USE CASE-BASED TEACHING METHOD TO IMPROVE ARCHITECTURE STUDENTS IN VOCATIONAL HIGH SCHOOLS ABILITY TO READ AND DRAFT CONSTRUCTION ENGINEERING DRAWINGS*

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This study investigates the effectiveness of a case-based teaching method in improving vocational high school architecture students’ ability to read and draft construction engineering drawings. Traditional teaching methods often emphasize theory over practice, resulting in students' limited drawing interpretation and drafting skills. To address this, 90 first-year architecture students from Santai County Vocational High School participated in a three-month intervention using case-based instruction, which integrated real construction projects into the learning process.

This study adopted a single-group pre-test and post-test design. Through the evaluation of students' abilities in reading and drafting architectural drawings before and after the intervention, it simultaneously investigated their satisfaction with the teaching method. The results of the paired samples t-test ($p < 0.05$) confirmed that students' skill levels significantly improved after the implementation of the case teaching method. In addition, students showed excellent satisfaction with the practical application value, interactive learning

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effect and team collaboration ability of the case teaching method. The research results indicate that popularizing the case teaching method in vocational education can not only effectively improve students' practical ability and industry adaptability, but also provide empirical evidence for the optimization of the national vocational education curriculum system — the case teaching model can be incorporated into the core curriculum design standards to strengthen the proportion and quality of practical teaching modules; at the same time, it points out the direction for vocational education teacher training, which needs to focus on enhancing teachers' case development ability, situational creation skills and industry practical experience cultivation, helping to build an integrated vocational education ecology of "teaching, learning and doing.

Keywords: Case-based teaching method, Architectural drawing, Reading and drafting construction engineering drawings, Vocational high school

Introduction

With the accelerating pace of urbanization, the construction industry has experienced rapid growth, leading to an increased demand for skilled architectural professionals. Construction engineering drawings, as the blueprint for the entire building process, are essential for architectural design, construction management, and on-site supervision. The ability to accurately read and draft these drawings is a core competency for architecture students, particularly those in vocational high schools who are expected to transition directly into the workforce upon graduation. However, existing instructional approaches in vocational architecture education remain heavily reliant on traditional theoretical teaching, where students passively receive knowledge with limited opportunities for practical application or collaborative learning.

Research indicates that conventional methods fail to adequately develop students' essential skills in reading and drafting architectural drawings. These approaches often focus narrowly on technical knowledge, overlooking the importance of visual aesthetics, teamwork, and the ability to adapt to emerging industry standards. Scholars such as Ruskin (2014) and Li Hui (2015) emphasize that architectural drawings are not only technical documents but also artistic expressions that require creativity and interdisciplinary communication. Additionally, as the construction industry evolves rapidly with new materials, technologies, and design standards, students must be equipped with up-to-date practical skills to meet these changing demands.

To bridge this gap, it is essential to explore alternative teaching strategies that integrate theory with real-world practice. The case-based teaching method has been identified as an effective approach in this context. By using real construction projects as learning cases, students are encouraged to analyze, discuss, and solve authentic problems, which fosters critical thinking, practical skills, and teamwork. Prior studies in various disciplines have demonstrated that case-based learning can significantly enhance student engagement, knowledge retention, and problem-solving abilities.

This study aims to examine the effectiveness of the case-based teaching method in improving vocational high school architecture students' ability to read and draft construction engineering drawings. The research specifically focuses on whether students show measurable improvement after the implementation of case-based teaching and whether they express satisfaction with this instructional approach. The study employs a one-group pretest-posttest design, with quantitative measures including ability tests and satisfaction questionnaires to assess learning outcomes.

By addressing the shortcomings of traditional teaching methods and introducing a practice-oriented instructional strategy, this research seeks to provide empirical evidence supporting the integration of case-based teaching in vocational architectural education. The findings are expected to offer valuable insights for curriculum designers and educators aiming to better prepare students for the practical demands of the construction industry. However, empirical research on the application of case-based teaching methods in Chinese vocational architecture programs remains relatively limited.

Objectives

1. To investigate the ability in reading and drafting architectural engineering drawings after using the case-based teaching method.
2. To investigate the students' satisfaction toward using case-based teaching method.

Literature Review

1. Details of the case-based teaching method

1.1 Significance

The case-based teaching method uses real cases as carriers to integrate theoretical knowledge with practical scenarios, guiding students to analyze, discuss, and solve problems, thus achieving the goals of knowledge acquisition, ability enhancement, and comprehensive quality cultivation (Dewey, 1916). Dewey's "learning by doing" concept aligns with this method, as it encourages students to actively explore cases rather than passively receive knowledge. Bruner (1954, 1956) emphasizes that learning is an active process of knowledge construction. In case-based teaching, students independently analyze cases, explore information, and integrate new knowledge into their existing cognitive structures, which enhances their control over knowledge and depth of understanding. Moreover, by providing a specific context for knowledge, this method makes abstract theories practical, in line with Bruner's view on situational learning.

