

## Research on the Flipped Classroom Design of "Construction Project Evaluation" Based on Bloom's Taxonomy

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**ABSTRACT:** "Construction Project Evaluation" is a subject that is biased towards practice and application. The current teaching methods are too mechanized, and there is not enough awareness of the students' main body status, and it is difficult to achieve the expected teaching effect. As an emerging teaching model, flipped classroom emphasizes the central position of students and reverses the teaching process, which is conducive to the promotion of personalized learning. The research is guided by Bloom's Taxonomy, and makes full use of the micro-class and network teaching platform to design the "Construction Project Evaluation" flipped classroom teaching mode, teaching objectives, teaching activities and assessment methods. And use textbook chapters to verify practice, which provides a useful reference for the implementation of flipped classroom.

**KEYWORDS** - Bloom's Taxonomy, Construction Project Evaluation, Flipped Classroom.

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### I. INTRODUCTION

With the rapid development of the Internet, information technology has been widely used in the field of education. The flipped classroom was born and is valued by universities in various countries. Flipped classroom reverses the two stages of knowledge transfer and knowledge internalization in traditional teaching. It is a new teaching mode that focuses on the internalization of knowledge, and completes difficult questions and answers, collaborative exploration, and interactive communication in class. Flipped classroom frees students from the study confinement of pursuing academic qualifications. It provides a useful reference for the implementation of the concept of quality education in Chinese universities(Liu Jianzhi, 2014). "Construction Investment Project" is a highly professional and technical subject. This course not only requires mastery of theoretical knowledge, but also proficiency in mathematical calculation and evaluation report writing. In the traditional classroom model, the transmission of pure theoretical knowledge by teachers makes it easy for students to lack emotional input in learning. Therefore, the learning dimension only stays at the short-term conceptual memory level, and cannot realize the internalization of knowledge, and the final teaching effect is not satisfactory(Liu Jianzhi, 2014). Flipped classroom optimizes the traditional classroom teaching process and helps to make up for the current "Construction Project Evaluation" course teaching practice guidance. This is of great benefit to enhancing the breadth and depth of learning. This research combines the classic education theory-Bloom's theory of education goals classification. In order to provide references for curriculum teaching practice, the research mainly discusses the "Construction Project Evaluation" flipped classroom teaching design, teaching objectives, teaching content, and assessment methods.

### II. CURRENT PROBLEMS

The "Construction Project Evaluation" classroom mainly adopts the traditional teaching model of "teacher speaking, students listening", and the amount of practical teaching is insufficient. As a result, students' initiative and enthusiasm are greatly reduced, and students cannot really use construction project assessment knowledge to guide practical work in the future. At present, there are mainly the following problems in the teaching process of "Construction Project Evaluation":

#### 2.1 Single Course Teaching Method

Curriculum teaching is limited to the passive teaching mode of "teacher-centered, classroom-centered, and knowledge-centered". In class, teachers mainly explain theoretical knowledge and ignore students' understanding of knowledge. After class, there is little interaction between teachers and students, and practical guidance is difficult to carry out. The knowledge units of "Construction Project Appraisal" are systematic, interrelated and inseparable, especially the parts of investment estimation and fund raising, financial and economic benefit analysis, and uncertainty analysis. The teacher's single theoretical explanation, lack of case teaching and practical teaching, cannot allow students to form a systematic knowledge framework.

#### 2.2 Curriculum Teaching Resources are Fixed and Lagging

The "Fixed" of teaching resources is mainly manifested in PPT teaching. Teachers mainly use PPT to assist teaching in the classroom. PPT mainly refers to the chapter order and content of the textbook to complete the design and production. In addition, the main energy of teachers is not teaching, and the content of PPT is rarely updated later. "Lagging" is manifested in the slow update of course materials and difficulty in keeping up with the development of the project evaluation industry. The current teaching materials adopt the parameters of 2006 my country Development and Reform Commission as a whole. The project evaluation course parameters need to be adjusted continuously with the development of different industries, such as the CIF price and the sensitivity calculation method of variable factors.

