, individual recordings should be made of the classes taught by all teachers on the teaching team, which will constitute the main audiovisual resource.

Micro-Lecture Videos, According to the content of each section, and especially in relation to key points and difficulties, short animated videos should be created to help students better understand the material.

Making Appropriate Use of Online Resources, Information technologies have become deeply integrated into people's work, learning, and daily lives. In the classroom, the comprehensive use of these technologies and online educational resources has become an essential tool for both face-to-face and virtual teaching. Notable examples include: the Open Class platform: <http://www.openke.net/>; the AiKuSu website: <http://www.icourses.cn/home/>; China MOOC University Network: <http://www.icourse163.org/>; XuetangX.com: <http://www.xuetangx.com/>; and NetEase Cloud Classroom.

3.3 Main Content of the Course

This course is a specialized subject that combines theoretical instruction with practical application. Given its nature, instructors must not only thoroughly explain fundamental theories but also closely integrate them with practical applications, ensuring the content is both comprehensive and up-to-date. The curriculum comprises four main components: building water supply and drainage systems, building heating systems, building ventilation systems, and building electrical engineering.

Key Points and Difficulties in Course Content, shown in the Table.1

table.1 Course Difficulty and Key Points Distribution Table

Course Content Overview	Key Points of Knowledge	Key Challenges in Understanding
building plumbing system	Composition of building water supply systems; Water supply methods for buildings; Hydraulic calculations for water distribution networks; Composition, scope of installation, and layout of fire protection water supply systems in low-rise buildings	Principles and methods for selecting building water supply systems, as well as hydraulic calculations for water distribution networks
Building Heating System	Composition and Working Principles of Hot Water Heating Systems and Steam Heating Systems	Composition and working principle of mechanical circulation hot water heating systems; Hot water heating systems for high-rise buildings

Building Ventilation System	Methods of building ventilation, equipment and accessories for mechanical ventilation systems	Calculation of ventilation volume for different ventilation methods; schematic diagram of indoor fire alarm systems
Building Electrical Engineering	Types of building electrical systems, selection of electrical equipment, and lighting design	Lighting power supply and distribution system, electrical layout diagram.

3.4 Group Design

Taking as an example a key knowledge point from the book Construction Equipment Engineering: building ventilation methods. First, the teacher should design a discussion question related to the concepts and applications of building ventilation, so that students can work in groups to draw conclusions on this topic within the limited time allocated in class. A schedule can be set as follows: 30 minutes (presentation of the question + group discussion), plus 10 minutes (group self-assessment and peer evaluation), and 5 minutes (teacher evaluation).

4. Application of Group Teaching

At present, the technical facilities of many universities still do not meet the requirements necessary for all classrooms and educational equipment suitable for group learning. Taking a class of 42 students as an example, they can be divided into six groups of seven people each (as shown in the figure). According to the lesson preparation plan formulated by the teachers, group leaders are appointed to guide students in effectively carrying out group discussions. Subsequently, the group's learning outcomes, the performance of the group leader, as well as their innovative and outstanding aspects are evaluated; the rest of the group members and their collaborative abilities are also assessed. During the teaching process, a look, a gesture, or a smile from the teacher constitutes very valuable evaluations; finally, the teacher conducts an overall evaluation and summary.

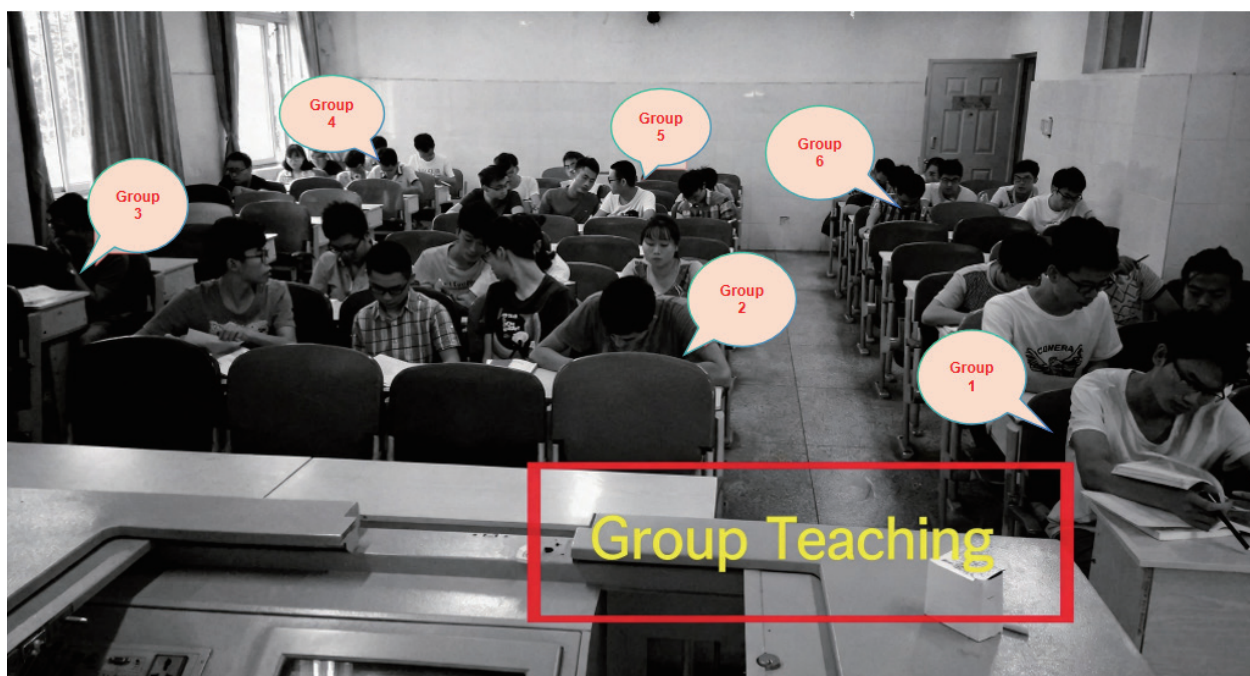


Fig.4

5. Conclusion

The group teaching method facilitates personalized instruction, improves classroom organization, and enhances educational quality; it is particularly suitable for specialized training in universities. It not only develops students' autonomous learning abilities but also strengthens their teamwork

skills, promoting a culture of mutual assistance and collaboration among students and between teachers and students. It allows for closer integration with the blended teaching model and constitutes one of the most important components of its classroom teaching methods.

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