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The Exploration of the Comprehensive and Advanced Training Transformation Model for New Engineering Graduate Students

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Abstract

During the "14th Five-Year Plan" period, the cultivation of innovative graduate students has become an important issue in the reform of higher education, with the rise of new engineering disciplines. The education of new engineering graduate students is not only related to national scientific and technological innovation and industrial upgrading but also a key force in promoting social progress and economic development. The integration of industry, academia, research, and comprehensive innovation model, which is the deep cooperation of industry, knowledge, scientific research projects, and ideological and political education, provides a new educational model and practical platform for new engineering graduate classrooms. This model emphasizes the combination of theory and practice, aiming to cultivate high-quality talents with innovative capabilities and practical skills to meet the development needs of the new era. The integration of "industry-academia-research-comprehensive" achieves the transformation from theoretical knowledge to "comprehensive" and "advanced" levels, integrating theoretical knowledge with engineering practice, transforming scientific research achievements into teaching resources, and achieving a reciprocal relationship between teaching and scientific research. It strengthens the relationship between theory, practice, scientific research, and overall strength, achieving the "cross-integration" of theory, practice, and literacy, highlighting the scientific nature of engineering. Through comprehensive quality training, students can clearly position themselves and set future goals, cultivating applied talents who serve local industries.

Keywords

Comprehensive, Advanced Training, Transformation Model, New

Engineering Students

1. Situation Analysis

Graduate students in universities play a crucial role in advancing knowledge and innovation. They contribute significantly to research and development, often working on cutting-edge projects that push the boundaries of their fields. Their work helps generate new insights, technologies, and solutions to complex problems. Additionally, graduate students enhance the academic environment by engaging in intellectual discussions and bringing diverse perspectives. They also serve as future leaders and educators, shaping the next generation of scholars and professionals. But graduate students currently face some challenges:

1.1. Employment Issues

With the increase in opportunities for advanced studies, the difficulty of employment for master's degree students has increased, especially for those from non-"Double First-Class" universities, who face a phenomenon known as employment inversion, where the employment rate for master's degree graduates is lower than that for undergraduates (Chu et al., 2020). The expected monthly salary for master's graduates is significantly higher than that for undergraduates, leading to a situation where they are neither satisfied with low-paying jobs nor qualified for high-paying ones, thus increasing employment pressure. The number of master's graduates has surged, but the job market has not shown a significant improvement, further exacerbating employment pressure.

1.2. Psychological Issues

Students face various psychological issues, including anxiety, depression, and suicidal ideation. Graduate students experience psychological problems to varying degrees in areas such as scientific research, academic pressure, employment pressure, feelings of inferiority, and social phobia (Méndez-Prado & Ulloa, 2022; Shaikh et al., 2024).

1.3. Educational System and Training Issues

The graduate education system is facing new challenges in interdisciplinary studies and professional degrees, necessitating the optimization of disciplinary and professional layouts as well as talent training systems. There is an inadequate understanding of educational training assessments (Skittou et al., 2024; Iannone et al., 2021).

These issues involve multiple aspects of graduate students' education, employment, and mental health, requiring joint efforts from universities, governments, and society to take effective measures to address them.

2. Tactics and Measures

Traditional engineering education models typically focus on theoretical knowledge and follow a more rigid curriculum structure. They emphasize foundational principles and often prioritize classroom lectures over hands-on experiences (Abedi et al., 2023). This approach has the advantage of providing students with a strong theoretical foundation, which is essential for understanding complex engineering concepts. However, it may limit students' opportunities for practical application and innovation, as it does not always incorporate real-world problem-solving or interdisciplinary learning.

New engineering graduate education should introduce micro-courses and case-based teaching models to keep pace with the development needs of the new era, and to build an integrated industry-academia-research system and a diversified evaluation system. This model helps to enhance the practical abilities and innovative thinking of graduate students. It is necessary to break the closed disciplinary system and promote interdisciplinary integration and communication to expand professional space and improve innovation capabilities. Actively explore the construction of an integrated industry-academia-research system to enhance the comprehensive quality and ability of graduate students, and provide talent and technical support for enterprise innovation. Employ a driving employment model and construct a doctoral application system.

However, the new model also has its limitations. It requires substantial resources, including modern facilities, equipment, and a diverse faculty with expertise in multiple disciplines. Additionally, the flexibility of the curriculum may pose challenges in ensuring that students acquire all the necessary foundational knowledge. Balancing the practical aspects with the theoretical underpinnings remains a key challenge in implementing this model effectively.