### 2.3 The Course Assessment Method is too Simple

Most of the course assessments focus on the learning process and the learning results. The final closed papers are used for assessment and scoring, while the group assessment report is only an auxiliary assessment method. Students usually don't listen carefully, and the teacher is asked to focus on the key points before the exam and stay up late to prepare for the exam. The assessment results are not for reference. On the other hand, small groups of workers can not complete the evaluation report in a systematic and complete evaluation report, and the division of labor is prone to be unreasonable, causing group members to free ride, which has little effect on the cultivation of students' practical ability.

### 2.4 Blurred Learning Objectives of Students

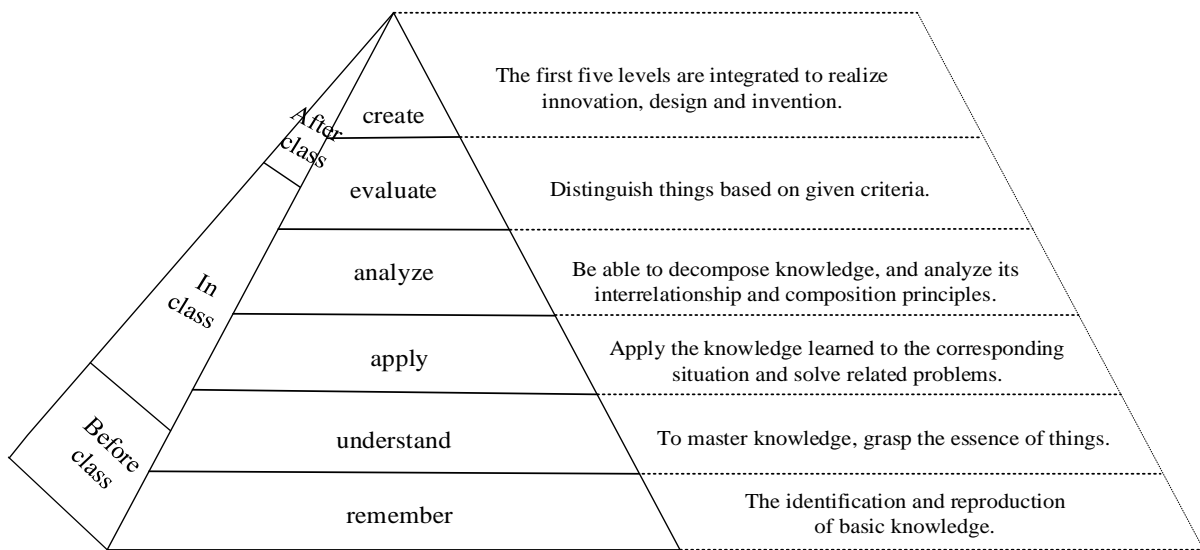
Students have a simple understanding and understanding of construction project evaluation. For example, they do not understand the role of the course and the professional quality requirements of the project evaluation industry. As a result, students have poor self-discipline in the course of learning, even playing mobile phones and sleeping, unable to grasp the key points of the course, and cannot absorb 100% of the theoretical knowledge taught by the teacher. They are even more perfunctory about group tasks. After the course is over, they still have a little knowledge of project feasibility studies and evaluations.

## **III. INSTRUCTIONL DESIGN**

### 3.1 Teaching Mode

The early classification of Bloom' s Taxonomy includes three parts: cognitive domain, motor skill domain, and affective domain. Among them, the target classification theory in the cognitive domain is the most widely used. After the reform and development of Anderson, Krathwohl and others, the knowledge dimension was incorporated into the cognitive process of knowledge. The cognitive process covers six levels from low to high: "memory, understanding, application, analysis, evaluation, and creation". The knowledge dimension is divided into four dimensions: "factual knowledge, conceptual knowledge, procedural knowledge, and meta cognitive knowledge" (Aly Amer, 2017). Traditional teaching is limited to a single teaching mode that imparts pure theoretical knowledge. Since the application of knowledge is mainly carried out by students after class, this mode can only achieve the low-level goals of "memory and understanding", but it is difficult to achieve high-level goals.

