Exploration and Practice of Cultivation Models for Exceptional Engineering Talents in Environmental Majors in the Context of New Engineering Disciplines

Ma Xiaohang[1], Xu Jun[2]， Zhang Jun[1], Ji Mingfei[1], Li Yuying[1]

[1]College of Water Resources and Environment Engineering, Nanyang Normal University, Nanyang, Henan, China

[2]College of Civil Engineering and Architecture, Nanyang Normal University, Nanyang, Henan, China

Abstract: With the increasing demand and development requirements for environmental majors in the context of the New Engineering Disciplines, new challenges have emerged in nurturing exceptional engineering talents. This study aims to explore and implement an innovative model for cultivating exceptional engineering talents in environmental majors. This research provides valuable insights and references for the exploration and practice of exceptional engineering talent cultivation models in environmental majors.

Keywords: New Engineering Disciplines; Environmental Majors; Exceptional Engineering Talents; Training Model; Practical Teaching

1. Introduction

1.1 Research Background and Significance

In the context of the New Engineering Disciplines, environmental majors play a crucial role in addressing the increasing demand for environmental protection and sustainable development. Consequently, there is a growing need to cultivate exceptional engineering talents in the field of environmental majors. Therefore, it is of great significance to explore and implement innovative models for nurturing exceptional engineering talents in environmental majors. By studying the cultivation models for exceptional engineering talents in environmental majors, this research aims to provide theoretical and practical support for educational reforms and practices in related fields.

1.2 Research Objectives and Methods

The objective of this study is to explore and implement an innovative model for cultivating exceptional engineering talents in environmental majors. To achieve this objective, a comprehensive research approach will be adopted, including literature review, survey analysis, and empirical research. Firstly, through a comprehensive review of relevant literature, the theoretical foundations and practical experiences of cultivating exceptional engineering talents in the context of the New Engineering Disciplines will be examined. Secondly, by conducting surveys and analyzing the current situation of cultivation models in environmental majors, the existing challenges and issues will be identified. Subsequently, taking into consideration industry demands and student needs, a practical and effective model for cultivating exceptional engineering talents in environmental majors will be designed. Finally, the implementation of this model will be carried out, and its effectiveness and improvement measures will be evaluated through empirical research, providing feasible models and experiences for cultivating exceptional engineering talents in environmental majors.

2. Analysis of the Current Status of Cultivation Models for Environmental Majors in the Context of the New Engineering Disciplines

2.1 Educational Reforms in the Context of the New Engineering Disciplines

In recent years, the field of engineering education has undergone significant reforms in response to the evolving needs of society and industry. the emergence of the New Engineering Disciplines has brought about a

shift in the traditional approach to education, emphasizing interdisciplinary collaboration, project-based learning, and the integration of theory and practice. These reforms aim to produce graduates who possess not only technical expertise but also problem-solving skills, adaptability, and a holistic understanding of societal and environmental challenges.

2.2 Characteristics and Challenges of Cultivation Models for Environmental Majors

Cultivating exceptional engineering talents in the field of environmental majors presents unique characteristics and challenges. Environmental majors encompass a wide range of disciplines, including environmental science, environmental engineering, and sustainable development. the cultivation models for environmental majors need to address the interdisciplinary nature of the field, integrating knowledge from various disciplines such as biology, chemistry, and engineering.

One of the key challenges is to strike a balance between theoretical knowledge and practical skills. Environmental issues often require hands-on experience and fieldwork to apply theoretical concepts in real-world scenarios. Therefore, the cultivation models for environmental majors should incorporate experiential learning opportunities, such as internships, research projects, and community engagement activities, to enhance students' practical skills and problem-solving abilities.

Another challenge is keeping pace with the rapid advancements in technology and the dynamic nature of environmental issues. Environmental majors need to adapt to emerging trends and technologies, such as remote sensing, data analytics, and renewable energy systems. Cultivation models should provide students with opportunities to gain knowledge and skills in these emerging areas, fostering innovation and adaptability.

Furthermore, collaboration and interdisciplinary teamwork are essential in addressing complex environmental challenges. Cultivation models should emphasize the development of effective communication, teamwork, and leadership skills, as well as the ability to work across disciplines and engage with stakeholders from diverse backgrounds.

To overcome these challenges, cultivation models for environmental majors should be flexible and adaptable, allowing for continuous improvement and incorporating feedback from industry professionals, alumni, and students. Collaboration between academia, industry, and government agencies can also enhance the relevance and effectiveness of these models.

3. Exploration and Discussion of Relevant Theories and Models

3.1 Engineering Education Theories

In the context of cultivating exceptional engineering talents in environmental majors, it is important to explore relevant engineering education theories. One prominent theory is the CDIO (Conceive, Design, Implement, and Operate) framework, which emphasizes the integration of engineering fundamentals with project-based learning. This framework promotes hands-on experiences, teamwork, and the development of professional skills, aligning well with the practical nature of environmental majors. By adopting the CDIO approach, students can apply their theoretical knowledge to real-world problems, enhancing their problem-solving abilities and creativity.

