The Practice of Blended Learning integrated with Flipped Classroom——an example of *Construction Laws and Regulations*

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Abstract: *The Flipped Classroom and Blended Learning exhibit inherent logical coherence. All four primary modes of blended learning have the intrinsic characteristics of the reversal of knowledge imparting and knowledge internalization. So the blended learning demonstrates superior educational outcomes with joint application of Flipped Classroom. The teaching team of the "Construction Laws and Regulations" course in Yunnan University has redefined the course objectives and reset the content of this curriculum based on the characteristics of the college, orientation of major, and students' basic situation. Then Blended Learning approach integrated with Flipped Classroom have been implemented, which has yielded favorable outcomes.*

Keywords: *Blended Learning; Flipped Classroom; teaching and learning mode; Construction Laws and Regulations*

1.The Inherent Consistency between Flipped Classroom and Blended Learning

1.1 Modes of Blended Learning

Blended learning is a teaching and learning model based on Constructive Learning Theory. It generally refers to the integration of online and offline learning nowadays. Research has found that in blended learning, the convenience of online learning is utilized to facilitate students in attaining low-level learning objectives, while teacher aid students in internalizing knowledge and fostering high-level cognitive development in offline classroom[1], which lead students to engage in reflective thinking and focused learning activities[2], enhance their capacity for autonomous learning[3], thereby significantly enhancing the effectiveness of teaching and learning[4-5].

The COVID-19 pandemic has significantly accelerated the global advancement of blended learning. While many courses have reverted back to conventional offline teaching post-pandemic, a substantial number of courses continue to embrace blended learning, which is anticipated to be the predominant teaching and learning model in the future.

There are many implementing models of blending learning. In the universities and colleges in China, most used implementing models of blending learning are as follows.

1.1.1Mode 1: Online – self-learning; Offline – teacher instruction

In this mode, students complete their online self-learning based on the materials provided by the teacher. Teacher provides in-depth explanations to key and difficult points and expands on topics not covered in the online learning materials in offline classroom teaching. This blended teaching mode is the closest one to conventional offline instruction and has the lowest implementation difficulty. In the context of advanced information technology and abundant online resources, even in courses that only conduct offline instruction, teachers also encourage students to use online materials to preview before class. Therefore, the difference between this blended learning and offline instruction mainly lies in how teachers allocate course content between online and offline. As the proportion of online learning hours decreases, the blended teaching model gradually converges towards the conventional offline teaching model.

1.1.2Mode 2: Online – self-learning + practice; Offline – teacher explanation + answer question

For courses that require extensive practice to achieve learning objectives, an effective approach of

blending learning is to have students complete their learning online and then engage in exercise training arranged by the teacher. During offline classroom instruction, the teacher can focus on the exercises which most students made mistakes and answer any question raised by student.

1.1.3Mode 3: Online – self-learning + practice + set question; Offline – student explanation + answer question

Mode 3 is an upgraded version of Mode 2. After completing online learning and exercise practice, students compile exercises based on their understanding of the knowledge. Offline classes involve interactive teaching, questioning and answering by students to facilitate exercise and further practice. Teachers only address students' specific difficulties during Q&A sessions.

In both Mode 2 and Mode 3, the effectiveness of online exercise plays a pivotal role in achieving teaching objectives. Therefore, it is crucial to design a reasonable difficulty ladder that allows most students to experience a sense of accomplishment through gradual mastery of acquired knowledge. Additionally, appropriate program designs should be implemented to prevent cheating such as copying or searching online as these factors significantly influence the pattern's ability to attain its intended goals.

1.1.4Mode 4: Online – self-learning + research; Offline – student presentation + discussion

In this mode, students complete the learning of fundamental knowledge online and subsequently engage in inquiry-based investigations and research on topics arranged by teachers. In offline classroom, students present their research findings and participate in guided deep discussions facilitated by teachers to construct novel knowledge. This model is suitable for courses with a certain degree of openness and close alignment with real-life contexts. Among various blended learning modes, this approach places the highest demands on both teachers and students. Students can maximize their knowledge acquisition from the course while experiencing significant personal growth.

1.2 The intentional logic of Flipped Classroom

Flipped classroom is originated in 2007 from the practice in Woodland Park High School in Colorado. Two chemistry teacher record instructional videos to help students who cannot come to school to make up their missed lessons. Then they tried to require all students to watch videos and learn course content prior to class, followed by engaging in guided exercise during class. In case of any difficulties, the teacher offers personalized tutoring[6].