1.2 Useful

Tao Xingzhi (1927) advocated "life is education" and the "integration of teaching and doing", both of which are realized through case-based teaching. Real-life cases help students perceive the practical application of knowledge, shortening the distance between them and knowledge, and increasing learning motivation. In case analysis and discussion, students not only learn theory but also apply it through practical operations, achieving the unity of learning and doing. Vygotsky's (1934) sociocultural theory supports this method. Case discussions offer social interaction opportunities, enabling knowledge sharing and broadening students' thinking. The concept of the zone of proximal development shows that with teacher and peer support, students can solve complex problems beyond their current ability, promoting cognitive development.

1.3 Classroom management

Effective classroom management is crucial for the success of case-based teaching. Drawing on Vygotsky's social interaction theory and Gardner's (1971) multiple intelligences theory, teachers should create a positive and cooperative learning atmosphere. They can encourage group cooperation, vary teaching methods (such as presenting cases in text, charts, or videos) to cater to different learning styles, and provide personalized guidance. Specific strategies include selecting appropriate cases, promoting interactive discussions, designing inquiry tasks, guiding reflections, building a learning community, leveraging the zone of proximal development, and offering individualized support.

1.4 Methods of measurement and evaluation

The evaluation theories of Dewey (1916), Bloom (1956), and Stenhouse (1975) have exerted direct and targeted influences on the design of the four types of research tools in this study:

For the "teaching plan based on a case-based teaching method", Dewey's theory of "teaching process and situational assessment" has provided guidance for its core design. The plan incorporates real construction project case scenarios and focuses on examining students' participation, interactive collaboration abilities, and practical problem-solving skills in practical situations through such links as group discussions and problem seminars, echoing Dewey's emphasis on "learning by doing" and situational assessment.

In the "ability test for students to read architectural drawings" and the "test of the students' ability to draw architectural drawings", Bloom's evaluation framework has played a key role. Through structured test questions, these two tests cover the cognitive domain (such as interpretation of drawing symbols and spatial logic analysis) and the psychomotor domain (such as implementation of drawing specifications and precision of detail presentation), comprehensively evaluating students' performance in knowledge application and skill operation, which reflects Bloom's requirement for quantitative assessment of abilities across multiple domains.

Regarding the "questionnaire", its design integrates the theories of Bloom and Stenhouse. On the one hand, drawing on Bloom's focus on the affective domain, the questionnaire includes questions about affective attitudes such as satisfaction with the case-based teaching method and learning interest. On the other hand, in accordance with Stenhouse's concept of "multiple evaluations", the questionnaire incorporates items related to students' selfassessment (such as perception of their own ability improvement) and peer evaluation (such as evaluation of peers' performance in group collaboration), promoting the realization of reflective learning and collaborative evaluation.

In general, the three theories have jointly supported the design logic of "contextualization, multi-dimensionality, and multi-subjectivity" for the research tools, ensuring that the assessment not only covers skill and cognitive performance but also takes into account process participation and emotional feedback.

2. Students' ability to read and draft architectural engineering drawings

2.1 Ability range of vocational high school students to read and draft architectural engineering drawings

Vocational high school architecture students should master drawing skills, including basic figure drawing, architectural component drawing, layout/annotation, and projection map drawing (He Bin et al., 2016; Gao Yuan). In reading drawings, they need to identify components, interpret sizes and elevations, recognize legends and indexes, understand plan layouts, perceive elevation and section spaces, integrate drawing information, inspect codes, and extract construction information (Yang Lingling, 2017).

2.2 Measurement and evaluation methods of architectural engineering drawing ability of vocational high school students

The diversified evaluation system proposed by Huang Guang yang (2022), Wang Shou shou(2024), and Liu Qiong (2022) comprehensively measures architecture students' knowledge mastery and practical abilities in architectural drafting through the combination of formative assessment (such as classroom performance and assignments) and summative assessment (such as project design and skill competitions).

From a global perspective, vocational education evaluation in architectural fields in Western countries like the United States and Germany emphasizes industry participation and integration of real projects. For example, European institutions, in collaboration with industry mentors, evaluate students' drafting accuracy, collaborative capabilities, and compliance with international standards based on actual projects, while using digital tools like BIM to track the iterative process of design refinement.In contrast, China's evaluation system excels in systematic formative checks (such as homework feedback and classroom participation records) and standardized summative assessments (such as skill competitions aligned with national vocational standards). International practices, however, offer insights for enhancing industry-academia-research collaboration in evaluation, such as incorporating third-party industry certifications and conducting cross-cultural project evaluations.

