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Teaching Practice and Curriculum Reform of Housing Architecture Based on Knowledge Application Strengthening

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Abstract

"Housing Architecture" is a professional basic course for civil engineering, building environment and building electrical, etc. which is highly comprehensive and practical. In recent years, through the course assessment of students and the graduation design of Undergraduates who are working on building structure design, it is found that the teaching and learning effect of this course is not ideal. Students do not master enough knowledge about housing architecture and lack of application ability. Through the reform and innovation of teaching mode, practical learning and course assessment, optimize the teaching content and form, add the process of students' use of theoretical knowledge and apply it to practical assessment, improve students' learning initiative and effect, and promote students to master and apply knowledge in practice.

Keywords

Housing Architecture, Teaching Reform, Curriculum Practice, Knowledge Application

1. Introduction

In the past 20 years, with the increase of the number of students and the improvement of talent training requirements, the existing teaching resources and measures have been difficult to meet the teaching needs. For a long time in the past, students mainly studied theoretical knowledge at school, and rarely had the opportunity to stay at the production site or apply theory to practice. As the old saying goes, "Knowledge and action are one", from "knowing" to "action", back to "new knowledge", and then to "new action", goes back and forth. The effec-

tive combination of theory and practice is very beneficial to the improvement of students' comprehensive ability. "Action" is not only the application of the knowledge, but also the process of inspection and correction. It is a learning and teaching method of "review what has been learned and learn something new". Spady W.D. (Spady, 1994) proposed the Outcome-Based Education (OBE) concept in 1994, which is defined as "Clearly focusing and organizing the education system to ensure that students gain experience of substantial success in future life". In the OBE, educators must have a clear idea of the ability and level that students should achieve when they graduate, and then seek to design an appropriate education structure to ensure that students achieve these expected goals. Student output rather than textbooks or teacher experience has become the driving force for the operation of the education system, which is clearly in sharp contrast to the traditional content driven and input oriented education.

Civil engineering involves knowledge fields such as mechanics, machinery, materials, electricity, etc. In the course setting, the study of basic knowledge often accounts for a large proportion, while the courses to cultivate students' practical and innovative abilities account for a small proportion. And limited by some conditions, some practical courses are executed online, which is difficult to meet the requirements of students' ability improvement. The knowledge and ability of students after graduation are difficult to meet the employment needs. In recent years, diversified teaching models and assessment methods have been widely proposed, but the classroom teaching method of theoretical indoctrination is still widely used, with teachers as the leader of the classroom and students as the main body. The OBE concept has realized two major changes in teaching. The first is to change from "teacher centered" to "student centered". The second is to shift from "focus on disciplines" to "focus on expected results".

"Housing Architecture" is a professional basic course for civil engineering. It plays a very important role in the professional curriculum system. It is a highly comprehensive, applied and practical course (Wei & Wang, 2020; Liu, 2020). This course mainly describes the design guidelines of civil and industrial buildings, the construction requirements of each component and the identification of drawings (WANG, 2021), which provides important professional basic knowledge for the subsequent courses such as "Civil Engineering Drawing", "Building Engineering Construction", "Civil Engineering Materials", "Foundation Engineering", "Concrete Structure Design", etc. Especially in the undergraduate graduation project, for students who choose the building structural design, the knowledge of this course will greatly influence the rationality, standardization and scientificity of building structure design. Through the teaching and guiding graduation project in recent years, it is found that students do not have enough knowledge of the "Housing Architecture" course, the design of the building plane and facade is often unreasonable, and the drawing is not standardized, indicating that the teaching and learning effect of this course is not ideal.

Improving the classroom teaching quality and enhancing the learning effect of

students can lay a good foundation for the study of subsequent professional courses and provide useful guidance for graduation design students who are in the direction of architectural structure design. Through the theoretical knowledge learning and practical application of this course, students can develop the good habit of lifelong learning and practice in the face of complex and changeable construction structure in their future career. The teaching practice and curriculum reform of this course will make a beneficial exploration and stride forward in the long way of cultivating senior engineering and technical talents with engineering ability and innovation ability. The technical roadmap is shown in Figure 1.