2.1. Introducing Micro-Lectures and Reconstructing the Knowledge System

To address the issues of graduate students' lack of concentration, disinterest, and rejection of courses, instructors can adopt the following strategies to improve teaching effectiveness (Jimoh, 2018):

(1) Reconstructing Teaching Content: Divide the teaching content into two parts: basic teaching content and deepening and expanding content. The basic teaching content should form a coherent system, while the depth of the deepening and expanding content depends on the students' grasp of the material.

(2) Micro-Classroom Teaching: Implement a "large-class teaching + small-group tutoring" model. Large-class teaching focuses on delivering the main content of the course, emphasizing the establishment of the knowledge system and the logical sequence of knowledge points. Small-group tutoring, on the other hand, addresses students' individual learning issues, discussing and responding to students' difficulties and questions.

(3) Problem-Driven Teaching: Become an excellent course designer, using problem-driven methods to stimulate students' curiosity and desire to explore,

allowing students to learn knowledge in the process of solving problems.

(4) Flexible Teaching Methods: Increase student participation by requiring students to complete relevant foundational knowledge learning within a certain time frame. Implement on-the-spot questioning, discussion, and communication in the classroom to enhance students' sense of participation and interest.

(5) Targeted Setting of Teaching Content: Stimulate students' interest in research related to interdisciplinary fields within their major, and precisely enhance each student's professional background by constructing a certain knowledge framework for their research.

(6) Integrating the Latest Scientific Research: Incorporate the latest scientific research developments into teaching, allowing students to understand the forefront of the discipline and increasing the attractiveness and practicality of the course.

2.2. Mentor-Team Leadership for Enhancing Practical Skills

In response to the issues of graduate students having numerous courses, heavy scientific research tasks, poor hands-on abilities, and lack of in-depth problem analysis, mentor teams can take the following measures (Su, 2024):

(1) Project Driven: Guide students through practical scientific research projects, allowing them to enhance their theoretical application and practical skills by solving specific problems.

(2) Integration of Theory and Practice: Mentors should combine scientific research theory with experimental design, clarify the plan, purpose, and expected outcomes of experimental research, and encourage students to actively participate in academic lectures and reports, communicate with experts in the field, and broaden their horizons.

(3) Research Team Building: Establish research and mentor teams to enhance students' scientific innovation abilities through teamwork and foster a positive academic atmosphere.

(4) Strengthening Hands-On Skills: Encourage students to participate in research projects to improve their hands-on skills through practical operation, and simultaneously enhance research efficiency and standards through regular reporting, attending academic presentations, and discussions.

(5) Cultivating Critical Thinking: Guide students to widely discuss topics such as technological revolutions in daily discussions, promoting the formation of dialectical viewpoints and deepening the depth of their thinking.

(6) Personalized Educational Guidance: Provide personalized educational guidance for each graduate student's ideological confusion, achieving the transformation from theory to practice, and helping students form correct life values and pursue updates.

By engaging in horizontal projects, understanding industry bottleneck issues, and through provincial and national scientific research projects, students are exposed to the most cutting-edge scientific questions. They confront these issues

directly, engage in scientific practice, and develop scientific thinking, innovation capabilities, and the ability to analyze and solve problems, achieving a transformation of theoretical knowledge to "comprehensive" and "advanced" levels (Wu et al., 2023). Focusing on Industry Needs to Achieve a "Comprehensive" Transformation of Theory: By collaborating with enterprises through professional and team efforts, students independently connect with the corporate environment, directly address corporate issues, and place a high value on transforming scientific and technological achievements into real productive forces, solving a series of critical technical challenges in the industry. Focusing on the Essence of Scientific Research to Achieve an "Advanced" Transformation of Theory: Assisting in scientific research, students independently connect with provincial/national scientific research projects, bringing them into laboratories and integrating research products into the classroom. This ensures that scientific achievements nourish the classroom, bringing research products into the learning environment, and visually summarizing the relationship between "structure-property-application," truly solving practical problems, enhancing original innovation, and improving the efficiency of the innovation system (Mao et al., 2023). This allows students to feel that knowledge can be applied and emotions can be grounded.

2.3. Energy Leadership and Future Guidance

Energy leadership, they possess a unique energy field that can guide and influence others. Projectors, by waiting to be invited, use the attractiveness of their energy field to lead others, prompting people to take action under their guidance (Baksh, 2021).

(1) Guidance on the Essence of Scientific Research: Emphasize the exploratory and innovative nature of scientific research, encouraging students to start from fundamental theories to cultivate critical thinking and the ability to solve problems independently.

(2) Psychological Support: Provide psychological counseling services and regularly conduct mental health lectures to help students relieve stress and establish a positive attitude.

(3) Positive Energy Influence: Share successful cases and scientific achievements to stimulate students' enthusiasm for scientific research, enhancing their confidence and motivation.

