Exploration of Teaching Reform in Engineering Drawing Course

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Abstract: With the construction of new engineering disciplines and a relative reduction in class hours, adjusting the content of university professional courses has become an urgent challenge. In addition, the certification of engineering education programs requires that the university curriculum be student-centered and outcome-guided. This article focuses on teaching reform in Engineering Drawing, a fundamental courses in civil engineering. It analyzes the selection of knowledge unit, the incorporation of ideological-political content, and innovations in teaching methodology, proposing useful suggestions based on specific practices.

1. Introduction

In recent curriculum reform, the number of courses has expanded to provide students with a broader knowledge base. However, the original course hours have been reduced. Under the new training program, the reasonable optimization of teaching content has therefore become an urgent problem.

Engineering Drawing is a fundamental course for freshmen majoring in civil engineering, and it is one of the earliest professional courses they are exposed to after enrollment. This course mainly covers the principles of descriptive geometry, projection methods for solving geometric problems, and engineering drawing recognition and drafting. It does not have many computational theories or formulas but instead focuses on fostering students' spatial imagination and logical thinking. These abilities are essential for a future career in civil engineering. It is worth exploring how to balance the content and reasonably arrange the teaching time for each part in course instruction, as well as how to improve teaching methods to enhance students' enthusiasm and learning efficiency.

2. Teaching content Reform

2.1. Content Arrangement for Theoretical and Experimental Courses

Civil engineering students will choose their specialization after their freshman year. Therefore, when planning the curriculum, it is important to consider the different majors available to them. The institution discussed in this paper currently provides two majors: civil engineering and urban underground space engineering. In the third year, students in civil engineering will choose between two specializations: construction engineering and geotechnical engineering.Therefore, the curriculum must not only include essential topics like basic views, sectional views, and simplified drawing methods, but also broaden its scope to comprehensively cover the reading and creation of professional drawings.And the curriculum should include building, bridge, tunnel, and water conservancy engineering drawings to help students develop a fundamental understanding.

As a signatory to the Washington Accord, China has made the accreditation of its engineering programs a major priority for universities. The output-oriented OBE educational philosophy is a cornerstone of our educational reform efforts. This concept focuses not only on students' academic performance but also on their long-term career progression after graduation. This involves evaluating their professional competence, and assessing whether feedback from employers (e.g.,

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through promotions) aligns with the program's goals, and whether the graduation requirements meet industry needs.

Guided by this concept, we must reform university teaching to make it more student-centred. This involves constantly optimizing the curriculum, ensuring it adapts to national and social development, incorporating the needs of employers, and carefully supporting students' career planning and long-term development. The content of each coursemust align withthe graduation requirements. Typically, each course is designed to map to 2-5 specific indicators within the graduation requirements. These requirements outline the intended learning outcomes (knowledge, skills, and attributes) that students must achieve.

Currently, the total hours for Engineering Drawing are 40, with 8 allocated to experimental work and 32 to theoretical instruction. Thus, the provision of experimental work appears sufficient. The arrangement of experimental course content directly affects the course's effectiveness. The main purpose of the experimental class is to enable students to master the steps and skills of drawing civil engineering drawings. Despite the existence of an AutoCAD course in the sophomore curriculum, this experiment required manual drafting, thus utilizing tools such as a T-square, triangle, drawing board, and compass. Manual drawing is slower and less accurate than computer drawing. However, by drawing manually, students gain a deeper understanding of detailed drawing requirements and the rules behind specific symbols. Therefore, this is not optional; the selection of content must be more selective and focused. Therefore, the bottom-floor plan in the construction drawings was selected as the experimental content. Compared to other floor plans, the bottom floor plan is more comprehensive, including a compass, outdoor steps, a sprinkler, and sectional index symbols. By drawing the bottom floor plan, students can gain a comprehensive understanding of the creation process for architectural blueprints.

The general drafting conventions for structural concrete are difficult for students to master. Theoretical courses can only provide students with a preliminary understanding. To help them better understand this material, we should add practical examples. A set of actual engineering drawings should be introduced in the experimental class. Students can complete reading exercises based on these drawings to solidify their understanding.

When selecting theoretical content, we should be guided by practical needs. The auxiliary projections of points, lines, and planes, as well as the unfolded drawings of three-dimensional surfaces, are rarely used in civil engineering drawings and therefore have been removed from the curriculum[1]. When teaching how two solid shapes intersect, the goal is to teach the underlying drafting principles. Solving complex problems that require multiple auxiliary surfaces takes a lot of time. Therefore, it is recommended that students choose this topic as optional learning content; teachers will provide guidance if students have any questions.

2.2. Curriculum Ideological and Political Content Arrangement

At present, the Ministry of Education attaches great importance to integrating Ideological and Political Education into professional courses across colleges and universities. There is an important synergy between the mandatory Ideological and Political Education courses and its integration into professional curricula, together they provide a robust framework for student development. A skillfully designed Ideological and Political Education in course can powerfully help establish students' Socialist Core Values. It also serves to stimulate their learning motivation more effectively[2].

