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Teaching Reform Exploration of Modern Lighting Technology and Its Practice Oriented by Multiple Interests

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Course of "Modern Lighting Technology (MLT)" plays a pivotal role in the development of lighting technology and architectural lighting design. It provides students with the chance to acquaint themselves with cutting-edge technologies and nurture their ability to master advanced lighting techniques, thus devoting to the scientific and technological advancement of entire lighting field. At present, teaching of the "MLT" curriculum is encountering significant challenges. To effectively tackle the difficulties, this paper conducts an in-depth analysis of the specific teaching methods of "MLT" from multiple perspectives. These perspectives include aligning teaching and educational goals with the times, reflecting contemporary characteristics, diversifying educational means, implementing diverse teaching approaches, and adopting unconventional assessment schemes, which are all guided by multiple interests. On one hand, this diversified teaching model can fully harness students' principal role in learning, ignite their enthusiasm and initiative, and cultivate their innovative thinking. On the other hand, it also provides fresh insights and references for the enhancement of teaching efficiency.

Keywords: multiple interests, modern lighting technology, teaching reform, teaching efficiency

Introduction

Modern lighting technology (MLT) is a comprehensive science and applied technology on basis of different areas of knowledge from materials science, optics, electronics and electrical engineering, architectural design, vision and physiology, etc. Especially with the development and high requirement of contemporary new materials, new light source devices, modern buildings, and high standardization of application effects, its related knowledge education, skill teaching, and teaching practice are all encountering new challenges. Course of "MLT" is not only suitable to the major of Photoelectric Technology Application, but to undergraduates and postgraduates specializing in electronic information-related fields. Moreover, this course is also applicable in society to train personnel engaged in lighting design and scientific research, production technicians for lighting sources and luminaires, lighting engineering design and construction technicians, as well as the government departments and management personnel at all levels.

In this course, students mainly study and research the basic principles, technical schemes, testing standards

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of modern lighting, various lighting equipment, as well as the core theoretical knowledge and professional techniques that were integrated from the key necessary technologies in lighting project operations. Obviously, these contents have strong theoretical and practical requirements. Through comprehensive learning of this course, students will master the modern scientific theories and technical methods and utilize them to solve practical problems in modern lighting system planning and design. This will empower them to possess the necessary competencies in modern lighting project management after graduation, devoting to China's urban construction and development, and contributing their professional skills to the modernization drive.

In the teaching process, comprehensive stimulation of students' learning interests, cultivation of their "lighting"-based innovative thinking abilities, and improvement of their operation levels of international-standard professional simulation software and systems are urgent methodological issues, which need to be addressed and carried out for necessary explorations. Considering the existing problems in the present course teaching, the changes in students' learning methods, and the new schemes and requirements of MLT, it is essential to optimize and reform the traditional teaching concepts and methods of "MLT".

Problems in Classroom Teaching of "Modern Lighting Technology"

Disengagement Between Educational Instruction and Contemporary Development

Teaching materials like textbooks are the foundation of educational work. Degree of advancement and practicality of textbooks directly affects the actual teaching effectiveness. Currently, field of MLT has been developing at an extremely rapid pace. New lighting principles, new types of lighting fixture materials, and intelligent lighting control systems are emerging continuously. Thus, there have been significant optimizations and improvements in the application models and methods of lighting technology. However, most of the "MLT" textbooks were compiled before 2016. The theoretical knowledge in the "MLT" curriculum often lags behind, remains at the stage of traditional lighting technology, and lacks timely updates to integrate with these new development trends. New innovations should be made in the teaching methods. According to Cheng and Li (2024), modern teaching tools (e.g. virtual simulation, multimedia technology) are introduced to enhance the intuitive nature of teaching and learning, and methods such as project-based learning and case studies are used to enhance students' active participation and problem-solving abilities.

On the other hand, the elaboration on the principles of intelligent lighting control is inadequate. With development of the Internet of Things technology, intelligent lighting control systems have achieved the more complex and efficient control methods. For instance, there emerge intelligent dimming and color-tuning technologies based on sensor fusion and distributed intelligent lighting control networks. Yet textbooks may not have been updated promptly regarding these new principles of intelligent lighting control and are still stuck at basic levels like simple manual switch control and single-sensor control. Meanwhile, in the part of lighting design, the coverage of new design concepts is incomplete, and in lighting calculation methods, there still exist limitations to operate various lighting simulation softwares based on ray-tracing algorithms. Under such circumstances, higher education needs to adopt textbooks to meet the requirements of the times, better carrying out the education work of the "MLT" course (Montoya, Peña-García, Aunidi, & Manzano-Agugliaro, 2024).

