

Exploration and Practice of Teaching “Engineering Ethic” for Professional Degree Graduate Students Under the Background of “New Engineering”

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ABSTRACT

Under the background of new engineering and curriculum ideological and political construction, the ethics education of engineering ethics courses for engineering graduate students must be constantly explored and tried. Based on the actual situation of the training of professional degree graduate students in our university, this paper starts from various aspects such as teaching content, teaching methods, textbook cases and comprehensive assessment. This paper probes into the course construction and teaching reform of engineering ethics for engineering graduate students, and explores the mode of engineering ethics education which adapts to the needs of our country's own development.

Keywords: New Engineering, Engineering ethics, Integrative teaching method

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NEW ENGINEERING BACKGROUND AND REALISTIC REQUIREMENTS

Against the backdrop of frequent engineering problems in various fields, the engineering technology community is increasingly facing conflicting ethical choices in engineering practice, including personal and collective interests, corporate and social interests, economic and environmental interests. Due to the relative lack of engineering ethics knowledge and ability among engineering technology groups, it often appears inadequate and difficult to make decisions. In addition to possessing solid professional theoretical knowledge and practical abilities, engineering ethics and moral qualities have become a core competency that this group must quickly supplement. However, engineering ethics are not innate and related concepts are

constantly changing with the development of the times. To enhance the engineering ethics awareness and social responsibility of the engineering technology community, it is necessary to carry out engineering ethics education that meets the national conditions and the requirements of the times.

Since 2016, China has officially joined the Washington Agreement of the International Union of Engineering, and the certification of engineering majors in higher education institutions is mainly based on the standards and procedures of the American ABET (Accreditation Board for Engineering and Technology). In 2017, the construction of higher engineering education in China in the new era was launched, emphasizing the integration of disciplines, the integration of science and engineering, the intersection of engineering and engineering, and the infiltration of engineering and culture. This education model nurtured interdisciplinary, interdisciplinary, and interdisciplinary training of engineering talents, cultivating compound, innovative, and outstanding engineering talents. In 2018, the Academic Degrees Office of the State Council required universities to include the "Engineering Ethics" course as a public compulsory course for engineering master's degree graduate students. The status of engineering ethics education in professional master's degree graduate education has been significantly improved. In 2020, the Ministry of Education issued the "Guiding Outline for the Ideological and Political Construction of Curriculum in Higher Education Institutions", which pointed out that "comprehensively promoting the ideological and political construction of curriculum is a strategic measure to implement the fundamental task of cultivating morality and talents". The curriculum teaching of engineering majors should strengthen engineering ethics education. It can be seen that the moral education content in engineering education is very rich, including ideological and political education that closely follows the pulse of the times, as well as engineering ethics education that keeps pace with the times. Strengthening engineering ethics education is not only an important task for China's higher engineering education to fulfill the requirements of "cultivating morality and cultivating talents", but also an objective requirement for the development of modern engineering. In recent years, with the increasing awareness of universities participating in engineering professional certification and the urgent need to solve practical problems in engineering practice, various universities have increasingly attached importance to engineering ethics education. Engineering ethics education has become an important link in the training of engineering technology talents in China's new era higher engineering education system^[1-5].

In the new situation of new engineering and ideological and political construction of courses, the ethical education of engineering ethics courses for engineering graduate students must be constantly explored and attempted. This article is based on the actual teaching situation of our school, and starts from various aspects such as teacher construction, teaching content, teaching methods, case teaching, assessment methods, etc., to explore and practice the construction and teaching reform of engineering ethics courses for engineering graduate students, explore engineering ethics education models that meet the needs of China's own development. Carrying out value guidance from a high level of ideological and political education aims to enable students to acquire professional knowledge of engineering ethics, exercise their critical thinking ability, enhance ethical awareness, and enhance their ability to understand, analyze, and solve practical engineering problems, thus becoming engineering specialized composite talents with profound ethical literacy.

DEVELOPMENT STATUS AND EXISTING PROBLEMS

Engineering ethics, as an interdisciplinary humanity and engineering interdisciplinary integration course, has accumulated a certain amount of experience and unique practices in various universities across the country through recent years of exploration and development in how to coordinate organization, training plans, content settings, teacher selection, textbook selection, teaching methods, and teacher training. However, there are still some universal difficulties, confusion, and problems.

Insufficient Emphasis on Various Aspects and Lack of Deep Integration

Although various universities have recognized the necessity and importance of engineering ethics education, the emphasis is still insufficient. The tendency of "valuing science over literature" in the professional training of science and engineering colleges has long been prevalent. China's own cultural traditions and basic education models also lack training in students' critical and speculative abilities. It is believed that engineering ethics education is optional for science and engineering students, and the so-called "engineering spirit" refers to precision and efficiency. Engineering education has little to do with ethics, which to some extent leads to a lack of engineering ethics literacy among students.

