



## Teaching Optimization of Interior Design Based on Three-dimensional Computer-aided Simulation

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**Abstract.** Interior design, as a highly practical subject, is a new design concepts. It is the application of new teaching methods and the expression of new design elements which make the teaching continuously optimized and adaptable to the development of today's interior design industry and talents cultivation. Three-dimensional (3D) computer-aided simulation is a technology that uses computer-related software to design, express, generate, process, and display 3D graphics. The application of this technology to interior design teaching program enables students to have an intuitive experience of space volume, material, proportion, color and other aspects and preview the design effect, thereby greatly improving classroom efficiency. Therefore, on the basis of summarizing and analyzing previous research works, this paper first expounded the research status and significance of interior design teaching optimization, elaborated the development background, current status and future challenges of 3D computer-aided simulation, then proposed the curriculum construction optimization of interior design based on 3D computer-aided simulation including strategic optimization and structural optimization. Through the analysis of the teaching practice optimization of interior design based on 3D computer-aided simulation including teaching system optimization and practice system optimization, the paper discussed the teaching optimization mode and its realization paths of interior design based on 3D computer-aided simulation. Finally, the paper provided a reference for the further researches on teaching optimization of interior design based on 3D computer-aided simulation.

**Keywords:** Interior Design; Teaching Optimization; Computer-aided Design; 3D Simulation

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### 1 INTRODUCTION

Interior design is a core professional curriculum with strong practicality in architectural decoration technology, art design and so on. As time goes by, new design concepts, design ideas and design expression methods are constantly developing and changing. Therefore, the teaching methods in

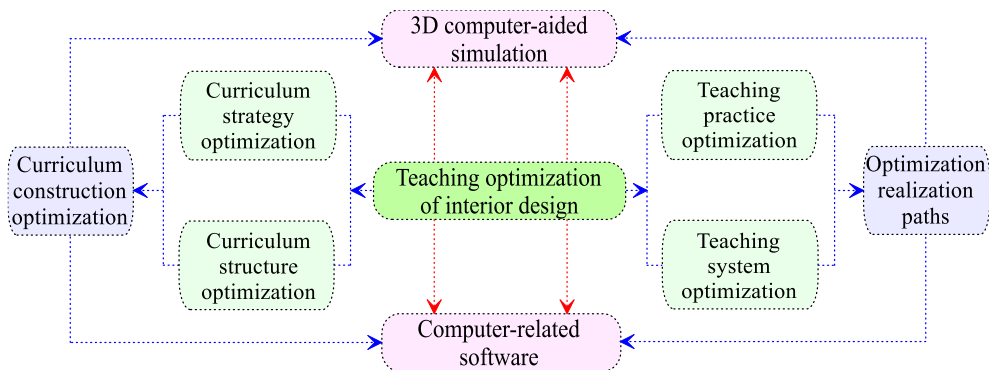
interior design subject are also facing various challenges and it is necessary to keep pace with the times and optimize its teaching environment in order to meet the development needs of today's interior design teaching [1]. In traditional interior design classes, teachers are often only able to teach students through picture information combined with theoretical knowledge in textbooks. Islamoglu and Deger (2015) pointed out that the lack of simulated drills makes students unable to accurately grasp the essence of knowledge they have learned and cannot apply relevant knowledge to practices [2]. In addition, if students need to make manual drawings and interior design models by hand, not only will it take a lot of time during this period, but it will also be detrimental to teachers' comprehensive evaluation of students' design ability. Because the professional knowledge of interior design is relatively complex, many teachers describe the 3D space very abstractly, and often need to rely on some small models to assist in the explanation. However, this kind of design model cannot bring intuitive feelings to students, so classroom efficiency is generally low [3]. With the functional development of computer drawing software and the advancement of informatization teaching reform, computer-aided simulation has greatly promoted the development of interior design teaching. The introduction of 3D computer-aided simulation can enable students to get a more intuitive experience and a clearer understanding of the details of the design [4]. With this kind of teaching assistance, the effect of interior design classroom teaching has been greatly improved. Through this 3D data design, modern interior design concepts are taught to students, and more interior design professionals are trained for the society. Liu and Hsueh (2016) believed that the 3D computer-aided simulation technology has greatly improved design efficiency and has become an important part of artistic design; using 3D software technology to do most of the work in design has become a general trend in the future [5]. At present, the 3D computer-aided simulation technology is widely used in interior design and has achieved good design results. When designing, it should be based on the requirements of the owner, not only to look good, but also to reflect the profound design ideas and exquisite art. Therefore, this simulation technology has very important practical significance in the application of interior design [6]. On the basis of summarizing and analyzing previous research works, this article expounded the research status and significance of interior design teaching optimization, elaborated the development background, current status and future challenges of 3D computer-aided simulation, proposed the curriculum construction optimization of interior design based on 3D computer-aided simulation including strategic optimization and structural optimization, analyzed the teaching practice optimization of interior design based on 3D computer-aided simulation including teaching system optimization and practice system optimization, and discusses the teaching optimization mode and its realization paths of interior design based on 3D computer-aided simulation. The study results of this paper provide a reference for further researches on the teaching optimization of interior design based on 3D computer-aided simulation. The detailed chapters are arranged as follows: Section 2 proposes the curriculum construction optimization of interior design based on 3D computer-aided simulation; Section 3 analyzes the teaching practice optimization of interior design based on 3D computer-aided simulation; Section 4 discusses teaching optimization mode and its realization paths of interior design based on 3D computer-aided simulation; Section 5 is conclusion.