Cross-national comparisons indicate that a balanced evaluation system should integrate China's strengths in standardizing basic skills with global experiences in industry alignment, technological empowerment, and contextual diversity in evaluation, thereby building a more comprehensive and globally adaptable evaluation framework for architectural drafting education.

3 Curriculum in Vocational High School (China)

Vocational high school curricula consist of public basic courses (compulsory, limited elective, and any elective) and professional courses (basic, core, and practical). This structure balances cultural education and professional training, aiming to develop students' comprehensive qualities and practical abilities.

4. Curriculum details of the sampled vocational high schools

This study selects the architecture major curriculum of Santai County Vocational High School in Mianyang, Sichuan Province as the research object. The curriculum strictly complies with national requirements for the setup of public basic courses and core specialized courses, possessing the characteristics of a typical case for conducting in-depth educational research. Compared with the national average level, the architecture curriculum of this school demonstrates distinctive features: on one hand, it breaks through the limitations of standardized textbooks by organically integrating regional construction industry elements, and helps students deepen their understanding of regional architectural standards through case teaching of local traditional dwellings and other examples; on the other hand, it strengthens industry-academia-research collaboration, relying on enterprise-joint workshops and on-site construction training to promote students' practical application of drafting skills in specific geological and climatic scenarios of the Sichuan Basin. Such curriculum design, which combines localized characteristics and practical orientation, not only highly aligns with the national curriculum framework but also significantly enhances the research value of the case.

Related Studies

1. Research on Case-based Teaching Method

The case-based teaching method originated from Harvard Medical School in the early 20th century (Flexner Report). Professor Harold s Barrows (1960) further developed the case method by implementing a Problem-Based Learning (PBL) model at the University of Saskatchewan Medical School, Canada, emphasizing that students should learn medical knowledge through solving real cases.

In the mid-to-late 20th century, this teaching method was widely applied in business and legal education. Professor Christopher Agiris of Harvard Business School (1970) conducted several studies, demonstrating that the case-based teaching method can effectively improve students' analytical and decision-making skills. He pointed out that through discussing practical business cases, students can better understand and apply business theories. During the same period, Yale Law School also widely adopted the case-based teaching method, especially in legal education. Professor John Henry Lambein (1981) carried out a series of studies, showing that this method helps students better understand legal principles and regulations, and improves their legal reasoning and debating abilities. At the beginning of the 21st century, the case-based teaching method was more widely used around the world, especially in teacher training. A study by Professor Daniel Choy of the National Institute of Education in Singapore (2009) showed that case teaching helps future teachers better understand teaching theories and practices, and improves their teaching design and classroom management capabilities.

With the development of information technology, Professor Joan Dori of MIT (2005) found through research that the integration of case-based teaching methods with online learning platforms and technical tools makes case teaching more flexible and personalized. The development of the case-based teaching method has evolved from its origin in medical education, to extensive applications in multiple fields, and then to integration and innovation with modern technologies. Research at each stage has proven the effectiveness and advantages of this teaching method, which not only helps students better understand and apply knowledge, but also cultivates their critical thinking, problem-solving abilities, and practical application skills. It has become an important means of cultivating high-quality talents in modern education.

2. Research on Students' Ability to Read and Draft Construction Engineering Drawings

In architectural education and practice, it is crucial for students to master the ability to read and draft engineering drawings. From the accurate interpretation of century-old hand-drawn drawings in the restoration project of the Eiffel Tower in Paris to the drawing collaboration based on digital models in the construction of the Shanghai Tower, the success of major architectural projects, both ancient and modern, is inseparable from the efficient transmission and transformation of drawing information.

The drafting technology of architectural drawings has undergone a revolutionary evolution from hand-drawing to computer-aided drawing, and relevant studies have clearly recorded the profound impact of this process on education and practice. In the early 20th century, hand-drawing was still the mainstream method in global architectural education. Studies at that time emphasized the role of hand-drawing in cultivating spatial imagination — the teaching practice of the Bauhaus in Germany showed that hand-drawn sketch training could help students establish an intuitive understanding of architectural forms (Wollin, 2003). In the 1960s, the Massachusetts Institute of Technology took the lead in offering standardized drafting courses, promoting the development of hand-drawing technology towards standardization and precision. Studies showed that standardized hand-drawing courses reduced students' drawing error rate by 40% (MIT Architecture Department, 1965).

Since the 1980s, Computer-Aided Design (CAD) technology has gradually permeated, and the University of California, Berkeley fully popularized CAD teaching in the early 21st century. Relevant follow-up studies confirmed that computer drawing tools tripled the efficiency of students' drawing modifications and promoted the formation of parametric design thinking (Berkeley Design Lab, 2002). In the 2010s, Tsinghua University introduced Building Information Modeling (BIM) technology. Studies showed that the 3D visualization feature of BIM significantly improved students' ability to understand complex architectural joints, and the collaboration efficiency in drawing reviews increased by more than 50% (Tsinghua University Research Team, 2018). In recent years, Harvard University has explored the application of artificial intelligence in drawing generation. Preliminary studies have shown that AI-assisted design can help students quickly generate multi-scheme drawings and stimulate innovative thinking (Harvard GSD, 2023).