Bloom' s Taxonomy is applied to the flipped classroom, and low-level goals can be "flipped" before class, and the memory and understanding of knowledge concepts can be realized with the help of teaching resources such as micro-classes. In the classroom, teachers guide students to conduct comprehensive analysis and problem-solving inquiry activities based on students' understanding of existing knowledge. This teaching mode promotes students' in-depth understanding of teaching content, and forges the top thinking and creative ability of educational goal theory. The teaching mode is shown in Figure 1.



**Figure1. Flipped Classroom Teaching Model Based on Bloom's Taxonomy of Educational Objectives**

### 3.2 Teaching Objectives

According to Bloom's Taxonomy, this study summarizes the six levels of teaching objectives of the "Construction Project Evaluation" course, as shown in Table 1.

**Table 1. "Construction Project Evaluation" Course Teaching Objectives**

Stage	Target level	Teaching Objectives
After class	Create	Summarize whether it is reasonable to analyze the economic benefits, social benefits, and national economic benefits of the project, and whether there are any points worthy of improvement.
	Evaluate	In view of the existing problems, comprehensively master the information and knowledge, and propose the best solution.
In class	Analyze	In the analysis of investment decision-making, it can basically summarize the project's profitability, solvency, anti-risk ability and existing problems.
	Apply	Use Excel to fill in auxiliary statements and cash flow statements, calculate financial indicators, and write evaluation reports.
Before lass	Understand	Distinguish feasibility study and project evaluation, retell the main content of project evaluation, compare dynamic indicators and static indicators.
	Remember	Understand the principles, basis, procedures, content and methods of construction project evaluation.

### 3.3 Teaching Activities

"Construction Project Evaluation" flipped classroom teaching activities are mainly for pre-class micro-class design preparation, classroom discussion and inquiry activities, and after-class practical operations.

#### 3.3.1 Design Preparation for Micro-classes

The simple application of micro-classes in teaching is not equivalent to the practice of flipped classrooms. Only the advancement of knowledge transfer and the real realization of knowledge internalization can realize the connotation of flipped classrooms (Zhu Zhiting, 2015). The design of the micro-course should focus on the core teaching objectives of "Construction Project Evaluation" and provide students with personalized teaching resources. At the same time, it should have a certain degree of difficulty, which can arouse students' thinking and truly realize "learning first". The core teaching objectives of "Construction Project Evaluation" include: First, on the basis of project feasibility studies, master core knowledge points such as market demand, engineering technology, financial benefits, economic benefits and social benefits analysis. The second is to investigate, predict, and analyze the above core content based on relevant national policies, laws, regulations and method parameters. Carry out summative evaluation of the proposed project, and propose corresponding professional judgment ability training. Based on this, micro-classes can be divided into two content forms: basic knowledge points explanation and excel operation demonstration. The excel operation demonstration not only helps students build a knowledge framework, but also assists students to answer questions in practice after class. In addition, supplementary knowledge testing and questioning links urge students to learn independently and help teachers understand students' mastery of micro-classes so as to facilitate the development of classroom teaching activities.

### 3.3.2 Discussion and inquiry activities in class

#### (1) Micro-class Q&A and Case Consolidation

The teacher summarizes the students' weak knowledge points and lack of problem-solving skills based on the students' micro-class learning results, and answers questions one by one in the classroom. Attention should also be paid to situational case teaching. The case should collect authentic public events, and set up questions for the disputes of the case, guide students to link theory with practice, and consolidate basic knowledge.

#### (2) Skills Practice

Skills practice is the most important part of classroom inquiry, which can encourage students to study in depth and apply knowledge points comprehensively. The object of skill practice is a comprehensive case, in the form of a group, to discuss the writing of the report chapter content, Excel operation, calculation of financial indicators, etc. In order to prevent the homogeneity of evaluation results among the groups, each group selects different cases for evaluation. In the process of skill practice, teachers play a key role in guiding, which affects the effectiveness of skill practice, so teachers should not relax in this link.