## **2 CURRICULUM CONSTRUCTION OPTIMIZATION BASED ON 3D COMPUTER AIDED SIMULATION**

### **2.1 Curriculum Strategy Optimization**

The application of 3D computer-aided simulation has not only changed the original design model, but also caused certain changes in future development. This is a good phenomenon and proves that the industry has gradually moved up to the pace of the times and the level of design also has been a general improvement. This facilitates teaching and puts forward higher requirements for teachers as well, so teachers also need to focus on improving their own abilities, and can skillfully

apply software to the design, so that they can improve the comprehensive level of students more quickly. Lin et al. (2017) that drawing software determines a successful teaching reform and also promotes the development of a field [7]. Drawing technology can also be used in design teaching, which can significantly improve the effect of teaching, not only promotes the development of interior decoration teaching, but also has a positive impact on the entire interior decoration industry (Figure 1). These advantages determine that the software will inevitably shine in the design field and will actually bring benefits to many designers. It should be noted that the design limit is smaller, so students must be more attentive when designing to reduce operational errors.



**Figure 1:** Teaching optimization framework of interior design based on 3D computer-aided simulation.

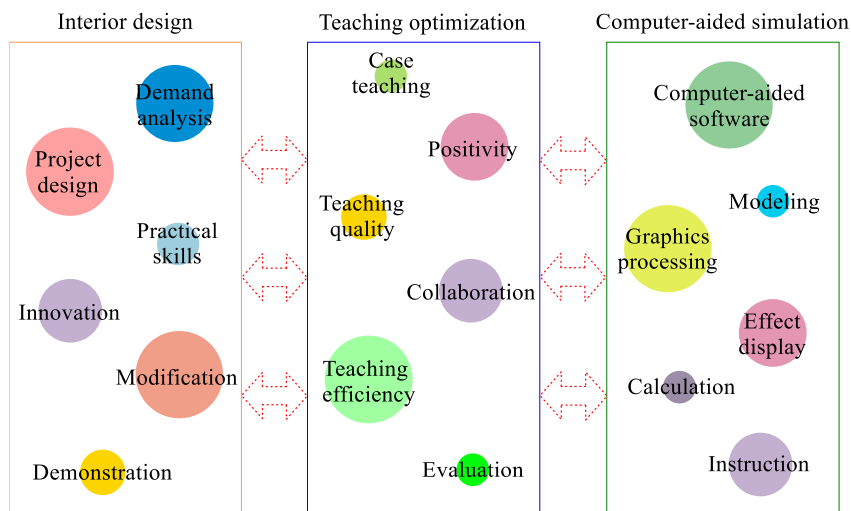
To design a reasonable step-by-step professional time curriculum, professional teachers and relevant teaching and research personnel need to really go deep into the production of the enterprise and understand the real business content, so as to clarify the needs of the professional talents in the position, and formulate practices that can improve the competitiveness of students in employment curriculum. First of all, applying real enterprise cases and real materials in classroom training can enable students to receive professional training and skill training. Second, project teaching should be carried out in job training according to job tasks such as demand analysis, project design, and technical services. Finally, in the comprehensive training, the school should cooperate with the company to provide students with real internship positions and ask them to Mobile learning in different positions, so that they can truly understand the different requirements of the production process of computer enterprises and demand analysis, project design, project implementation and other production links. In addition, schools can also allow students to take turns in positions by simulating real cases role, cyclic operation, so as to grasp the relationship between different positions of the enterprise and the responsibilities and obligations of each position, so that it can quickly adapt to the work process and working environment in future work.