The learning process can be categorized into two stages: knowledge imparting and knowledge internalization. In the conventional instructional model, knowledge imparting is accomplished through teacher-led classroom lectures, while knowledge internalization takes place through students' post-class practice and exercises. This novel instructional approach reverses these stages by prioritizing knowledge imparting prior to class and facilitating knowledge internalization in classroom. Hence, it is referred to as Flipped Classroom[7].

Compared to the conventional teaching model, this new approach enables teachers to offer personalized guidance to students during the phase of knowledge internalization in the classroom, based on their individual learning progress. Consequently, it contributes to improving students' overall learning outcomes. The conventional teacher-centered instructional approach is reversed in Flipped Classroom, so as the students' enthusiasm for learning fostered, classroom engagement promoted[8], and students' learning abilities cultivated. On the other side, Flipped Classroom also places higher requirement on teacher's competence and evaluation methods[9-10]. The flipped classroom presents different effects in various teaching practices[11], as its successful implementation necessitates alignment with specific teaching contexts[12].

In the context of higher education, the Flipped Classroom model is not only reflected in the reversal of the learning stage, but also perform as the reversal of the lecturing subject. In-class lecture and presentations are often assigned to certain students, followed by error correction, supplementary explanations and expanding discussions provided by teacher and other students.

1.3 The Inherent Consistency between Flipped Classroom and Blended Learning

It can be seen from the above discussion, the two teaching models of Flipped Classroom and Blended Learning exhibit inherent logical consistency. In order to effectively reverse knowledge imparting and internalization, students are required to engage in self-learning and practice prior to classroom instruction. In regions where information infrastructure meets the requirements for online learning, students heavily

rely on internet resources. Online learning is also regarded as the most efficient and effective mode for pre-class self-learning.

The initial implementation of Flipped Classroom teaching at Woodland Park High School already integrated a Blended Learning approach, encompassing both online and offline learning. However, during that period, MOOCs had not yet gained widespread popularity; hence their flipped classroom practice relied on teachers' pre-recorded lecture videos as instructional materials for pre-class learning. Fundamentally speaking, this also constitutes a form of online learning.

The aforementioned four modes of blended learning all incorporate the concept of Flipped Classroom. From Mode 1 to Mode 4, there is a progressive increase in the degree of "flipping" and requirement for students. Among these blended learning modes, those that integrate with flipped classroom teaching can better demonstrate the advantages of blended learning[13]。The integration of flipped classrooms and blended learning can enhance students' higher-order thinking[14], bring about effective learning[15], and plays a significant role in fostering students' learning abilities and improving educational quality [16].

With the development of information technology and AI, students have more channels to access the knowledge they desire. The role of teacher is shifting from "knowledge providers" to "learning architects". Setting appropriate course goals and content, adopting suitable blended learning modes, and setting up effective teaching and learning activities based on different teaching objectives, course characteristics, teachers' teaching abilities, as well as students' basic conditions, should be the right approach to achieve expected teaching and learning objects.

2. The Practice of Blended Learning integrated with Flipped Classroom in the Course of Construction Laws and Regulations

2.1 The disadvantage of conventional teaching and learning model

The Construction Laws and Regulations is a compulsory course for civil engineering and other relevant majors, primarily introducing various provisions in laws and regulations in relevant to the construction industry. Conventionally, this course solely focuses on the specific provisions of these systems, with little discussion on the underlying reasons behind their formation and historical changes. It introduces regulations in China without adequately introduction to similar systems in developed countries. It predominantly informs students about how regulatory provisions are formulated but provides limited information about their practical implementation and existing problems. The content of the course lacks depth and exhibits poor internal logical coherence, resulting in diminished student engagement.

In order to change this situation, the teaching team of the course has carried out teaching reforms by resetting the course objectives and reconstructing the course content. Then Blended Learning approach integrated with Flipped Classroom was introduced, which has yielded favorable outcomes.