2. Analysis of the Reasons for the Teaching and Learning Effect

2.1. Course Features

This course content is complicated, and knowledge points are fragmented. Students do not have a deep understanding of the architecture logic (Liang, 2020). 40 theoretical class hours for this course seems to be stretched, students are often trapped in messy and complicated knowledge points, separated from engineering practice, the learning effect is not ideal.

2.2. Classroom Teaching

Classroom teaching is mainly based on the combination of blackboard explanation and PPT presentation. Blackboard explanation is mainly the introduction, classification, and summary of knowledge points. In addition to knowledge points, the content of PPT presentation is mainly two-dimensional pictures and physical photos. The knowledge points are further elaborated in combination with the physical objects in the pictures to help students understand (Dang & Zhang, 2020). Using two-dimensional pictures to explain three-dimensional buildings requires students to have a considerable reserve of architectural theoretical knowledge and good spatial imagination, This is something that some students do not have, resulting in students' poor understanding and not ideal learning effect.

2.3. Practical Learning

Practical learning is the application of knowledge points in real life or engineering, which plays an important role in understanding and mastering the knowledge points of the course (Zhu, 2021). Limited to the consideration of course features, practical funds and on-site safety, especially the uncertainty of the current epidemic situation, it is quite difficult to carry out practical activities.

3. Teaching Reform Measures

3.1. Teaching Mode

The teaching content will rely on textbooks and shared resources of excellent

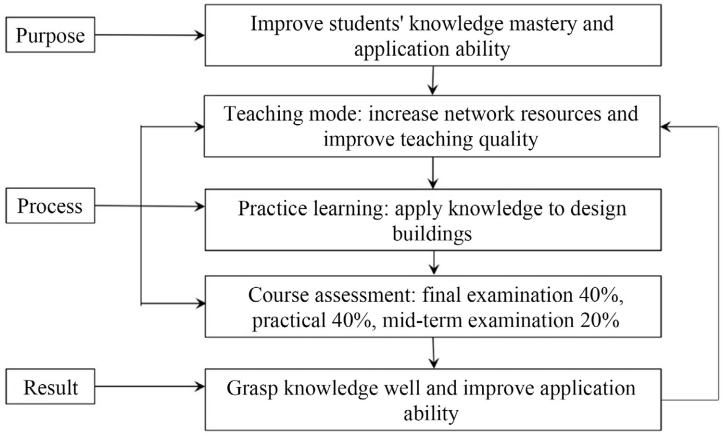

Figure 1. Technical roadmap.

courses. On the one hand, the network will be used to impart the micro class, MOOC and fragmented course knowledge to students; On the other hand, in the traditional classroom teaching, improve the teaching materials and teaching quality (Yang & Cui, 2021), leave part of class hours for students to make self-study and practice summary, and enhance the communication and interaction between teachers and students.

3.2. Practice Learning

The practice learning of the course should be divided into two parts: surveying, mapping reproduction of buildings and design. The professional analysis and evaluation of existing buildings are carried out on the basis of re engraving. The design of buildings is mainly based on relevant professional knowledge and pursues the rationality, standardization and scientificity of building design.

3.3. Course Assessment

The assessment of the course is mainly divided into two parts: final assessment and usual assessment. The final assessment accounts for 40%, which is carried out in the form of end-of-term examination. The examination content not only needs to examine students' memory of knowledge points, but also needs to focus on the flexible application of knowledge; The usual assessment is divided into two parts: practical work and mid-term examination, totaling 60%. The practical work is divided into three times, accounting for 40%. Two times are the replica analysis of existing buildings, accounting for 10% each time, and one time is the design of buildings, accounting for 20%; The mid-term examination is to assess students' learning situation at a certain stage, accounting for 20%. The purpose of the examination is to investigate the students' mastery and application ability of theoretical knowledge, understand the students' learning situation in multiple stages, and urge the students to make continuous progress.