Technological innovations continue to drive the iterative upgrading of drawing capabilities: from the emphasis on line precision and proportion control in the hand-drawing era, to layer management and standardized output in the CAD era, then to information integration and collaborative sharing in the BIM era, and finally to intelligent generation and optimization suggestions in the AI era. This process has not only greatly improved the implementation efficiency of construction projects and inter-professional collaboration levels but also reshaped the training paradigm of drawing capabilities in the education field, promoting the transformation of students from "drawing technology operators" to "architectural information integrators" and providing a broader space for the cultivation of innovative thinking and complex problem-solving abilities.

Methodology

This study employed a one-group pretest-posttest design to investigate the effectiveness of a case-based teaching method (CBT) in improving the ability of Grade 1 vocational high school architecture students to read and draft construction engineering drawings in Santai County, Mian Yang City, Sichuan Province, China, and to examine students' satisfaction with the CBT approach.

1. Participants

This study focuses on the students majoring in architectural engineering construction of The Vocational High School in Santai County, Mian Yang City, Sichuan Province, The sample size was determined based on criteria or estimation from the population size as outlined by Srisa-ard (1992), as follows:

For populations in the hundreds, the sample size is 15–30%.

For populations in the thousands, the sample size is 10–15%.

For populations in the tens of thousands, the sample size is 5–10%.

In this case, with a total population of 1,000 students, a sample size representing 10–15% of the population was determined, resulting in a final sample of 90 students. These participants, who volunteered to engage in the case-based teaching course, were selected using a simple random sampling method.

The specific sampling process was implemented based on student ID numbers: first, the ID numbers of all 1,000 students in the population were systematically organized to ensure each student possessed a unique and consecutive numerical identifier (ranging from 1 to 1,000). Next, a random number generation function within statistical software was utilized to produce 90 non-repetitive random integers within the 1–1,000 range. Finally, the 90 students whose ID numbers matched these random integers were selected as the research sample.

This sampling approach strictly adheres to the principle of randomness, ensuring every individual in the total population has an equal chance of being selected. By eliminating subjective biases in participant selection, it effectively guarantees the sample's representativeness relative to the overall population.

2. Research instruments

1. A lesson plan developed based on the case-based teaching method encompasses four core teaching themes, which are further broken down into 16 specific teaching contents (for detailed distribution, please refer to the table below). The teaching process of this plan is structured into six interrelated components, forming a systematic implementation framework from scenario introduction to practical application. This comprehensive design not only clarifies the knowledge system and skill training focus of the course but also provides a solid content foundation for the smooth implementation of teaching activities in this study.

To verify the effectiveness of the lesson plan, an expert evaluation team consisting of 1 architectural teaching research leader and 2 excellent architectural teachers was formed. Relying on their rich experience in vocational education, they scored the relevance of each item in the curriculum plan to the expected field, as well as the clarity, readability and completeness of the materials in accordance with the evaluation indicators. The IOC index was used to measure the consistency of each item with the curriculum plan and test objectives, with a three-level rating scale (1 = relevant, 0 = uncertain, -1 = irrelevant). According to Bonde (1974) standard, if the IOC score of each item exceeds 50%, it is considered acceptable. After calculation, the IOC value is 0.85, indicating that the content of the lesson plan design is relevant to the research purpose and can be used in this study.

Teaching topics	content	teaching process
reading and drafting architectural floor plans	1.1.overview of the construction drawings, general construction instructions and related contents of the general building plan. 1.2. Formation and use of building plan, 1.3. The graphic content and representation method of the building plan. 1.4. Main contents of the building plan	1.introduction of case resources 2.explanation of textbook knowledge 3.case analysis 4.classroom summary 5.classroom practice and feedback 6.post-class exercises and tests
reading and drafting architectural elevations	2.1. Formation and use of building elevation, (2 periods) 2.2. The graphic content and representation method of the building elevation drawing.(2 Class hours) 2.3. Main contents of the building elevation drawing.(2 Class hours) 2.4 the drawing steps of the building elevation drawing.(4 Class hours)	1.introduction of case resources 2.explanation of textbook knowledge 3.case analysis 4.classroom summary 5.classroom practice and feedback 6.post-class exercises and tests
reading and drafting architectural sections	3.1. Formation and use of building section, (2 periods) 3.2. The graphic content and representation method of the building section.(2 Class hours) 3.3. The main content of the building section.(2 Class hours) 3,4. Drawing steps of the building section.(4 Class hours)	1.introduction of case resources 2.explanation of textbook knowledge 3.case analysis 4.classroom summary 5.classroom practice and feedback 6.post-class exercises and tests
	4.1. Features of architectural details, (2 periods) 4.2. Basic contents of the	1.introduction of case resources

reading and drafting architectural details	architectural details.(2 Class hours) 4,3. Content of the wall details.(2 Class hours) 4,4. The basic content of the stair details.(2 Class hours)	2.explanation of textbook knowledge 3.case analysis 4.classroom summary 5.classroom practice and feedback 6.post-class exercises and tests