2.2 Reset course objectives

The target learner of this course is undergraduate students majoring in Civil Engineering at Yunnan University. They have a solid foundation of professional knowledge and certain self-learning abilities, but lack knowledge about the law . They possess superficial knowledge and strong interest in the construction industry. After graduation, most of them will initially engage in technical management work guiding construction workers, several years later, they are likely to become middle or senior managers in various companies engaged in construction industry. Therefore, they should not only be familiar with the current regulations but also have a clear understanding of how these regulations operate in reality, identify existing problems and their causes, and be able to design feasible solutions based on existing conditions. Simply teaching the provisions of current systems about construction industry cannot meet the job requirements for these students. Based on such considerations, two levels of learning objectives have been set for this course.

Basic objectives: Students should be able to determine the legality of various behaviors in construction industry; list the main content and procedures for various approvals required for construction project; explain the background and evolution process of various government regulatory systems in construction industry.

Advanced objectives: Students will be able to analyze the causes of major illegal phenomena in the current construction industry; be able to explain the logic of evolution of various government regulatory

systems in construction industry; will be able to evaluate government regulatory systems and policies, and design solutions based on current conditions, technology, economics, and other factors.

Moral Education Objective: Deepen the understanding and recognition of values such as rule of law, integrity and dedication; cultivate professional ethics of abiding by laws and regulations, and integrity in employment; enhance awareness of the rule of law and sense of social responsibility; improve the ability to analyze issues in the industry using historical materialism and dialectical materialism methods; strengthen confidence to the prospects of the industry and nation.

2.3 Reconstruct course content

According to the objectives of course and the requirements of blended teaching, we have categorized the course content into two sections: fundamental content and advanced content. The fundamental content encompasses various current regulations in the construction industry, which are relatively straightforward and primarily acquired through online self-learning. On the other hand, the advanced content delves into aspects such as implementation status and major challenges faced by different systems in the industry, along with their causes and governance complexities. Additionally, it explores relevant systems employed in developed countries as well as potential paths for future reforms in our country. These contents possess a certain level of depth, lack standardized solutions, and are predominantly learned through offline classroom sessions.

2.4 The Blended Learning mode in this course

Based on the objectives and content of the course, The Blended Learning mode integrated with Flipped Classroom is adopted in Construction Laws and Regulations.

The foundational content is primarily learned through online self-learning with MOOC videos, teacher-assigned textbooks, and other learning materials. These foundational content is summarized and reviewed, with deep explaining to difficult points in offline class. Firstly, students are selected to summarize the foundational content of this chapter, while other classmates contribute and correct any missing or incorrect information. This helps students construct a network of knowledge acquired. Subsequently, through classroom quizzes, the foundational knowledge learned online is reviewed and reinforced. Thirdly, explanations for weak areas identified during the chapter test are provided by teachers to ensure that all students understand key points of the content. Finally, class test are conducted to evaluate the effectiveness of learning. After class, homework assignments are given to consolidate. Through anonymous peer evaluation, students' memory of these contents are reinforced.

For advanced content, The teacher assigns specific topics and students are required to form groups to conduct independent research on relevant materials prior to class. Presentation groups are required to submit an outline one week in advance for teacher's guidance, while other groups engage in online discussions in the discussion platform of MOOC. During offline classes, presentation groups deliver their presentation. Some controversial issues of general interest in the industry are debate by students' group. Classmates participate in group discussions and express their opinions as the teacher continuously probes based on the discussion, providing a contextualized learning framework that guides students' critical thinking and facilitates constructive acquisition of advanced content.

For example, in the section of construction bidding system, a debate topic "Should the use of lowest price bidding be prohibited in construction project bidding and tendering?" is set to address the discussion on quality issues caused by the lowest price winning method. Two groups of students who made preparation are then engaged in the debate. Other students will cast their votes to determine the outcome by assessing changes in support rates. The most outstanding debater is selected in this vote too. The outcome of the debate and each student's performance will be included in offline classroom grades. Subsequently, building upon both sides' perspectives presented during the debate, teacher further poses thought-provoking questions for group discussions among all students. Finally, a summary is conducted to extract key knowledge and perspectives from this offline course.

Through this constructivist learning process, students gain an in-depth understanding of commonly used procurement methods and evaluation criteria in construction projects while developing a more profound comprehension of public debates surrounding lowest price winning methods. Students become more conscious about applying dialectical materialism as an analytical approach to industry and social issues while analyzing reasons for change from internal factors as well as external ones. By criticizing common misconceptions and one-sided arguments in social media, students' independent thinking,

reflective spirits, and an objective attitude that values practicality over theoretical concepts are cultivated.