This part of the content mainly teaches the setting of test parameters and drawing parameters and the test parameters are set to improve the efficiency of drawing. The drawing parameters are the key factors that affect the final effect and this modeling method requires gradual progress and strengthened practice to master its operating skills. Teachers should try not to put high demands on students in class; otherwise, it will greatly affect students' enthusiasm for learning the software, thereby reducing the quality of teaching. The case teaching refers to explain targeted cases' function and use command skills in detail and vividly, so that students can master the functions and application skills of command in their interest. Task-driven is to let students be driven by a clear task, use relevant knowledge and methods to guide students from simple to complex, from easy to difficult, and gradually complete a task, thereby training students' ability to analyze and solve problems. Therefore, 3D computer-aided simulation is of great significance for optimizing interior design teaching, stimulating students' enthusiasm, and improving teaching quality.

## 2.2 Curriculum Structure Optimization

The teaching process of interior design major requires a lot of subject practice. Without the participation of computer-assisted simulation software, students need to spend a long time to complete the subject homework. Restricted by the requirements of fine hand-made, some good ideas are restricted, and the rich imagination cannot be released, which is not conducive to the cultivation of innovative thinking. Through design assistance software, students can add innovative thinking in their minds to their design works. However, if they are limited by traditional hand-made techniques, they often fail to accurately show the students' design concepts, and on the computer design platform the ability to modify the work in a timely manner greatly improves the teaching efficiency and saves the time for students to complete design tasks. Teaching through computer-assisted simulation software will show certain differences. For example, in the process of staged assessment, students can use computer-aided simulation software to complete design works within a specified time, and teachers can view the students' design steps through the software. Moreover, the intuitive 3D model can also observe the students' design ideas and the value of the design works, which can help teachers make more objective evaluations.

The teaching process based on 3D computer-aided simulation emphasizes the relationship between artistic design and practical training skills, highlights the strengths and broad development prospects of computer-aided simulation technology. On the basis of mastering basic skills, it is required to learn daily life techniques, overcome the urbanization phenomenon of computer graphics, and shapes the space of architecture, interior and landscape environment (Figure 2). In addition to the need for students to master the work process, operating methods, and design skills of the computer-assisted simulation curriculum, it is more important to strengthen the high quality and efficiency of student drawing to meet the needs of the design industry under the market economy. Kwon et al. (2016) suggested that these teaching methods not only provide students with high-speed and high-capacity information resources, but also increase the attractiveness and appeal of teaching with its dynamic scenes combining sound, shape, sound, painting, and huge virtual design functions [8]. Through the network teaching platform, synchronous or asynchronous interaction between teachers and students can be carried out, which stimulates the collaboration and participation of students in learning, and helps learners solve problems encountered in learning in time.



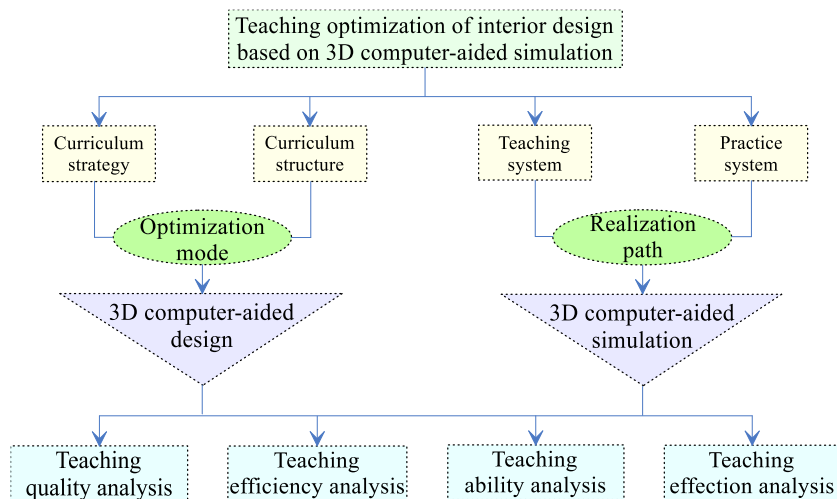
**Figure 2:** Curriculum construction optimization of interior design based on 3D computer aided simulation.