(4) Practical Opportunities: Offer students opportunities for laboratory research and corporate internships, allowing them to learn and grow through practice.

Employment Guidance: Regularly hold career planning lectures and job fairs to help students understand industry trends and clarify career directions.

(5) Communication and Feedback: Establish open communication channels, encourage students to raise questions and difficulties, and provide timely feedback and guidance.

Currently, through the continuous advancement of comprehensive measures,

our teachers have been forging ahead, constantly innovating and reforming. The team has won provincial-level teaching research projects, awards in provincial teaching competitions, and provincial talent titles. They have inspired the students around them with their efforts and energy, leading the students to win awards in provincial innovation competitions and scholarships. This has effectively cultivated the students' balanced thinking between scientific research and industry, enabling them to integrate research and industry from a subjective consciousness and plan their own future. Moreover, the students can internalize themselves with a positive attitude and positive actions, influencing and changing those around them.

Certainly, In the implementation of comprehensive and advanced training transformation reforms for graduate students in engineering, universities, governments, and society each play significant roles.

Universities are the direct implementers of the reform, responsible for developing and executing specific training programs. They need to adjust curricula, strengthen practical teaching, and promote interdisciplinary integration to cultivate high-level talents with innovative abilities and practical skills. Moreover, universities must enhance faculty development, improving teachers' teaching and research capabilities to adapt to the new training model (Lee et al., 2019).

Governments provide policy support and financial guarantees. By enacting relevant policies, they guide and encourage universities to undertake educational reforms and increase investment in graduate education to ensure the necessary funding and resources (Allen et al., 2018).

Society, particularly industries and enterprises, offers practical platforms and demand orientation for the reform. Cooperation between enterprises and universities can facilitate the deep integration of industry, academia, and research, making graduate education more aligned with practical needs and producing engineering and technical talents that better meet market demands. Additionally, societal support includes providing internships and employment opportunities for graduate students, helping them integrate more effectively into the workforce (Sullivan et al., 2023).

Actually, when implementing a comprehensive and advanced training transformation model for graduate students in engineering, several potential challenges or obstacles may be encountered. Firstly, the limitation of resources and funding is a significant barrier. The transformation requires substantial investment in human, material, and financial resources, including updating teaching facilities, introducing advanced experimental equipment, and hiring high-level faculty. However, many universities or research institutions may face the issue of insufficient funding (Donato & Rya, 2022). Additionally, building a strong faculty team presents challenges. The transformation demands that teachers not only possess solid professional knowledge but also master interdisciplinary teaching methods and innovative thinking. However, the professional backgrounds and teaching experience of many current teachers may not meet these requirements.

Secondly, the imperfection of systems and management is also a problem. The existing graduate education system may be too rigid to adapt to the needs of a comprehensive and advanced training model (Stewart & McMillan, 2021). For example, reforms are needed in curriculum design, evaluation systems, and mentor guidance, but the reform process may encounter issues such as mismatched systems and uncoordinated management. At the same time, the challenge of student adaptability should not be overlooked. Students need to adapt to the new training model, change traditional learning methods, and develop innovative thinking and practical skills. However, some students may find it difficult to adapt due to their familiarity with traditional learning modes. Lastly, the transformation of culture and mindset is also a significant barrier. The transformation requires breaking away from traditional educational concepts and culture to establish an innovation-oriented educational culture, a process that may be hindered by traditional mindsets. Furthermore, the support of society and industry is crucial. The implementation of the transformation model needs recognition and support from society and industry, but currently, the understanding and acceptance of this new training model by society may not be high enough.

The expected outcomes of the new engineering education model are multifaceted. Firstly, it aims to produce graduates who are not only well-versed in engineering principles but also equipped with practical skills and real-world problem-solving abilities. These graduates should be more innovative and adaptable, ready to contribute effectively to diverse industries and tackle contemporary challenges. Additionally, the model seeks to enhance students' soft skills, such as communication and teamwork, which are crucial for success in the modern workplace. Overall, the goal is to create a more holistic and industry-relevant educational experience that prepares students for the dynamic demands of the engineering field.

3. Conclusion

The transformation of "comprehensive" and "advanced" training for new engineering graduate students is crucial. In the rapidly changing technological environment, comprehensive training means that students must not only master professional skills but also possess interdisciplinary knowledge, innovative thinking, and the ability to solve complex problems. Advanced training emphasizes deep learning and critical thinking to meet the future job market's demand for high-level analysis and decision-making. The inevitability of this training model lies in its ability to better adapt to industrial upgrading and social development, cultivating high-quality engineering and technical talents who can lead the future for the nation.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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