Additionally, the constructivist approach emphasizes student-centered learning and active engagement. This approach encourages students to construct their own understanding of concepts and actively participate in their learning process. Thus, in the context of environmental majors, educators can employ project-based assignments, case studies, and experiential learning activities to foster students' critical thinking skills and their ability to apply knowledge to real-world scenarios.

Furthermore, the theory of transformative learning suggests that education should go beyond the acquisition of knowledge and skills. It posits that education should facilitate personal growth and transformation. In the context of cultivating exceptional engineering talents in environmental majors, educators can design learning experiences that challenge students' assumptions, broaden their perspectives, and foster their ethical and social responsibilities towards the environment. This approach can empower students to become change agents and leaders in tackling environmental issues.

3.2 Cultivation Models for Exceptional Engineering Talents

Numerous cultivation models have been explored and implemented in the context of the New Engineering Disciplines. One common model is the integration of industry collaboration and internships. By establishing partnerships with industry organizations, students can gain practical experience and apply their knowledge in real-world settings. This model not only enhances students' technical skills but also provides them with insights into industry practices and demands.

Another model is the establishment of interdisciplinary research centers or laboratories. These centers provide students with opportunities to engage in cutting-edge research projects, collaborate with faculty members and industry professionals, and develop their research and innovation abilities. Through this model, students can gain a deeper understanding of the interdisciplinary nature of environmental issues and contribute to the development of innovative solutions.

Furthermore, mentorship programs can be implemented to provide guidance and support to students. Mentors, who can be experienced faculty members or industry professionals, can provide valuable insights, advice, and networking opportunities to help students navigate their academic and professional journeys. This model fosters a supportive and nurturing environment for students, allowing them to develop both professionally and personally.

Additionally, incorporating sustainability and environmental ethics into the curriculum is essential. This can be achieved by integrating courses and modules dedicated to sustainability principles, environmental law and policy, and ethical decision-making. By instilling a sense of responsibility and stewardship towards the environment, this model cultivates environmentally conscious engineers who consider the long-term impacts of their work.

4. Design and Construction of Cultivation Models for Exceptional Engineering Talents in Environmental Majors

4.1 Needs Analysis and Goal Setting

Before designing a cultivation model for exceptional engineering talents in environmental majors, a thorough needs analysis should be conducted to understand the industry requirements, student expectations, and societal needs. This analysis can involve surveys, interviews with industry professionals, alumni, and students, as well as a review of relevant literature and research. Based on the findings, clear goals and objectives should be set, aligning with the vision and mission of the educational institution and the specific needs of the environmental majors.

The goals could include developing students' technical skills in environmental engineering, fostering interdisciplinary collaboration and problem-solving abilities, nurturing leadership and communication skills, and cultivating a strong ethical and sustainable mindset. These objectives should guide the design and implementation of the cultivation model.

4.2 Curriculum Design and Teaching Method Selection

The curriculum design is a crucial aspect of the cultivation model for exceptional engineering talents in environmental majors. It should strike a balance between core disciplinary knowledge and interdisciplinary perspectives. the curriculum should include courses that cover fundamental concepts in environmental science and engineering, as well as courses that integrate knowledge from related disciplines such as biology, chemistry, and policy studies.

Project-based learning (PBL) is an effective teaching method that can be incorporated into the cultivation model. PBL allows students to work on real-world environmental problems, encouraging collaboration, critical thinking, and innovation. It promotes the application of theoretical knowledge in practical scenarios and prepares students for the challenges they may face in their future careers.

In addition to PBL, other teaching methods such as case studies, simulations, and fieldwork should be utilized to provide students with a comprehensive learning experience. Guest lectures from industry professionals, site visits to environmental facilities, and participation in environmental conferences and workshops can also enrich students' learning and expose them to the latest trends and practices in the field.

Furthermore, technology-enhanced learning tools can be integrated into the curriculum to

enhance students' engagement and facilitate self-directed learning. Online platforms, virtual reality simulations, and data analysis software can provide students with opportunities to explore complex environmental issues and develop their technical skills.

5. Implementation and Evaluation of the Cultivation Model for Exceptional Engineering Talents in Environmental Majors

5.1 Development of Practical Teaching Plans

To implement the cultivation model, practical teaching plans should be developed. These plans should outline the specific activities, assignments, and assessments that align with the goals and objectives of the model. the plans should specify how the curriculum will be delivered, the resources required, and the timeline for implementation.

The practical teaching plans should incorporate a variety of activities to cater to diverse learning styles and abilities. These activities can include laboratory experiments, group projects, case studies, internships, and community engagement initiatives. the plans should also consider the availability of resources, such as laboratory facilities, industry partnerships, and funding opportunities, to support the implementation of the model.