The teaching optimization of the practical curriculum of interior design is to combine theory with practice, fully tap the imagination and creativity of students and at the same time master theoretical knowledge in an all-round and in-depth manner. They comprehensively improve the actual design level of students on the premise of completing the teaching requirements of high quality, make it adapt to the needs and development of the social design market, and better serve the society. The most important thing is that they can combine competition with teaching to improve the interaction between students and teachers. The interaction with the class, while fully mobilizing the enthusiasm of students, perfectly integrates theoretical teaching and practical teaching. After in-depth communication with students, the teacher puts forward some guiding opinions to improve the actual project, improve its feasibility and practicability, and infiltrate the knowledge needed to be taught in this process, and fully carry out the theory and practice. In this way, while guiding and encouraging students to give full play to their imagination and creativity, they also have a deeper understanding of theoretical knowledge.

### 3 TEACHING PRACTICE OPTIMIZATION BASED ON 3D COMPUTER AIDED SIMULATION

#### 3.1 Teaching System Optimization

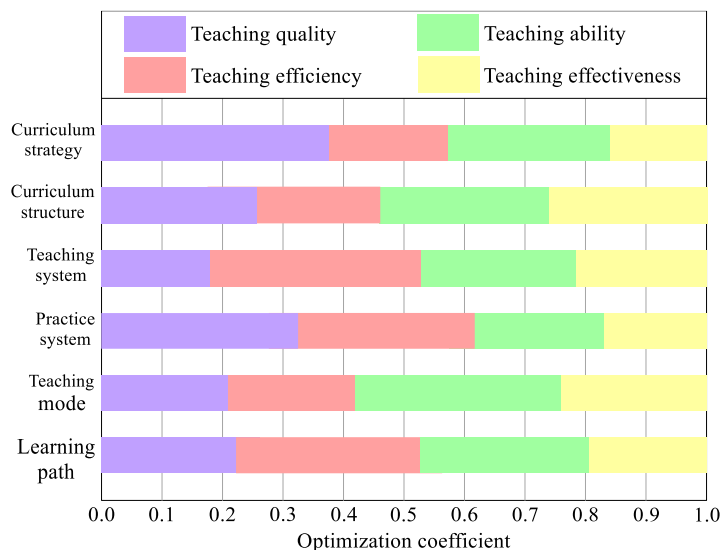
Through 3D computer-assisted simulation, students can have an intuitive experience of space volume, material, proportion, and color and preview the design effect, improve students' ability to express design schemes, and effectively cultivate students' overall space vision ability. Computer-aided simulation technology refers to the application of powerful computing power and graphics and image processing functions to assist designers in completing design tasks. Compared with traditional manual design methods, the efficiency and quality of computer-aided simulation are greatly improved. Computer-assisted simulation technology has been widely used in interior design, mechanical design, landscape architecture design and other fields. The use of computer-aided simulation software for interior design teaching can enable students to quickly add design thinking in their minds to their design works, and improve the efficiency of transforming design thinking into design products. At the same time, it can quickly compare the design works were modified, which greatly improved teaching efficiency and saved valuable classroom time. Therefore, the optimized interior design curriculum has a significant teaching prompt effect (Figure 3).



**Figure 3:** Factor analysis in teaching optimization of interior design based on 3D computer-aided simulation.

There is a big difference between computer-aided simulation software and traditional interior design drawing. First of all, computer work is highly efficient; it is more convenient than traditional design in terms of design, modification and optimization, and the operation method is also very simple. It can quickly transform innovative thinking into actual design, which is conducive to improving the work efficiency of designers and computer drawing has incomparable advantages over traditional drawing in program modification. Secondly, computer drawing is more accurate and manual hand drawing is very unrealistic for some details and small sizes in the design. With the aid of computer-assisted simulation software, the design effect can be displayed in a more 3D manner, so that users can have a more intuitive experience and facilitate good communication between designers and users. In short, computer-aided simulation software plays an important role in interior design. Designers and design companies should correctly understand the development of technology to the industry, actively learn new design methods, improve their business capabilities, and provide users with better interior design works.