#### (3) Works Display and Evaluation

Through the division of labor and collaboration, discussion and exploration of the group, students should submit corresponding evaluation works, and send representatives to display the works, group self-evaluation, mutual evaluation, and teacher evaluation. Teachers should summarize the problems that still exist in each group, propose improved methods, help students understand knowledge, and lay a solid foundation for practical operations after class.

### 3.3.3 Practice Operation and Expansion after Class

The skill exercises in the classroom are pertinent, and the students' thinking ability is still at the top. It is still necessary to fully grasp the knowledge points and realize the creation of knowledge with the help of practical operations after class. Skills exercises in class work in small groups, which may cause members to free ride, so students try to choose different proposed projects in the practice after class to prevent project evaluation reports from being highly similar.

### 3.4 Assessment Method

Traditional course assessment focuses on learning results, ignoring the course of class hours, and has a single assessment method. The flipped classroom training students' independent learning ability, problem-solving ability and innovation ability requires a multi-dimensional evaluation system to assess students' learning performance. The main body of the assessment is student self-evaluation, group mutual evaluation, and teacher general evaluation, as shown in Table 2. The content of the assessment is micro-class (20%), classroom (30%), and personal results after class (50%). Students conduct self-evaluation on the learning effect of micro-classes and individual project evaluation reports. The group conducts mutual evaluation on the exchanges in the classroom and the results of the group. In the whole teaching process, the teacher makes an overall evaluation of the students' knowledge mastery, classroom activity, achievement display, and problem-solving ability performance, and at the same time summarizes classroom teaching experience.

**Table 2. Evaluation Form**

Stage	Student	Teacher	Platform	Percentage of Assessment
Micro Lesson	Online Test Statement of Problem Personal speech	Post teaching tasks Summarize knowledge points Solve the problem	Network Teaching Platform	20%
Classroom	Group discussion Group results	Boot problem Outcome evaluation	Offline Classroom	30%
After Class	Communication After Class	Solve the Problem	Network Teaching Platform	50%

## IV. TEACHING PRACTICE

Bloom's Revised Taxonomy, in which knowledge dimensions are incorporated into the cognitive process of learning, is widely used in teaching goals, arranging teaching content and activities, and evaluating student performance (Huang Tao, 2009). The author combines the knowledge dimension to carry out the "Construction Project Evaluation" teaching on the cognitive process survey table, taking the seventh chapter of the textbook "Project Financial Analysis and Evaluation" as an example. The premise of teaching is that students have completed the learning content of the first seven chapters of the textbook. The teaching environment is the school network covering the entire campus. Students can interact and communicate with teachers at any time on the online education platform via mobile phones.

#### 4.1 Unit Teaching Objectives

Familiar with and understand the content of financial benefit estimation, basic procedures, and basic data of financial analysis, master the preparation of financial statements such as financial cash flow statement, profit and profit distribution statement, loan debt service statement, and balance sheet. Basically grasp the calculation of financial indicators, the analysis of project profitability, debt repayment ability, and anti-risk ability, and be familiar with the preparation of financial evaluation reports.

#### 4.2 Unit Teaching Objectives

##### (1) Micro-class Teaching Goals

Goal 1: Understand the concepts, principles, content and procedures of financial benefits and cost estimation;

Goal 2: Familiarize with the total cost, operating income, tax profit and profit distribution, the composition of loan repayment and the estimation method;

Goal 3: Understand the concept, meaning, goal, content and steps of financial analysis;

Goal 4: Understand the principles of basic financial analysis data and parameter selection such as financial prices, taxes, interest rates, exchange rates, project calculation periods, production loads, and financial benchmark yields;

Goal 5: Understand the concepts, classification and calculation methods of financial indicators;

Goal 6: Be familiar with the content and preparation sequence of financial statements.

##### (2) Micro-class Teaching Activity Design

The micro-course focuses on making students familiar with the basic content of financial analysis, calculation methods, and financial statement preparation methods. The micro lesson video in this unit is a 15-minute micro video aimed at goals 2, 5 and 6. In order to facilitate students' memory and understanding, the video is mainly based on Excel operations, introducing the connection between basic statements and auxiliary statements, financial statements corresponding to financial indicators, and basic function algorithms, as shown in Table 3.

