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Integrating Green Management Case Studies in Construction Engineering Courses to Improve Students' Critical Thinking

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Abstract

With the growing need in the industry for sustainable practices and critical thinking abilities, the inclusion of green management case studies in construction engineering education is becoming more and more crucial. Developing these talents is frequently not possible with traditional educational approaches. This paper investigates the theoretical foundations and practical implementation of case-based learning in construction engineering courses, with a focus on green management, to show how it might enhance students' critical thinking abilities. The project intends to close the gap between academic learning and industrial expectations by incorporating real-world examples of eco-friendly materials, energy-efficient designs, and cutting-edge green technologies. The results emphasize the value of hands-on learning in helping students develop a deeper comprehension of sustainable practices and getting ready for the difficulties of contemporary construction engineering.

Keywords: Green, Construction Engineering, Critical Thinking, Management, Case Studies.

Introduction

Professionals in the construction engineering sector need to be highly skilled in critical thinking in order to properly manage intricate projects and address unforeseen issues. Furthermore, incorporating sustainable techniques into construction processes is becoming increasingly important. These vital abilities are not sufficiently developed by the traditional pedagogical approaches in construction engineering education, which are primarily lecture-based. It is imperative that creative teaching approaches that promote sustainability and critical thinking be adopted as the sector changes. This essay explores how including case studies on green management into construction engineering curricula might help students develop their critical thinking skills and encourage sustainable lifestyles.

Case Studies to Improve Critical Thinking

The Role of Critical Thinking in Construction Engineering

Critical thinking is the process of examining data, weighing arguments, and coming to well-reasoned conclusions (Facione, 2011). It is essential for efficient decision-making, problem-solving, and project management in the field of construction engineering (Chang & Yu, 2016). Engineers often work in complex environments that need for a combination of technical expertise and critical and creative thinking to come up with workable solutions (Hadgraft & Kolmos, 2020). Theoretical knowledge and memorization are frequently emphasized in traditional educational approaches, which may not effectively prepare students for the dynamic and frequently unpredictable nature of real-world engineering tasks (Shernoff et al., 2020).

Benefits of Case-Based Learning with a Green Management Focus

Using real-world scenarios, case-based learning teaches students how to apply theoretical knowledge to solve real-world challenges. This approach boosts engagement, promotes active learning, and offers useful insights that may be used right away to professional practice (Owens et al., 2020). The efficacy of case studies in education is supported by the constructivist theory of learning, which holds that students build knowledge via experiences and reflection (X & Shi, 2018). Students can investigate sustainable techniques, such as resource efficiency, waste reduction, and environmental effect mitigation, by including green management into case studies (Ribeiro et al., 2021). This promotes a more thorough and responsible approach to construction engineering.

Integration Of Green Management Case Studies Into Course Design

Course Design and Implementation

Carefully choosing pertinent and difficult cases, developing instructional methodologies that encourage active learning, and creating a welcoming learning atmosphere are all necessary for incorporating green management case studies into construction engineering courses (Sukackė et al., 2022). The theoretical underpinnings of course design and useful execution strategies are examined in this section.

Selection of Case Studies

Case studies should be chosen with consideration for how well they will serve to illustrate important construction engineering and green management ideas, as well as how well they will relate to the course objectives (Badi & Murtagh, 2019). A variety of subjects, such as eco-friendly materials, energy-efficient building designs, innovative green technology, and sustainable project management, should be included in the cases (Gebreslassie & Zayegh, 2023). It is crucial to select instances that accurately represent the intricacies and unpredictabilities of actual engineering projects, pushing students to use their knowledge in novel and productive ways (Rosen, 2019). Professionals from the industry can also guarantee that the cases are in line with current issues and practices in the sector, especially with regard to sustainability (Appolloni et al., 2022).A rainwater harvesting system, for example, is shown in figure 1 below, which is an example of how green technology is used in building. In addition to promoting sustainable water management, this kind of equipment gives students a practical illustration of how to examine and comprehend the challenges associated with applying environmentally friendly solutions in real-world settings (Cardoso et al., 2020).

Figure 1. Rainwater harvesting system

Instructional Strategies

Role-playing, group projects, and guided discussions are useful teaching strategies for case-based learning (Yan et al., 2024). By leading discussions, giving challenging questions, and providing feedback, instructors can help students develop their critical thinking skills (Foo & Quek, 2019). The cornerstone of these strategies is the principle of experiential learning, which stresses learning via application, reflection, and experience (McDonald & Spence, 2016). Collaborative learning activities such as peer reviews and group discussions may enhance the educational process even further by allowing students to gain from each other's perspectives and ideas (Mora et al., 2020). The engagement and realism of case-based learning can both be enhanced by the use of technology (Dickinson et al., 2018). Virtual simulations and digital collaboration tools are two instances of this.

Creating an Immersive Learning Environment

Creating an immersive learning environment is crucial to integrating case studies in a successful manner (Hutson & Olsen,2022). This entails integrating digital tools like augmented and virtual reality to create surroundings that are both realistic and interesting (Arena et al., 2022). Students' understanding and memory of difficult subjects are improved in immersive learning environments (Mulders et al., 2020). For example, by mimicking construction sites, virtual reality allows students to explore different scenarios and make informed judgments in a risk-free environment (Ouyang, et al., 2020). In contrast, augmented reality allows students to better understand structural and architectural ideas by superimposing digital information over actual models (Hajirasouli & Banihashemi, 2022). In addition to increasing student engagement, these technologies provide priceless real-world experience that conventional teaching techniques frequently are unable to offer (Broderick, 2016).