In the students' practice operations, teachers should encourage students to put forward more innovative ideas and skills, and guide more students to participate in thinking about problem solutions through discussion groups (Figure 4). For example, students can observe the structure of the classroom in the classroom, and then put forward their own reformation opinions, and carry out feasible homework tasks that meet the needs of interior design through examples around them. In the early stage of the curriculum, the basic operations are drilled through more cases, which is a problem that is easy to ignore in many textbooks. Johnson et al. (2016) concluded that a large number of basic example exercises can enable students to have a deeper memory of these important operating commands, and to clarify the location of the menu and its purpose [9]. In the information age with the rapid development of computer applications, traditional teaching content and methods must be adjusted and innovated accordingly with the development of the times. In continuous innovation and exploration, seek for effective teaching methods that are more popular with students and create a solid foundation for the jobs that students are about to enter.



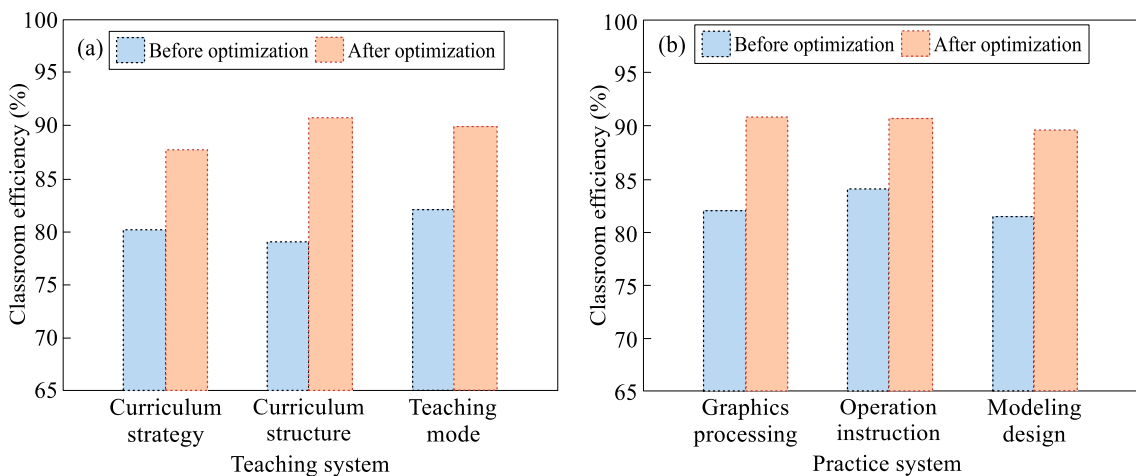
**Figure 4:** Optimization coefficient of multidimensional evaluation parameters.

### 3.2 Practice System Optimization

Computer-aided simulation software has gradually been popularized and promoted, and its importance is also briefly analyzed in the previous section. This part mainly combines the teaching

experience and issues that need attention in the teaching of computer-aided simulation software in interior design majors. Generally speaking, design majors mainly have the characteristics of relatively weak cultural foundation curriculums and not good at logical memory. Therefore, in the actual teaching process, the relevant instructions of the software should be integrated and processed, and students should try their best to operate in actual specific cases. In the process of learning software operating instructions, teachers are required to clarify and contextualize boring design theory and operating instructions. In the actual teaching process, it is found that many students' design creativity and ideas are relatively novel, but their design works are difficult to express scientifically and reasonably. Many students often make mistakes in proportions and scales when using computer-aided simulation software. Problems such as large deviation in color matching of works. Therefore, in the actual teaching process, it is necessary to help students strengthen the operating technology and performance technology of computer software. In addition, they should also help students summarize and sort out common problems to avoid problems in the actual design process.