In the Engineering Drawing curriculum, teachers can incorporate ideological and political education through cases built around the concept of technical representation. For example, when teaching the projection method, instructors can introduce the world intangible cultural heritage, Chinese shadow puppetry. When discussing the history of the discipline's development, they can introduce ancient texts such as “Construction Method” and “Tiangong Kaiwu”. Exposure to China's acclaimed artistic accomplishments can strengthen students' confidence in their cultural heritage.

When teaching painting, instructors can help students understand the dialectical relationship between learning and gradual progress through the connections between points, lines, surfaces, and

bodies. No matter what they do, they need to have a down-to-earth attitude, a step-by-step approach, and the spirit to make solid efforts.

When teaching the importance of engineering drawings, teachers should help students develop an awareness of the need to maintain confidentiality regarding drawings for major national projects. Professional ethics require engineers not to disclose their employer's project drawings without authorization. Furthermore, quality problems arising from negligent design may lead to criminal liability.

In addition to its careful selection, the integration of ideological and political content should be constantly updated, keep pace with current political developments, and highlight advanced examples from contemporary industry. It is also necessary to study narrative techniques and integrate educational content seamlessly into key lesson segments. This approach helps students listen with interest, think critically, gain substantial knowledge, and creates a virtuous cycle of interaction between teaching and learning. From a practical perspective, after integrating ideological and political content into the teaching, student engagement has greatly increased, and their average grades have subsequently risen by 2.5 points.

3. Teaching Methods Reform

3.1. Coordinating Traditional and Electronic Presentations

The Engineering Drawing course should enable students to solve geometric problems using the projection method , including finding the intersection line of two solids, solving solid cutting problems, tackling solid intersection problems, and representing the basic views of a solid. The following section discusses how to effectively coordinate PowerPoint and the blackboard for demonstrating the drawing process[3].

Before the rise of multimedia teaching, teachers had to rely solely on chalk and a ruler to draw, point by point, line by line, on the blackboard for students while explaining the process. Students will be able to watch the process clearly, which will impress them. The disadvantage is that some students may not see clearly due to glare from the blackboard or because they are sitting too far back; as a result, they may not master the content. In addition, blackboard drawing is less accurate and time-consuming. In the current class, the number of demonstration topics may be small.

The PPT display is relatively clear. The problem-solving process is carefully designed to be presented on screen step by step. This method is much faster than using a blackboard, allowing instructors to cover more material. Additionally, thanks to the larger and clearer graphics, every student in the classroom can see without difficulty. The downside of using PPT is that the drawing steps are shown too rapidly, making it difficult for students to follow along and memorize the process. However, traditional blackboard drawing is generally more immersive and engaging.

For this reason, it remains an indispensable teaching tool that should not be entirely abandoned. For each major topic, instructors should perform at least one demonstration on the blackboard, preferably using simpler diagrams. Furthermore, pre-recorded videos of teachers solving problems on paper can be created and shared as supplementary resources to support students' self-study and homework. Through this approach, the benefits of both pedagogical methods can be harnessed simultaneously.

3.2. Enhance Students' Practical Ability

Engineering students should possess not only solid theoretical knowledge but also strong practical skills. Beyond internships and lab courses, we can enhance these practical abilities through specific instructional activities integrated into regular coursework[4,5]. For example, when teaching the establishment of a three-dimensional projection system, the instructor asked students to prepare a small paper box in advance. In class, the teacher demonstrated on the platform and asked them to tear it along the crease and mark the symbols V, W, H, X, Y, Z, O on the three connected sides.Then, the instructor can have them observe the folding and unfolding process of a three-view projection.

When teaching the two-line positional relationship, the teacher can have students use two pens to

model the spatial positions, helping them better understand the difference between intersection and skew lines. The author also focused on the concept of special line positions. The teacher would call out a type of line (e.g., 'parallel' or 'vertical'), and students would immediately hold up their pens to demonstrate it. The students participated very actively in this exercise. Furthermore, students can use clay or plasticine to build simple prisms and pyramids. This hands-on activity is an effective way for them to practice creating solid models.These teaching activities have greatly improved the students' practical skills.

4. Conclusion

As one of the basic courses of civil engineering, Engineering Drawing has seen its reform of teaching content and methods become a hot topic among educators. Based on teaching practice, some useful suggestions are given by the author. Firstly, optimizing course content must align with the school's academic programs. Secondly, the integration of ideological and political content into the curriculum effectively boosts student motivation and significantly enhances the learning environment. In addition, a combination of blackboard drawing and multimedia presentations is recommended to take full advantage of the unique benefits of each. Finally, during instruction, teachers should actively encourage students to get hands-on practice. These suggestions provide valuable insights for improving the instructional effectiveness of Engineering Drawing.

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