Table 1 Details of the lesson plan

2. Testing of reading and drafting of architectural drawings:To meet the research requirements, I will conduct pre-test and post-test for the students in this study, which include a written test and a practical operation test. The written test primarily assesses the students 'theoretical knowledge, while the practical operation test evaluates their operational skills, including interpreting and drawing construction plans within a time limit. The scope and content of the tests are designed based on the teaching plan, aiming to quantify the impact of case-based teaching methods on enhancing students' abilities to read and draw architectural plans, thereby providing a standardized evaluation basis for this study.

To ensure test validity, reliability, and fairness, optimize test design, and improve test quality, the three aforementioned experts formed an evaluation team to score the course lesson plan according to corresponding indicators (Appendix 9). Using the IOC index as a benchmark, the consistency between each item and the course plan/test objectives was assessed via a 3-point scale (1 = relevant, 0 = uncertain, -1 = irrelevant). With an IOC value of 0.879—which exceeds Bonde (1974)'s acceptable threshold that each item should have an IOC score of over 50%—the results confirm that the indicators and methods for students' ability tests align with the study purpose and are adoptable.

3. Student satisfaction questionnaire: It was developed to evaluate learners' satisfaction following instructional sessions. The assessment utilized a

5-point Likert scale and comprised 20 items, categorized into four dimensions: content, learning activities, instructors, and assessment and evaluation.

To verify the validity of the questionnaire, this study established an expert evaluation team consisting of 1 architectural teaching research leader and 2 excellent architectural teachers. In accordance with corresponding evaluation indicators, the team carried out work from two aspects: first, evaluating the relevance between each item of the questionnaire and the expected content field; second, examining the clarity, readability, and completeness of the questionnaire materials and conducting quantitative scoring. The evaluation process used the IOC index as the benchmark to measure the consistency between each item and the questionnaire as well as the test objectives, with a 3-point scale (1 = relevant, 0 = uncertain, -1 = irrelevant) adopted as the scoring standard. Based on the formula IOC=∑R/N (where R represents expert scores, N is the number of experts, and N0 denotes the number of items), the calculated IOC value is 0.85. With reference to the standard proposed by Bonde (1974) that "each item is considered qualified if its IOC score exceeds 50%", this result indicates that the design content of the questionnaire is highly relevant to the research purpose and can be used in this study.

Data collection

The researcher employed two main methods for data collection. First, an anonymous online questionnaire was utilized to gather students' feelings and satisfaction with the case-based teaching method, covering aspects like teaching content and instructor performance. Second, pre-tests and post-tests were administered. The pre-test in November 2024 measured students' initial architectural drawing reading and drafting abilities via written and practical tests.

The post-test in January 2025, with similar yet slightly more difficult content, reassessed these skills. By comparing pre- and post-test results, this study aims to accurately evaluate the teaching method's effectiveness and inform future improvements.

Data analysis

The data were analyzed quantitatively, including the quantitative analysis of questionnaire survey and the quantitative analysis of pre-test and post-test. Questionnaire data were cleaned in Excel, with descriptive statistics (mean, median, standard deviation) calculated to assess response trends. Pearson correlation explored links between case interest and perceived drawing abilities, and regression models identified factors (case complexity, interest, teaching clarity) influencing satisfaction. For pre-test (Nov 2024) and post-test (Jan 2025), scores and completion times were compared using mean, standard deviation, and histograms. Paired sample t-tests determined significant differences, evaluating case-based teaching effectiveness in improving drawing skills.

Results

This study evaluates the effectiveness of the case-based teaching method in enhancing first-year vocational high school architecture students' abilities to read and draw architectural drawings, while investigating their satisfaction with this approach. It focuses on two core questions: (1).Whether students' drawing reading and drafting abilities improve after adopting the case teaching method (2) Whether studentssatisfaction toward this method.

The findings reveal that the case-based teaching method significantly enhances students' capabilities in reading and drafting architectural engineering drawings. The study involved 90 first-year architecture students from a vocational high school who participated in a case-based teaching course.