**Table 3. Investigation of Cognitive Process in Micro-class**

The Knowledge Dimension	Cognitive Process					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	Goal 1					
Conceptual Knowledge	Goal 3、 5					
Procedural Knowledge		Goal 2、 4、 6 Teaching activities: online test				
Metacognitive Knowledge						

#### 4.3 Classroom teaching design

##### (1) Classroom Teaching Goals

Goal 1: Understand the concepts of operating costs, fixed costs, and variable costs;

Goal 2: Comprehensively use statements to estimate all financial income and expenditures, including total costs and expenses, operating income and tax surcharges, profit and profit distribution, and loan repayment;

Goal 3: Correctly distinguish between financial analysis before financing and financial analysis after financing, static indicators and dynamic indicators.

Goal 4: Skillfully fill in the financial cash flow statement, profit and profit distribution statement, loan repayment statement, balance sheet, and calculate financial indicators;

Goal 5: Use financial indicators for financial analysis to evaluate the project's profitability, solvency, and risk resistance.

Goal 6: Write financial analysis report.

##### (2) Design of Classroom Teaching Activities

Activity 1: Summarize the online test results of the students' micro-classes, and explain the knowledge points involved in the questions raised by the students in depth;

Activity 2: Supplement of in-depth knowledge;

Activity 3: Comprehensive case discussion, each team member selects different cases, uses Excel to fill in auxiliary reports, calculates the project's pre-tax and after-tax capital internal rate of return, project investment recovery period, net present value asset-liability ratio, and interest reserve ratio, Financial indicators such as the break-even point of debt service provision ratio;



Activity 4: Group report filling, indicator calculation, financial analysis report and other results display. The speaker of each group needs to report the basic ideas of case financial analysis, the difficulties encountered and unresolved problems, the advantages and disadvantages of the group result;

Activity 5: Group mutual evaluation, teacher general evaluation.

**Table 4. Investigation of Cognitive Process in Class**

The Knowledge Dimension	Cognitive Process					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge	Goal 1 Activity 1					
Conceptual Knowledge		Goal 3 Activity 2				
Procedural Knowledge		Goal 2 Activity 3	Goal 4 Activity 3	Goal 5 Activity 3		
Metacognitive Knowledge					Goal 6 Activity 4、 5	

#### 4.4 After Class Expansion and Improvement

In the process of personal case financial analysis after class, students asked the question "Why is the sum of assets is not equal to the sum of liabilities and owners' equity in the balance sheet, how to adjust the table data correctly; how to choose better sensitive factors in the sensitivity analysis".

In this regard, the author has answered that the assets of the balance sheet are not equal to the sum of liabilities and owner's equity, which proves that the data in the previous table is filled in error. This requires the use of EXCEL operations, associating the tables, and checking each item of data, especially projects in progress, construction investment loans, working capital loans, capital and other easily confusing projects. The selection range of sensitive factors is the factors that have a large impact on the net present value, financial internal rate of return, investment payback period and other indicators, such as product price, sales volume, total cost and other factors. First calculate the sensitivity coefficient, and then select the corresponding factors using the principle of maximum sensitivity coefficient. Through the author's guidance, students finally complete the data adjustment of the balance sheet efficiently, ensuring the accuracy of subsequent asset-liability ratio accounting, and the selection of sensitive factors is also reasonable.

## V. CONCLUSION

The course of "Construction Project Evaluation" has a strong theoretical and practical nature. The traditional boring teaching model emphasizes the teaching of theoretical knowledge and lacks practical interaction, which leads to high learning-weariness of students and unable to enable students to effectively master course knowledge. And through the introduction of Bloom's Taxonomy, combined with micro-classes and flipped classrooms to design teaching goals and teaching activities, explore the design of new teaching models and put them into practice, and initially verify the effectiveness of this model. In the context of Internet education, the combination of flipped classrooms and micro-classes has further improved the information literacy requirements of teachers, especially the recording of micro-class videos. Teachers need to make full use of Internet resources to ensure the quality of teaching in flipped classrooms.

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