Disconnect Between Theory and Practice in the Process of Educational Practice

Generally, the "MLT" course possesses relatively high theoretical feature, while the contents are rather

abstract, dull, and uninteresting. As a result, students often show a lackluster attitude. To address this issue, Gao (2017) proposed to combine explicit and implicit teaching, to improve the active learning of students' questions in course teaching, and to guide students' knowledge-practice correlation by combining real cases and scientific research frontiers. Afterwards, students will be influenced unconsciously and the shortcomings of traditional didactic teaching will be well compensated. In the current education and teaching context, to make teaching more vivid, Cheng and Li (2024) suggest that teachers can systematically expand on certain principles' explanations by closely combining practical cases from daily life with the latest scientific research frontiers. Students can then connect textual knowledge with real-life practices to solve their own puzzles. The cases closer to life are more appealing to students, which helps to increase the classroom interest and improve the actual teaching effect. In brief, addressing the theory-practice gap can reduce prominent issues such as the course's abstraction and dullness, potentially leading to that teaching outcomes align with anticipated objectives.

Insufficient Enthusiasm for Active Learning

The complexity of textbook content, the abstractness of certain concepts, and the depth of theories make the "MLT" a professional basic course or an optional course. Most students do not enroll in this course due to a genuine interest or a strong learning motivation. Instead, they are merely aiming to obtain the course credits. As a result, with the antiquated teaching models such as "lecturing non-stop", "the unilateral classroom teaching mode", and "cramming-type", most students do not pay attention in class and are easily susceptible to distractions (Huang, 2024). This can even lead to failure in the assessment of the course.

Humdrum Assessment Criteria Adopted in Teaching

At University of Shanghai for Science and Technology (USST), elective course grades are typically determined by the combination of the usual score and the examination sore. Generally, proportion of the usual score is not less than 30% but not higher than 70% of the total score, which includes assessments of attendance, classroom questions, experimental reports, etc. The final examination mainly tests students' mastery of important knowledge points. However, such an assessment method is rather one-dimensional. Most students will engage in last-minute cramming and rote memorization of notes as a strategy to prepare for examinations. This makes it difficult to judge whether students truly have flexible mastery and qualified application of knowledge. The final score cannot fully demonstrate students' learning process, ability level, and comprehensive quality. Such an evaluation method conflicts with the student-centered educational concept, and is not conducive to cultivating the MLT professionals with innovative and practical abilities.

Teaching Method Reform Oriented by Diversified Interests

The Times-Synchronized Educational Goal of Course Teaching

Interest is the best teacher. Besides theoretical teaching, the practice of the main contents in the "MLT" course should be implemented to make students clearly understand the current situation and development trends of the lighting industry at home and abroad. The feasible processes may include the development overview of lighting technology by visiting industries, lighting equipment and technology classification, lighting principles and characteristics, real-practice of lighting design and application (Olajiga, Ani, Sikhakane, & Olatunde, 2024). This enables students to clarify the goals of China's future lighting industry development, master the basic theory and modern lighting production technology, and ultimately cultivate their problem-analysis and management abilities.

Moreover, there exist textbooks related to the basic "MLT" courses. Given the current situations only in the course hours, it is quite challenging to master the content comprehensively. Therefore, it is necessary to reasonably arrange the teaching content sequence. By keeping the core content of theoretical course systematic and integral, the teachers should carefully select the optimal teaching content, clarify the logical relationship between chapters, and define the classroom teaching objectives.

Enriching Teaching Resources, Means, and Teaching Experiences

In the conventional classroom teaching of "MLT" course, the predominant pedagogical approaches center on teachers disseminating knowledge, whereby students ultimately engage in passive absorption through rote memorization. Although some higher-education institutions have advocated for student-centered and action-oriented teaching methods, in most universities, especially when it comes to engineering theory courses, the actual achievement and genuine implement of these methods are no so easy. It is uncommon to witness their complete implementation. The traditional teaching approach, even though, manages to cover every single knowledge point in the textbook, but completely overlooks students' initiative and enthusiasm for learning. Usually, students are confronted with certain "boring" theoretical formulas in the textbooks. At the end, the students not only lose their eagerness to actively acquire knowledge, but start to lose interest in professional theoretical courses.

Tamilselvi (2024) suggested that the teachers can adopt a variety of technologies to enrich the teaching contents and approaches. These in USST include using physical lighting fixtures, models, video animations, platforms like Xuexitong and Yiwang Changxue, remote lighting scene monitoring, picture display, and virtual simulation. Different types of lighting fixtures, light bulbs, lampshades and diverse powers can be shown in class. The video animations can cover aspects such as the production process of lighting fixtures, the display of lighting design cases, and light art performances. Jiang (2024) mentioned the combination of offline practical learning and online theoretical learning, e.g. through live Q&A, community discussions, to enhance the interactivity of learning. Through the Xue xi tong and Yi wang Chang xue platforms, teachers can share electronic materials with students in advance. By incorporating these elements, teachers can make knowledge more visual and vivid, which greatly stimulates students' interest in learning and their thinking in class.