Learning outcomes were assessed through pre-test and post-test. The average pre-test score was 10.33 (standard deviation 5.62), which rose to 12.43 (standard deviation 4.84) in the post-test. A dependent t-test confirmed the statistical significance of this score difference ($p<0.01$),To further interpret the practical significance, Cohen's d was calculated to measure effect size: for the reading test, Cohen's $d = (13.99 - 10.17) / \sqrt{[(4.57^2 + 2.47^2)/2]} \approx 1.04$; for the drafting test, Cohen's $d = (27.84 - 20.40) / \sqrt{[(4.33^2 + 1.10^2)/2]} \approx 2.35$. Both values indicate large effect sizes (Cohen, 1988), confirming substantial practical improvements beyond statistical significance. indicating substantial improvements in students' performance in reading and drawing architectural blueprints after the intervention.

The case-based teaching method incorporates real-world building projects, offering students practical opportunities that closely simulate professional settings. Students are tasked with analyzing the logic of case blueprints, adhering to drawing standards, and independently solving case-related problems. Through the process of "understanding-imitation-innovation," they integrate knowledge and skills, which aligns with Willis's (1996) "practice-oriented, task-driven" teaching philosophy. This approach promotes active learning via real-world case tasks, and the results confirm that students' abilities in reading and drawing architectural engineering blueprints have significantly improved after participating in the case-based teaching program.

Test Type	Full Score	Pretest		Posttest		N	t-test	p
		$\bar{x}$	S.D.	$\bar{x}$	S.D.			
Reading test	20	10.17	4.57	13.99	2.47	90	11.53	0.00
Drafting test	30	20.40	4.33	27.84	1.10	90	30.30	0.00
p<.01								

Table 2 Descriptive Statistics of the Pre-test and Post-test result

To address the second research question regarding students' satisfaction with the case-based teaching method, a satisfaction survey questionnaire was designed. It evaluates students' perceptions from four dimensions: teaching content, learning activities, teacher instruction, and assessment and evaluation. The questionnaire results show that most items scored between 4.81 and 4.92 on a 5-point scale (with 5 being the highest), reflecting a high level of student recognition. The corresponding tables and data are as follows:

1 .Teaching content

Statements	N	$\bar{x}$	S.D.
1.Do you think the architectural drawing cases selected in the case teaching are representative and diverse?	90	4.92	0.24
2.Is the teaching content clear and easy to explain the relevant theoretical knowledge of architectural drawings?	90	4.91	0.30
3.How much is the combination of the case teaching content with the actual construction project?	90	4.96	0.25
4.Do you think the depth and breadth of the teaching content is appropriate?	90	4.90	0.27
5.Does the teaching content explain the details of the architectural drawings?	90	4.96	0.25
6. Do you want to add more about the new building materials and techniques to the drawings?	90	4.96	0.25

Table 3 The Mean and Standard Deviation of Students' Satisfaction toward Teaching Content

2 .Learning Activities

Statements	N	$\bar{X}$	S.D.
7. Do group discussions in case-based teaching activities help you understand the architectural drawings?	90	4.96	0.24
8. How is the coordination of the field visit organized by the teacher with the case teaching?	90	4.91	0.32
9. How is the coordination of the field visit organized by the teacher with the case teaching?	90	4.96	0.28
10.Are you satisfied with the pace of the case analysis in class?	90	4.91	0.32
11. In the teaching activities, is the personal guidance and feedback given by teachers to you timely and effective?	90	4.96	0.28
12. Do you think the time schedule of the teaching activities is reasonable?	90	4.91	0.32

Table 4. The Mean and Standard Deviation of Students' Satisfaction toward Learning Activities

3 .The Instructor

Statements	N	$\bar{X}$	S.D.
13. Do you think the teacher's explanation of the architectural drawing case is professional?	90	4.92	0.24
14. Can teachers effectively guide students to participate in the discussion and thinking in the teaching process?	90	4.91	0.32
15. Do you think the teachers are serious and responsible in their teaching attitude?	90	4.93	0.28
16. Do teachers pay attention to and respond positively to the questions and suggestions raised by students?	90	4.91	0.32

17. Do you think the teacher's knowledge reserve is rich and can it meet the teaching needs?	90	4.96	0.28
18.Do teachers encourage students to propose different ideas and innovative ideas in their teaching?	90	4.91	0.32

Table 5. The Mean and Standard Deviation of Students' Satisfaction toward the instructor

4 .Assessment and Evaluation

Statements	N	$\bar{X}$	S.D.
19. Do you think the current evaluation methods (such as homework, exams, etc.) can accurately reflect your ability to read and draft architectural drawings?	90	4.92	0.24
20. Are you satisfied with the difficulty and amount of questions about the architectural drawings in the exam and homework?	90	4.91	0.32

Table 6. The Mean and Standard Deviation of Students' Satisfaction toward Assessment and Evaluation

Overall, students demonstrated significant improvements in their ability to read and draft architectural drawings and expressed a positive attitude toward the case-based teaching method. An unexpected result was the extremely small standard deviation in the post-test of the drafting test (S.D. = 1.10), indicating highly concentrated scores among students, which contrasts with the wider score distribution in the pre-test (S.D. = 4.33).Notably, the post-test score of the drafting test (M = 27.84) approached the full score of 30, suggesting a potential ceiling effect. This phenomenon may limit the test's ability to distinguish further improvements among high-achieving students, as the test difficulty was insufficient to capture variations in advanced drawing skills.