The teaching must be combined with the actual design plan. At the same time, students must use the studio to complete other different projects in their spare time, and make them in groups, so that they can learn from each other in the final plan exchange, and apply the professional knowledge and software they have learned to their own designs (Figure 5). In this way, students can not only be proficient in software operations, but also be able to experience how the professional knowledge they have learned can be applied to actual work. In the graduation design stage, the cooperation between the studio and the company is used, professional teachers undertake corporate projects, and corporate practical engineers are hired to give lectures at the school. To guide students' project practice or to lead students to participate in actual project research in the enterprise, and complete the design plan under the joint guidance of professional teachers and enterprise engineers. The students' practical class scores are determined according to the students' independent creative design thinking process, the correct understanding of the construction process and the communication with customers. School teachers and corporate designers participate in the teaching. Therefore, the assessment of student performance should be based on professional quality and comprehensive evaluation of abilities and job skills.



**Figure 5:** Classroom efficiency of teaching system (a) and practice system (c) before and after optimization.

Interior design teaching based on 3D computer-aided simulation should organically integrate the basic theoretical knowledge and methods of drawing software, follow the transformation from two-dimensional plane to 3D modeling, add space design and modeling design. The methods integrate

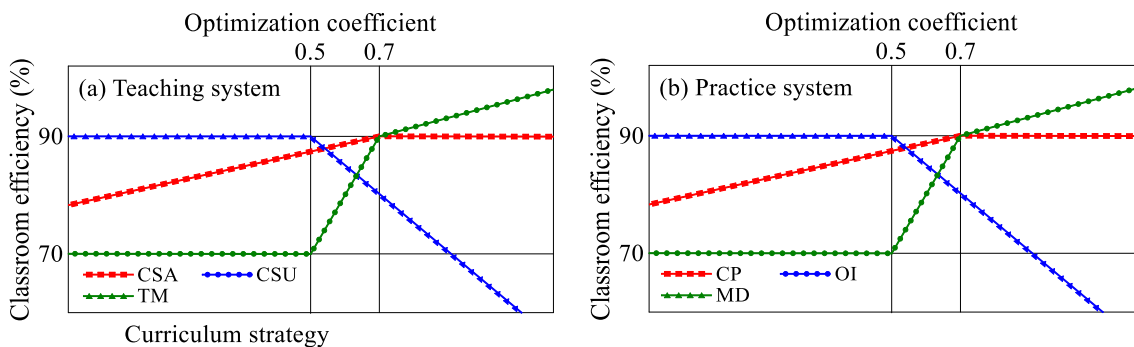


design and drawing closely, and develop students' ability of thinking and creative spirit, so as to improve students' hands-on ability in 3D modeling, model materials and textures, scene lighting and cameras. They also visualize, simplify, and materialize abstract spatial thinking processes, reduce the difficulty of learning and promote students' enthusiasm of 3D software stimulates interest in learning and improves teaching quality. This requires cultivating students' 3D space design capabilities, model operation and processing capabilities, and lighting material performance capabilities, and can adapt to the requirements of modern technology development for interior space layout capabilities and creative design capabilities of designers. Therefore, students use the knowledge they have learned to construct knowledge and further consolidate the professional operation skills of interior design in the process of completing project tasks.

## 4 DISCUSSIONS

### 4.1 Teaching Optimization Mode of Interior Design based on 3D Computer Aided Simulation

In the teaching process, the project-driven teaching method is piloted, that is, the real case of the enterprise is integrated into the teaching content, and the professional ability of the students is cultivated. Through the analysis of the professional job abilities required by interior designers, the training of students' knowledge and vocational abilities is used as the basis for the teaching system to form curriculum modules. At the same time, according to the needs of curriculum modules, scientifically and rationally design teaching projects, and project-driven teaching, so that students' professional ability and professional quality can be improved. In actual teaching, teachers can explain software-related knowledge points based on real cases of enterprises, guide students to analyze cases, obtain relevant knowledge points and problems prone to problems, and improve students' ability to solve practical problems. Students can clarify the ability goals and knowledge goals that need to be mastered in the curriculum, make the teaching content have certain pertinence, and mobilize students' enthusiasm for learning (Figure 6). After the teacher's explanation and the students' hands-on operations, they complete the construction drawing of a project in order from simple to complex on the basis of the theoretical knowledge. In the process of drawing, students have formed a clearer understanding of the construction technology of interior design and the performance of selected materials.



**Figure 6:** Relationship between classroom efficiency and optimization coefficient in teaching (a) and practice (b) system; CSA-Curriculum strategy; CSU-Curriculum structure; TM-Teaching mode; GP-Graphics processing; OP-Operation instruction; MD-Modeling design.