4. Introduction to Preliminary Practical Learning

In the first semester of the 2022-2023 academic year, the author attempted to as-

sign three times practical learning in the form of assignments in the course of "Housing Architecture" for undergraduate civil engineering students in the class of 2019. All three times practical learning were mapping replicas of existing buildings and did not involve the design of new buildings.

Firstly, 65 students in the class were divided into 11 groups with 5 - 6 Students in each group. Each group selects a building on Yaoshan campus of Guilin University of Electronic technology. After the Chapter 2 (Architectural Plane Design), students were required to measure and investigate the buildings which they choose from the perspective of architectural graphic design according to professional knowledge. Three students draw the first floor plan, standard floor plan and top floor plan respectively. Two students write analysis reports, which are required to combine textbook knowledge and relevant codes, explain the rationality or inappropriateness of building plane design and layout. Based on the work of the above students, one student needs to produce a PPT presentation to report the work of the group. After the Chapter 4 (Building Geometry and Facade Design), the second assignment was arranged, that is required to draw the elevation of the selected building, write the analysis report and produce a PPT presentation. After the Chapter 12 (Deformation Joint Structure), the third assignment was arranged, that is required to draw the profile of the selected building, write the analysis report and produce a PPT presentation. Specific tasks for each student were identified and reported before submitting the results. Submit results in group order, and a specially student introduce the practice through PPT. Teacher was on-site comments, questions and scores. Many students' learning outcomes were admirable. Through the measurement of classroom, dormitory, corridor, staircase, wall column, etc., and taking into account the function , pedestrian flow, day lighting, ventilation and other factors of the building, students were analyzed the rationality of building design and able to support or oppose it using knowledge points from the textbook or provisions on the code. For example, whether the distance from the first row of tables to the blackboard meets the code requirements. Of course, some problems have also been found. Students relied more on the software to automatically generate the drawings, even without modifications. And there are many normative problems in the drawings, such as the drawing of grid lines, dimensioning, etc.

Compare the assessment results of housing architecture in two years, as shown in Table 1 and Table 2. In Table 1, it is found that the total score includes the final examination (70%) and the usual assessment (30%). The usual assessment is composed of three assignments. The final examination scores are ranged from 27 to 95, with a pass rate of 75.36%. 59.42% of the students scored in the range of 60 to 79, and 24.64% of the students failed the final examination. The rules of the total score are similar to those of the final examination score. In Table 2, it is found that the total score includes the final examination (50%), the usual assessment (30%) and the mid-term examination (20%). The usual assessment is composed of three times practical learning. The final examination

scores are ranged from 50.5 to 96, with a pass rate of 93.85%. 69.23% of the students scored in the range of 70 to 89, and only 6.15% of the students failed the final examination. The rules of the total score are similar to those of the final examination score.

In Figure 2 and Figure 3, it is found that the teaching effect and assessment results in the first semester of 2022-2023 academic year are significantly better than those in the first semester of 2021-2022 academic year, indicated that the adoption of new teaching practice and curriculum reform is conducive to improving students' ability to master and apply knowledge points.

This is a beneficial and effective attempt. In the process of building measurement and analysis, students have effectively applied their learning knowledge in practice and strengthened the learning effect. However, this is only the reproduction and evaluation of buildings. How to apply the learned knowledge in practice independently, such as building design, has not yet been realized in the practical learning. On this basis, the author will further improve the teaching practice and curriculum reform, introduce BIM technology into classroom

Table 1. Analysis report on the quality of course examination in the first semester of 2021-2022 academic year.

Candidates: 69; Tested: 66; Absentees: 3; Delayed: 0; Disqualified: 0.						
Total scores: final examination (70%); usual assessment (30%).						
Analysis of the distribution of assessment scores	Final examination scores: the maximum score: 95, the minimum score: 27, the passing rate: 75.36%.					
	Final examination scores	90 - 100	80 - 89	70 - 79	60 - 69	<60
	Students number	5	6	23	18	17
	%	7.25	8.70	33.33	26.09	24.64
	Total scores	90 - 100	80 - 89	70 - 79	60 - 69	<60
	Students number	5	14	31	10	9
	%	7.25	20.29	44.93	14.49	13.04

Table 2. Analysis report on the quality of course examination in the first semester of 2022-2023 academic year.