The large effect sizes (Cohen's d = 1.04 for reading test; 2.35 for drafting test) further confirm the practical significance of the intervention beyond statistical significance. This further supports the suitability of this method for meeting the teaching needs of first-year vocational high school architecture majors. In a "practice-oriented and skill-training" teaching environment, it effectively enhances students' professional drawing abilities and lays a solid foundation for their subsequent vocational skill development.

Discussion

In this study, the findings demonstrated a significant improvement in vocational school architecture students' reading and drafting skills, along with high satisfaction with the case-based teaching method, indicating its suitability for architectural education in vocational contexts.

Skill Improvement and Method Acceptance

The observed progress, reflected in enhanced accuracy in reading drawings, adherence to drawing standards, and design creativity, can be attributed to the practical and scenario-based nature of case-based teaching, which differs from traditional theory-dominated lectures. Following the three-stage framework of "case introduction—analysis and discussion—practical application," the teaching cases were carefully designed to align with the professional development needs and practical skill requirements of vocational students. During the analysis and discussion stage, students engaged in real-world project simulations through individual exploration and group collaboration, fostering a sense of ownership in learning and increasing their enthusiasm for applying theoretical knowledge to practical operations. Prior research (Zhang & Li, 2021) has similarly highlighted that case-based environments, rooted in industry relevance, promote the development of practical skills and professional qualities. Compared to rigid traditional teaching models that separate theory from practice, case-based teaching provided students with more opportunities to integrate knowledge, solve problems, and innovate in design, which they clearly valued. This approach corresponds to the characteristics of vocational school architecture students, who thrive in applied, hands-on learning settings (Liu & Wu, 2018). Case-based teaching offers structured guidance while encouraging autonomy and teamwork, which is a combination supported by recent studies confirming its effectiveness in vocational architectural education (Huang Helin, 2021). Despite initial challenges in adapting to case-centered learning, students quickly adjusted, showing growing engagement and active participation, consistent with findings in related vocational education research (Wang & Zhao, 2020). The use of actual building project cases closely linked to future career scenarios further enhanced involvement and skill acquisition (Chen & Yang, 2019).

Student Feedback on Teaching Implementation

The post-implementation feedback revealed positive student attitudes toward the case-based teaching method. Regarding teaching content, unlike traditional lecture-based methods that focus on passive knowledge transmission, case-based teaching emphasized the integration of theory and practice, allowing students to actively explore solutions rather than merely memorize standards. This frequent exposure to real-world architectural projects helped them deepen their understanding of drawings, master standard drawing norms, and improve design creativity and operational proficiency. This aligns with constructivist learning theory, which emphasizes that knowledge acquisition through scenario-based exploration and practical application is crucial for enhancing learner engagement and skill retention. In terms of learning activities, the cases encouraged collaboration, critical thinking, and experience-sharing in professional practice. This collaborative dynamic aligns with the core principles of constructivist learning theory, where students supported each other during case analysis and practical tasks, enabling cooperative learning and mutual progress. The variety of real project cases used throughout the teaching process kept students motivated and avoided monotony, creating a classroom atmosphere where learners were eager to participate. Furthermore, by shifting from a traditional knowledge transmitter to a learning facilitator, the teacher fostered an interactive and supportive environment. The teacher's step-by-step guidance during case analysis and practical application, rather than direct instruction of standard answers, helped build students' confidence in independent problem-solving.

Limitations in Student Performance

Despite the overall positive outcomes, some limitations emerged in students' learning processes. Approximately 12% of students reported initial difficulties in translating abstract theoretical standards into concrete case operations, particularly when dealing with complex architectural details such as non-standard node connections. During group discussions, a small number of students struggled with balancing individual contributions and collaborative decision-making, occasionally leading to uneven participation. Additionally, several students noted challenges in time management during case analysis tasks, often spending excessive time on minor details while rushing through key problem-solving steps.