In the interior design, virtual roaming technology and animation design are used, which greatly fills in the shortcomings of static pictures, allows the owner to more clearly understand the final

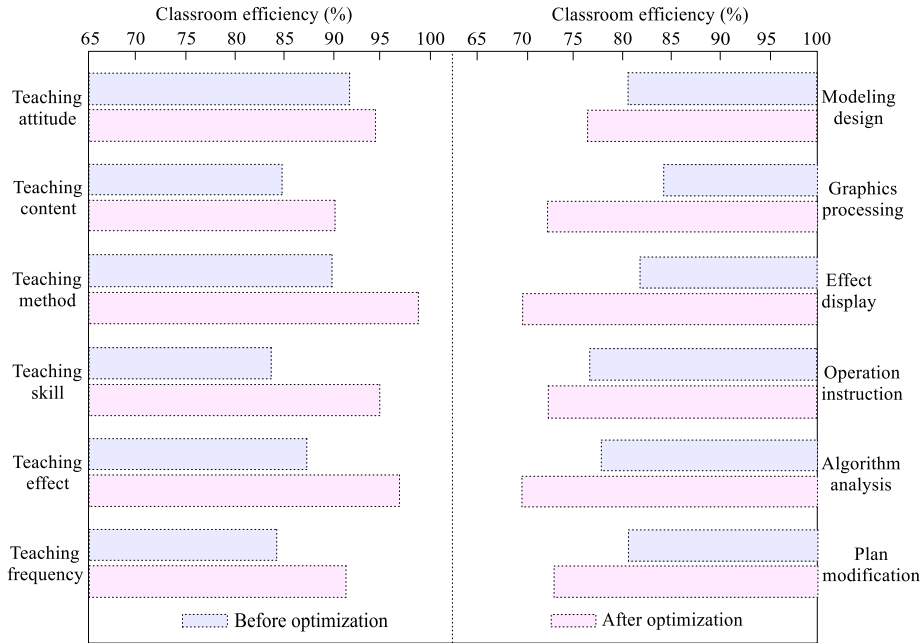


design scene and layout in the 3D space, and reflect the picture in his mind faster. Moreover, it can be distinguished from the traditional design plan, and the various parts can be broken down faster, which is also very beneficial to the observation of the organizational structure of each part. It is necessary to clarify the importance of theoretical teaching and practical teaching in the content of the assessment, and not only take a one-sided theoretical examination or a practical examination. In the content of the assessment, there must be both theoretical knowledge and practical operation content [10]. In terms of examination forms, it is necessary to diversify and highlight the cultivation of innovative ability, that is, to break a single theoretical examination or a computer-based operation verification examination, flexible and diverse examination methods should be adopted according to professional characteristics, and staged theoretical assessment, operational assessment, and oral examination, written examination and other assessment methods. In the theoretical class, the tasks for each student to learn on the computer are clarified, and they are required to complete the required operation content on time and according to the amount, and do a good job of correcting homework. In the form of teaching, an interactive multimedia teaching mode is adopted in which teachers and students operate simultaneously. This form of learning while operating, the teaching effect is relatively ideal.

The result of students' learning is ultimately to be verified in social practice, and knowledge can only be meaningful when transformed into practical activities. Therefore, teaching activities should never be written according to the text, and should always be kept in mind. The ultimate goal of teaching is to be professionally oriented and conduct curriculum training based on actual combat requirements. Try to introduce actual cases into teaching, and truly improve students' practical ability based on actual requirements. In the teaching content of software curriculums, in addition to basic knowledge, some excellent students are given better opportunities to improve. Many practical projects have been added to the teaching to make these students with strong understanding ability and quick hands to play better level. Teachers can take advantage of the cooperation opportunities between schools and enterprises to link software teaching with actual projects in teaching. Teachers introduce project conditions, base conditions, requirements, and guide students to design and produce. This kind of real project can inspire students after completing the required interest and students can gain a sense of accomplishment and increase their self-confidence. In addition, they must pay attention to the level of students' learning, and more importantly, their emotions and attitudes displayed in learning activities, to help them understand themselves and build self-confidence.