Acquiring Innovative Pedagogical Transformation

Raja and Nagasubramani (2018) highlighted that in the traditional teaching of theoretical courses, it is quite common to see the teacher standing at the podium and elucidating the PPT courseware. However, the students are stuck in the classroom throughout the day listening to these elucidations. It can get really dull and unappealing for them. Therefore, a key problem to be solved in the theoretical course teaching is how to arouse students' interest. One effective way is to actually operate or assemble relevant appliances and equipment in class. It was found that in practical teaching experience the real-life examples are incredibly effective in explaining the basic theoretical knowledge and concepts. In daily lives, when we compare a 60 W incandescent bulb with an LED bulb having the same power, some interesting differences can be observed: The light from the bulb has a relatively yellowish tint and does not appear much bright, while the LED produces whiter and brighter light. This contrast is exactly caused by their different luminous fluxes.

When it comes to those complex mathematical derivations and operations, the teachers should simplify them, and guide students to focus more on how to apply the formulas. Students should not just have a decent understanding of the theories in this course, but they should actually be able to blend theory with practice. For

example, operation of the DIALux lighting-design simulation software can turn those abstract theoretical concepts into vivid visual scenes. Students can play around with the different lighting parameters and watch how the lighting effect changes (Zhang, Yuan, Zhang, & Guo, 2021).

Innovative Change in the Assessment Methodology

Assessment of the "MLT" course ought to put great emphasis on the flexible application of theoretical knowledge and the capability to tackle practical problems. Hence, it is advisable to enhance the emphasis on process-based evaluation while diminishing the weight assigned to outcome-based evaluation. Moreover, practical operation ability should be integrated as a crucial component of the course assessment, proportion of which needs to be raised in the total score. The course can examine students' practical capabilities by real-world lighting design projects and experimental operation skills tests. For example, after-class tests account for 15%, practical assessment makes up 25%, innovation ability evaluation takes 10%, class performance contributes 10%, and the final exam scores make up 40%.

The after-class tests mainly involve students reading and summarizing relevant materials and papers on the MLT. The practical assessment and innovation ability evaluation would mainly rely on the DIALux lighting design software. Utilizing actual lighting design projects, students are required to carry out the lighting designs according to real-life scenes on basis of some known standards, such as "Architectural Lighting Design Standard" and "Urban Road Lighting Design Standard". As for the final exam score, it is determined by the DiALux software used for conducting classroom lighting design and analysis following the lighting design standard of GB 50034-2013. In all the design processes, students must not only focus on the lighting effect in strict accordance with the indoor lighting design standard for classrooms, but examine the cost-control and energy-saving effects of the design scheme with detailed analysis and measures (Zhang, Yuan, Zhang, & Guo, 2021). Finally, a complete design report needs to be submitted.

Teaching Reform Practice and Its Efficacy

High-Level Activity and High Recognition Rate Among Students

Guided by the multiple interest-driven teaching methods, students have responded quite positively at learning the basic theoretical parts. Using real-life cases to explain complex theoretical knowledge significantly boosted students' enthusiasm and initiative to engage in study. In the course feedback survey, students gave high recognition to these innovative teaching methods. A large number of students mentioned that such learning approaches allowed them to truly experience the charm of lighting technology in daily life. Furthermore, students' eagerness to explore the MLT beyond the class also had a remarkable increase. They currently consult literature and materials to verify problems, and actively participate in special discussions and classroom interactions.

New Teaching Concept Promoted by the Integration of Knowledge and Action

Besides the acquisition of theoretical knowledge in professional course, they also manage to apply the knowledge by flexibly operating the lighting-design simulation software. Through the integration of knowledge and action, it allows students to encounter/solve the problems and challenges they might face in real-world work ahead of time. Specifically, in the "MLT" teaching, the introduction of the DIALux software has been an extremely innovative endeavor. Many students stated that operating this software has deepened their understanding and awareness of lighting technology.

This learning approach that combines theory and practice vividly embodies the teaching concept of

integrating knowledge and practice. Students are no longer restricted to learning book knowledge. Instead, they can apply what they have learned to specific scenarios through hands-on operations, truly achieving the learning goals for applications. Meanwhile, such a teaching method also spurs students' innovative thinking and creativity. They keep experimenting with new methods and ideas during the design process, and injecting new vitality into the development of modern lighting technology, as discussed by Sinigaglia, Bellia, and Marchesi (2021).

Conclusion

In summary, taking the "MLT" course as representative, the critical problems and challenges encountered within the course teaching and students' learning were systematically analyzed. A series of new teaching approaches guided by diverse interests have been rationally suggested for teaching reform explorations. The practice of reformed teaching methods and that of diversified assessments have won high acclaim and positive feedback from students in the "MLT" course. These approaches not only enhance students' learning outcomes and practical capabilities, but offer robust supports for the teaching concept of integrating knowledge and action.

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