Long-Term Impact Projections

The effectiveness of case-based teaching in this study suggests several long-term benefits for vocational architecture students. In terms of job placement, the practical experience gained through real project simulations directly addresses employers' demand for graduates with hands-on drawing interpretation skills, potentially increasing employment competitiveness in the architectural design and construction sectors. Regarding workplace adaptability, the collaborative problem-solving abilities and standard application skills developed through case analysis are transferable to on-the-job scenarios, enabling graduates to quickly adapt to project teamwork and technical communication requirements. Longitudinal research in vocational education indicates that scenario-based learning methods enhance skill retention, which may lead to more sustainable professional development compared to traditional learning approaches, as students can better apply foundational knowledge to evolving industry challenges (Wang & Zhao, 2020).

Conclusion

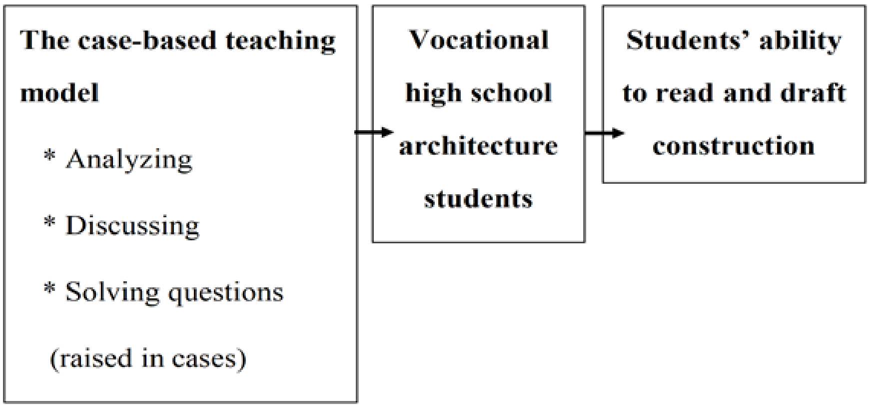

Figure 2 Use case-based teaching method to improve architecture students in vocational high schools Ability to read and draft construction engineering drawings

This study confirms through research data that the case-based teaching method significantly improves the ability of architecture students in vocational schools to read and draw architectural engineering drawings, with students reporting high satisfaction (an average score of 4.8/5). As a teaching model grounded in real-world cases, its core advantage lies in its integration of constructivist learning theory. By guiding students in independent exploration, facilitating group collaboration, and providing targeted summaries and guidance from teachers, it achieves deep integration of theory and practice—effectively addressing the limitation of traditional teaching models, where knowledge transmission is disconnected from practical application.

Furthermore, the core philosophy and implementation framework of case-based teaching exhibit extensive universality. Its adherence to a "student-centered" approach and the principle of "theory-practice integration" allows flexible adaptation across multiple disciplines and educational stages: whether in basic education or higher education, vocational skills courses or humanities and social sciences, it can yield significant results through customized adjustments. Building on this foundation, future research should focus on expanding student group coverage, integrating interdisciplinary knowledge systems, and advancing localized practical exploration. This will enable it to play a more substantial role in global education reform and provide an effective pathway for cultivating innovative and practical talents.

It is worth emphasizing that amid rapid industrial development and growing emphasis on practical skills, the value of such educational innovations is particularly prominent. They not only effectively resolve the current disconnection between vocational education and industry needs but also lay a solid foundation for narrowing the gap between talent cultivation and industrial development in the context of global economic transformation and technological advancement.

Recommendations

To enhance the practical effectiveness of case-based teaching in architecture majors of vocational schools, three improvement strategies are proposed:

1. Up-to-date and Diverse Case Selection

Establish a dynamic update mechanism to incorporate cutting-edge industry achievements such as BIM forward design into the case library. Meanwhile, based on Vygotsky's theory, design basic, intermediate, and advanced cases in a stratified manner according to students' proficiency levels. To implement this, establish quarterly collaboration meetings with local architectural firms to collect latest project cases, and conduct pre-course skill assessments to group students and match them with appropriate case difficulty levels.

2. Enhance the Inquiry Task Chain

Based on Bloom's Taxonomy of Cognitive Objectives, the inquiry process is decomposed into three progressive tasks—information extraction, logical analysis, and innovative application—with clear delineation of requirements and expected outcomes for each stage. To operationalize this framework, develop task-specific worksheets featuring stage-appropriate evaluation criteria; following the logical analysis phase, arrange structured peer review sessions to facilitate in-depth discussion and consolidate understanding before progressing to the innovative application stage.

3. Embed Industry Norms into Teacher Summaries

Embed Industry Norms into Teacher Summaries: Leveraging a three-in-one analysis framework ("case drawings - standard articles - engineering accidents"), teachers will systematically compare national standards with enterprise requirements to ensure effective integration of school teaching and professional practice. To operationalize this, develop a standardized summary template that structures the three-in-one analysis into modular sections (drawing interpretation, standard alignment, and accident lessons), while organizing monthly training sessions to help teachers master national-enterprise standard comparison skills—with typical engineering accident cases incorporated as practical teaching aids during both training and summary sessions.

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