#### **4.2 Optimization Realization Path of Interior Design based on 3D Computer-aided Simulation**

In interior design, the construction of 3D images is the main auxiliary function of the software, which helps students to directly observe and examine the interior design plan, and promptly improve the areas that do not conform to the design ideas or the design, so that the final quality of the final product is better design scheme. In order to match the overall effect and achieve overall harmony in the interior design, when the main light cannot be set, the auxiliary light source can also be used for illumination (Figure 7). The positioning of the auxiliary light source can also effectively display the characteristics of the indoor scene and the overall indoor lighting effect is designed. The teacher can guide the students to adjust the positions of different light sources reasonably and appropriately according to different design concepts and different styles and scenes to achieve the best lighting effect to achieve the best design effect in the end. The last is to guide students to set up a parade animation, in order to promote the design of the indoor plan to get a good 3D visual effect. In the design teaching process, they can guide students to use auxiliary software to simulate animation, and can make students understand the entire design product's panorama and details, design content, and features through the use of parade mode animation display. If the indoor space is large, it can also be guided to show the details of the design plan one by one with the help of space switching.



**Figure 7:** Classroom efficiencies of different interior design teaching indicators before and after optimization based on 3D computer-aided simulation.

Modern interior design has high artistic requirements, and the design content involved has high technical content, and it has a very close relationship with some emerging disciplines. Modern interior design has developed into an independent emerging discipline in the environmental design series. Modern interior design should meet the needs of people and interpersonal activities as the core and strengthen the overall view of the environment. In creating the indoor environment, students must attach great importance to science, artistry, and their mutual combination; the use of 3D computer-aided simulation technology can undoubtedly meet teachers' continuous demand for interior design. Therefore, facing a wide-ranging subject such as the application of 3D computer-aided simulation technology in interior design, it is necessary to conduct comparative analysis, explore and summarize from many fields, and jump research from the application of one discipline to another requires rapid change thinking and repeatedly adjust perspective [11]. Due to the functional development of computer drawing software, computer-aided simulation has accelerated the teaching development of interior design majors, and the most obvious change has improved the effect. Computer-aided simulation software can better complete the corresponding design subjects, thereby improving efficiency. Through the output of two-dimensional drawings and 3D models, modern interior design concepts can be better conveyed.

In higher education, this method has been accepted and used extensively by the world's art and design circles, colleges and universities, and related professional teachers and students due to the precise, efficient and powerful features of computers. Introducing this technology into teaching can not only improve the quality of teaching but also deepen students' understanding of art. Computer 3D simulation is the process of digitizing interior design and teaching. On the one hand, it is accurate, efficient, easy to change, and very convenient to operate; it is also very controllable in the design process and teaching effects. The space can express the perspective relationship quickly and correctly, and strive to be consistent with the future design state. The furniture and furnishings can be easily replaced during teaching and discussion, which can improve students' aesthetic ability and interaction in teaching, and avoid the inconsistency between the state of

design imagination and the effect of future decoration. More importantly, the design expression can enable students to grasp the types of decorative materials and their expression forms in different environments, and grasp the texture and cutting methods of these materials in the accurate transmission of material texture. This kind of auxiliary design teaching expression will promote the development of the design industry and increase people's aesthetic needs.

## 5 CONCLUSIONS

This paper proposed the curriculum construction optimization of interior design based on 3D computer-aided simulation, analyzed the teaching practice optimization of interior design based on 3D computer-aided simulation, and discusses the teaching optimization mode and its realization paths of interior design based on 3D computer-aided simulation. The work can be modified in time on the computer design platform, which greatly improves the teaching efficiency and saves the time for students to complete design tasks. In the students' practice operations, teachers should encourage students to put forward more innovative ideas and skills, and guide more students to participate in thinking about problem solutions through discussion groups. In the teaching content of software curriculums, in addition to basic knowledge, some excellent students are given better opportunities to improve. Many practical projects have been added to the teaching to make these students with strong understanding ability and quick hands to play better level. Therefore, facing a wide-ranging subject such as the application of 3D computer-aided simulation technology in interior design, it is necessary to conduct comparative analysis, explore and summarize from many fields, and jump research from the application of one discipline to another requires rapid change thinking and repeatedly adjust perspectives. The results show that the optimized interior design teaching program can significantly improve the students' ability to express the concept of the design program, effectively cultivate the students' overall space design ability, and is of great significance to stimulate students' enthusiasm and improve teaching quality. The study results of this paper provide a reference for the further researches on teaching optimization of interior design based on 3D computer-aided simulation.

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