5.2 Challenges and Issues in the Implementation Process

During the implementation of the cultivation model, challenges and issues may arise. These could include resistance to change from faculty members or students, resource limitations, and difficulties in ensuring industry collaboration and support. It is important to address these challenges proactively by fostering a culture of openness and collaboration, providing support and training for faculty members, and seeking external partnerships and funding opportunities.

Regular monitoring and evaluation should be conducted to identify any issues and make necessary adjustments to the model. Feedback from students, faculty members, industry partners, and other stakeholders should be collected and considered to improve the effectiveness of the model. Continuous improvement and flexibility are key to ensuring the model remains relevant and effective in a rapidly changing educational and environmental landscape.

5.3 Evaluation of Effectiveness and Improvement Measures

To evaluate the effectiveness of the cultivation model, multiple assessment methods can be employed. These methods can include exams, project evaluations, student surveys, and feedback from industry partners. the assessment should focus not only on students' academic performance but also on their development of key skills and competencies outlined in the goals and objectives.

Based on the evaluation findings, improvement measures should be implemented to address any identified areas for growth or enhancement. These measures can involve revising the curriculum, providing additional training or resources for faculty members, and strengthening industry partnerships. the feedback from the evaluation should be used to make evidence-based decisions and guide the continuous improvement of the cultivation model.

6. Conclusion

The exploration and practice of cultivation models for exceptional engineering talents in environmental majors in the context of the New Engineering Disciplines have yielded several key findings. Firstly, the integration of interdisciplinary knowledge and project-based learning is essential in preparing students for the diverse and complex challenges of the environmental field. By incorporating concepts from various disciplines and providing opportunities for hands-on experiences, students can develop a holistic understanding of environmental issues and acquire the necessary skills to address them.

While significant progress has been made in exploring and implementing cultivation models for exceptional engineering talents in environmental majors, there are still areas that warrant further research and improvement. One important aspect is the continuous assessment and evaluation of the effectiveness of the cultivation models. Future research should focus on developing reliable and valid assessment methods to measure the impact of the models on students' learning outcomes, skill development, and career readiness.

The exploration and practice of cultivation

models for exceptional engineering talents in environmental majors in the context of the New Engineering Disciplines have yielded important findings regarding interdisciplinary education, industry collaboration, skill development, and sustainability. Future research should focus on assessing the effectiveness of the models, incorporating emerging technologies, fostering a global perspective, and adapting to the changing needs of the field. By continuously refining and improving these cultivation models, educational institutions can effectively prepare exceptional engineering talents to address the complex environmental challenges of the future.

Acknowledgments

This work was supported by The Innovative practice station of teachers for Integration of Producing teaching and research of Henan colleges 2022; The off campus practical education base project for college students of Henan 2022; The teaching reform project of university teaching sub-committee of water supply and drainage science and engineering, Ministry of Education (GPSJZW2022-24); The 2023 higher education research planning project of the china association of higher education (23LK0406):The cultivate research on reform of local universities advanced technical talents for BIM Under the background of new engineering construction; Nanyang Normal University research and practice project on research based teaching reform (2023-JXYJYJ-1); Nanyang Normal University higher education teaching and research projects (2022JXYJZD1); Nanyang Normal University top-notch courses (2022-YLKC-039); The construction project of off campus practical education base for college students of Nanyang Normal University 2023; Nanyang Normal University curriculum Ideology and politics (2023-KCSZSFK-23、2023-KCSZSFK-24、2023-KCSZJXTD-03、2023-KCSZYXAL-61、2023-KCSZYXAL-62).

Reference

[1] Li H., Chen Q., Chen L., et al. (2018). Research on the Cultivation Model of Exceptional Engineers in the Internet of Things Major of Local Applied Universities under the Background of the New Engineering Disciplines. China Adult Education, (16), 5.

[2] Bao Y., Jin X., Zhang H., et al. (2023). Exploration of the Cultivation Model for Exceptional Engineers in Aircraft Manufacturing Engineering under the Background of the New Engineering Disciplines. Higher Education Journal, 9(16), 162-166.

[3] Huang X., Ying S., Hu X. (2023). Construction and Practice of the Cultivation System for Exceptional Engineers in Chemical Engineering under the Background of the New Engineering Disciplines. Educational Progress, 13(11), 4.

[4] Wang F., Xiang J., Jing L., Yanzhen L., Huaze D., Xiongzi D. (2022). Exploration and Practice of the Construction of a Cultivation System for Exceptional Engineers in Chemical Engineering under the Background of the New Engineering Disciplines. Yunnan Chemical Industry, 49(10), 150-152.

[5] Zhang G., Wu J. (2019). Exploration of the Cultivation of Exceptional Talents in Engineering Management under the Background of the New Engineering Disciplines. Journal of Small and Medium Enterprises Management and Technology, (017), 000.

[6] Zhang G., Wu J. (2019). Exploration of the Cultivation of Exceptional Talents in Engineering Management under the Background of the New Engineering Disciplines. Journal of Small and Medium Enterprises Management and Technology, (17), 3.