Candidates: 65; Tested: 65; Absentees: 0; Delayed: 0; Disqualified: 0.						
Total scores: final examination (50%); usual assessment (30%).						
Analysis of the distribution of assessment scores	Final examination scores: the maximum score: 96, the minimum score: 50.5, the passing rate: 93.85%.					
	Final examination scores	90 - 100	80 - 89	70 - 79	60 - 69	<60
	Students number	11	25	20	5	4
	%	16.92	38.46	30.77	7.69	6.15
	Total scores	90 - 100	80 - 89	70 - 79	60 - 69	<60
	Students number	2	39	19	5	0
	%	3.08	60.00	29.23	7.69	0

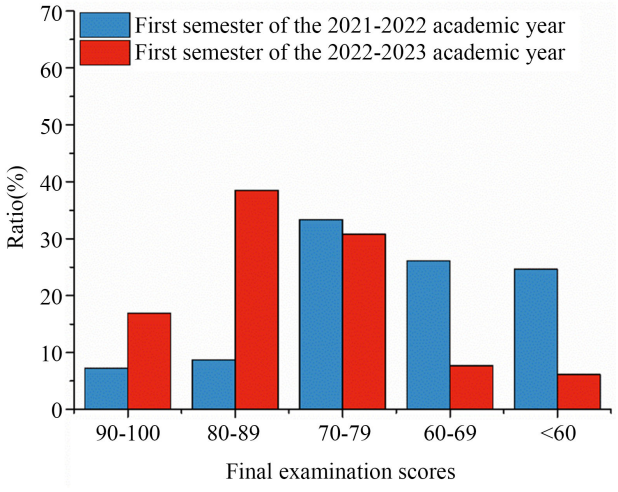

Figure 2. Comparison of final examination scores.

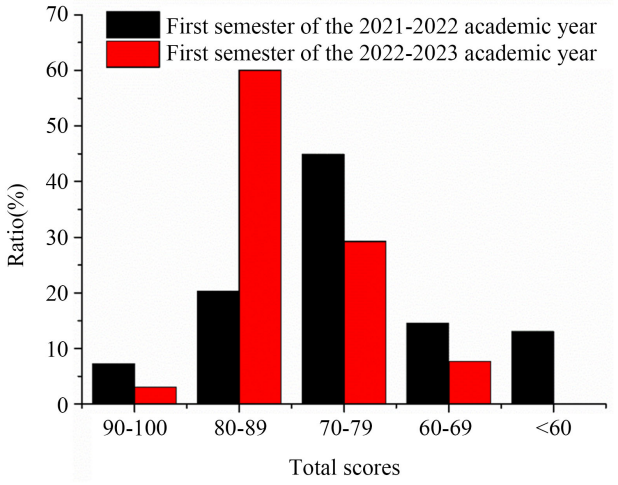

Figure 3. Comparison of total scores.

teaching, replace the original two-dimensional pictures with three-dimensional building models (Qi, Zhang, & Zhao, 2014; Liu & Shao, 2020), and appropriately add the content of innovative design in the original practical learning of building reproduction and analysis, so as to strengthen and improve the teaching effect of housing architecture in the application of knowledge. And students generally reflect that they have a good grasp of the course knowledge and can apply the knowledge.

5. Conclusion

"Housing Architecture" plays a fundamental role in the study of civil engineering and construction engineering. It is very important to improve the teaching effect and enhance students' ability to master and apply knowledge. It should be done: not limited to the textbook, make full use of the network, closely combine the new structures, new materials and new technologies of modern building design and construction, improve the teaching materials and spread the course

knowledge to students. In addition to classroom teaching, focus on students' learning and applying professional knowledge in practice, and carry out in the form of building surveying and mapping reproduction and innovative design. The course assessment is mainly divided into two parts: the final assessment and the usual assessment, of which the usual assessment accounts for 60%, encouraging students to pay attention to the process learning, and the practical assignment accounts for 40%, investigating students' application ability of theoretical knowledge and urging students to make continuous progress.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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