Enhancing Critical Thinking Through Green Management Case Studies

Cognitive Development

Higher-order thinking abilities can be developed in pupils by exposing them to challenging, real-world challenges, according to theories of cognitive development. Case studies push students to think critically and develop their cognitive abilities by requiring them to assess options, examine data, and come to well-reasoned conclusions (Burkhalter, 2016). Active and social learning is crucial for intellectual development, according to theories of cognitive development like Vygotsky's social constructivism and Piaget's phases of cognitive development (Huang, 2021). Through interaction with the material and peer cooperation, students actively develop knowledge and understanding through case studies, moving beyond passive learning.

Analytical and Problem-Solving Skills

Students must dissect difficult situations, pinpoint important topics, and assess the evidence when studying case studies. The analytical abilities necessary for construction engineering are developed through this procedure. Case studies help students become more adept at solving problems by giving them real-world problems with workable solutions (Tawfik & Kolodner, 2016). Analytical abilities include data analysis, logical reasoning, and critical thinking—all of which are essential for effective engineering practice. As students work through the case studies, they build their problem-solving skills by recognizing various solutions, analyzing the benefits and drawbacks of each choice, and choosing the best course of action (Chin et al., 2019). Students are prepared for professional practice through this iterative process of analysis and decision-making, which simulates the difficulties faced by construction engineers in the real world.

Challenges and Considerations

Resistance to Change

It is possible that instructors and students who are used to traditional teaching methods will object to the adoption of case-based learning. One way to get past reluctance is to train and assist teachers, include case studies into the curriculum gradually, and show the advantages of active learning (White et al., 2016). Educators might have to acquire new abilities and modify their methods of instruction in order to properly support case-based learning. Facilitating opportunities and resources for professional growth can aid instructors in making a seamless transition (Adnan, 2018). Furthermore, involving students in the discussion of the practical applications and advantages of case-based learning can boost their enthusiasm and adoption of this methodology.

Resource Allocation

Resources including time for case study development, instructor training, and student materials are needed for an effective case-based learning implementation (McLean, 2016). These resources must be allotted by institutions in order to facilitate the shift to case-based learning. It can take time and sometimes cooperation with industry professionals to produce case studies of the highest caliber. In order to facilitate immersive learning environments, institutions should also make investments in infrastructure and technology (Ntaba & Jantjies, 2021). Sufficient resources and assistance are necessary to guarantee the effective

incorporation of case-based learning and optimize its advantages for learners (Duan et al., 2021).

Assessment of Critical Thinking

Evaluating critical thinking abilities can be difficult. Standardized critical thinking examinations, project-based assessments, and reflective essays are examples of theoretical methods to assessment. In the context of case-based learning, these techniques can be used to assess students' analytical and problem-solving abilities (Wijnia et al., 2024). Students are encouraged to explain their reasoning and thought processes in reflective essays, which reveal information about their critical thinking abilities. Assessments focused on projects can gauge how well students apply their knowledge to real-world problems and come up with workable answers. Standardized assessments offer a more objective way to gauge critical thinking abilities and enable comparisons between various cohorts and educational settings (Shaw et al., 2020).

Conclusion

Synthesis of Theoretical Insights

Education ideas such as constructivist theory, contextual learning, and experiential learning all encourage the incorporation of green management case studies into construction engineering curricula. These theories offer a solid framework for comprehending the ways in which case-based learning might improve critical thinking. The active creation of knowledge via experience and reflection is emphasized by constructivist theory. The theory of experiential learning emphasizes the value of learning by doing and thinking back on experiences. According to the notion of situated learning, knowledge is most effectively acquired in situations that mirror its practical application. When taken as a whole, these theories lend credence to the idea that case-based learning fosters critical thinking abilities.

Implications for Practice

Drawing from theoretical insights, the incorporation of green management case studies into construction engineering courses can enhance students' readiness for professional difficulties by cultivating their analytical, problem-solving, and critical thinking abilities. Redesigning the curriculum, providing training for teachers, and allocating resources are among the practical ramifications in order to facilitate case-based learning. Employability and readiness of graduates can be improved by educational institutions by matching their practices to industry demands. Furthermore, cultivating an environment that values innovation and ongoing development in education helps guarantee that teaching methods continue to be applicable and efficient in a field that is undergoing fast change.

Future Directions

To improve the application of case-based learning and investigate its long-term effects on students' professional achievement in construction engineering, more theoretical investigation and research are required. Future studies can look into how well various case study formats, teaching techniques, and evaluation techniques aid in the development of critical thinking abilities. The effects of case-based learning on students' career paths and professional performance can be investigated through longitudinal research. Working

together, academia and business may share insightful knowledge and guarantee that teaching methods continue to reflect the demands and trends of business.

Contribution

This study makes a significant addition by creatively incorporating case studies on green management into the teaching of construction engineering with the goal of strengthening students' critical thinking skills. Through its capacity to connect theoretical understanding with practical application, this study provides a useful foundation for integrating sustainability into engineering curricula. The study offers practical advice for course design and implementation in addition to a thorough examination of the pedagogical advantages of case-based learning. It also discusses the difficulties and factors to be taken into account when using this strategy, providing suggestions for efficient resource management and critical thinking skill evaluation. By matching academic instruction with industry expectations, this study advances the conversation on engineering education reform by educating students for the changing needs of the construction industry.

Declaration of Interests

We declare that we have no relevant conflicts of interest, either financial or non-financial.

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