2.5 Reasonable evaluation mechanism

A reasonable evaluation mechanism is essential for achieving good learning effectiveness. For the Construction Laws and Regulations course, students' overall grades are composed of three components: online learning performance, offline learning performance and Test results. Details can be found in Table 1.

Table 1 The evaluation methods and composition of grades

Evaluation Method		Percentage	Criteria
Online Learning performance	Watching Vedio	5%	5 points for watching the entire course video as required. One point is deducted for each video that is not watched, and zero points are awarded for five or more videos that are not watched.
	Chapter Test	10%	Average test scores for each MOOC chapter.
	Discussion	10%	10 points are awarded for Posting or replyto a discussion, and 5 points are awarded for each "red flower" from a teacher. The full score is 100 points.
	Homework	10%	Each homework shall be submitted online, and students shall conduct two-way blind mutual evaluation according to the answers provided by the teacher. Each student shall conduct mutual evaluation for the other 3 students randomly selected by the system. The grade in this section is the average of all assignments.
Offline Learning performance	Offline Class Activities	10%	In the lecture and discussion sessions, 1 points were awarded for each initiative and good answer, and 0.5 points were awarded for each initiative and common answer.
	Group Task	15%	Each group should complete two group tasks such as group debriefing and group debate. Points were given according to the group's completion of the task. Evaluation points: correct content (30%), detailed information (30%), novelty of ideas (20%), concise and accurate expression (20%). The score of this part is the average score of all tasks.
Test	In-class Test	10%	Using mobile phone software and MOOC database, we will conduct offline in-class test. Each test will take about 10 minutes and the full score is 100 points. The score of this part is the average score of all tests.
	Final Exam	30%	Score of final examination

2.6 The effect of adopting Blended Learning

In order to measure students' perceptions and subjective teaching effectiveness of the Blended Learning mode in this course, a questionnaire survey was conducted using Likert's 5-point scale at the end of the semester. ("Strongly agree" is rated as 5 points, "strongly disagree" is rated as 1 point). The results of the questionnaire survey showed that most students welcome and accepted the blended learning mode, with an increase in their weekly study time from 1.5 hours to 2.2 hours after the implementation of blended learning. The course has achieved satisfactory effects in terms of knowledge imparting, skill development, and character shaping for students. Details can be found in Table 2.

Table 2 Result of Survey of the Effect of Course Leering (Part)

No.	Questions	Avg. Score
1.	The offline teaching components are well-designed and incorporate a variety of methods, which effectively engage me in active participation and interaction.	4.77

2.	The group tasks were challenging, providing me with significant opportunities for personal growth and enhancing my learning abilities.	4.67
3.	Diverse assessment methods in this course have served as a motivating factor for my learning.	4.77
4.	Compared to the conventional teacher-centered teaching model, I prefer the flipped classroom teaching model used in this course.	4.47
5.	Through this course, I have gained an understanding of the current status and problems related with the issues of construction regulations, and I am able to explain the causes of them.	4.73
6.	Through this course, I am able to determine the legality of various behaviors in the field of engineering construction.	4.70
7.	Through this course, my oral communication and expression skills have been improved	4.77
8.	Through this course, my teamwork collaborative skill has been enhanced.	4.60
9.	Through this course, I have a deeper understanding and greater affirmation of core values such as professionalism, integrity, and rule of law.	4.77
10.	Through this course, I have a better understanding of the course and great achievements of our country's reform and opening up.	4.73
11.	Through this course, I am able to make my own predictions about the future evolution of various regulations in the construction industry.。	4.67
12.	Through this course, I am more confident about the future prospects of the construction industry and the country.	4.73

3.Conclusion

Reasonable course objectives should be formulated based on the characteristics of the college and major, and the students' basic situation. On the basis of restructuring the course content, a Blended Learninging mode integrated with Flipped Classroom should be adopted to flexibly employ various instructional methods. This approach can effectively facilitate the seamless integration of online and offline learning and enhance students' learning achievements.

Fund project

1Undergraduate education and teaching reform research project of Yunnan province. The construction and promotion of first-class Blended Learning Course Construction Laws and Regulations based on the “Five Integration”.(JG2023176)

2Eminent teacher training project of Yunnan University

3Graduate core course construction project of Yunnan University.Cases in construction project management.

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