From the perspective of school enterprise cooperation, although universities, research institutes, and industry enterprises have jointly formed numerous industry university research cooperation alliances, their role in talent cultivation is still limited, and there is a lack of deep integration between them. From the actual teaching effect of engineering ethics, it does not play the expected role, which also reflects that engineering ethics education has not received the due attention in the design of engineering education system in Chinese universities.

The Curriculum is Relatively Chaotic, and the Construction of the Teaching Staff is Relatively Lagging Behind

The issue of teaching staff and curriculum design for engineering ethics courses is quite chaotic. Actually, this is both the pros and cons of a problem. The engineering ethics course has high requirements for the comprehensive quality of teachers. Each university has different approaches to the curriculum design and teacher selection of engineering ethics education based on its own actual situation, mainly in the following ways:

- a. Teachers from schools of Marxism or humanities and social sciences serve as the main lecturer;
- b. Professional teachers from professional colleges serve as the main lecturers;
- c. The teaching team is composed of teachers from schools of Marxism or Humanities College and teachers from the Professional College. The general section is given by teachers from the Horse Academy or Humanities College, and the sub section is given by teachers from the Professional College;
- d. Some schools have established engineering colleges or engineering education centers that undertake public courses related to engineering practice throughout the school, with professional teachers with engineering backgrounds serving as undergraduate and graduate engineering general education.

Although teachers from professional colleges with engineering backgrounds have rich professional knowledge, they relatively lack a deep reserve and understanding of humanities and ethics knowledge. For abstract ethical theories, it is not easy to explain them in just one or

two sentences, and most of them simply follow the text and list their theoretical viewpoints. Professional teachers generally feel that engineering ethics courses are difficult to teach and difficult to teach, requiring a lot of time and effort to polish lesson plans. It is difficult to produce teaching and research results in a short period of time, and there is a lack of motivation and motivation in the assessment system and mechanism, which results in more effort and less return. Objectively, professional teachers are not willing to actively choose engineering ethics as their academic direction.

Although teachers from Ma Yuan or Humanities College have systematic knowledge of philosophy, social sciences, and humanities, they lack professional engineering technology knowledge and specific engineering practice experience, making it difficult to introduce engineering ethics knowledge into specific engineering practice processes. When dealing with professional engineering cases, it is not possible to conduct in-depth analysis of the professional knowledge and relevant professional backgrounds involved in the case, and there is a lack of effective integration of humanities and social science knowledge such as ethics with specific engineering practices related to each profession.

Fully leverage the interdisciplinary advantages of universities, integrating teachers with backgrounds in social sciences, humanities, management, and other disciplines with professional teachers with engineering backgrounds. Some universities further incorporate engineering and technical management personnel from the production line of enterprises, forming a multidisciplinary integrated teaching team to participate in teaching together. On the basis of teaching professional engineering cases by professional teachers, humanities and social sciences teachers analyze engineering cases from the perspective of humanities and sociology, guiding engineering students to have a deeper understanding of engineering ethics issues from multiple perspectives. From a practical perspective, it can indeed enrich teaching content, expand teaching depth, and achieve good teaching results. However, establishing such a teaching team is highly challenging, largely due to the personal social resources of the lecturer, and sometimes even becomes a personal behavior of the teacher, making it difficult to unify the quality of teaching classes for different teachers. Due to the lack of corresponding institutional arrangements, it is difficult to organize such a teaching team solely by a certain college, department, or individual, and coordination is difficult. It requires the government, the administrative department in charge of universities, and various colleges, enterprises, and industrial alliances to comprehensively layout, connect various links, and form a long-term mechanism.

Teaching Methods and Teaching Cases are Difficult to Adapt to the New Situation

Some teachers still use traditional teaching methods, and students' participation is not high, which cannot fully stimulate their learning enthusiasm. During the teaching process, emphasis was placed on the analysis of engineering and technical aspects of cases, while the analysis of ethical responsibilities was not deep enough and was superficial and superficial. Some even started classes to complete teaching tasks. In terms of case selection, it is too outdated, with the majority of cases being "big, far, and empty", with insufficient professional fit and a certain disconnect from reality. Students may feel that these cases are empty and distant, and the teaching effect is often not ideal.

Some teachers conduct case studies solely on the basis of students in the classroom, often resulting in insufficient depth and breadth of case analysis, obvious lack of information, superficial and superficial. This is due to both students' and teachers' reasons. Teachers are limited by their academic background and cannot grasp the topic of discussion well. Engineering students tend to think and handle problems too rationally and lack sensitivity, and lack a comprehensive and in-depth understanding of basic engineering ethical principles and the responsibilities and obligations of engineers. In recent years, the current situation of employment pressure has led to an increasing number of students choosing to pursue graduate studies. Whether admitted as a professional degree or an academic degree, most of them lack work experience and engineering practical experience, making them unfamiliar with engineering practice. Students generally exhibit a bookish, simplistic, and idealized approach when conducting case studies and classroom discussions, with a clear lack of practical engineering perspectives. ^[6-7]

ADVANCED PRACTICES AND EXPERIENCE

In the context of the new industrial revolution, the primary goal of engineering ethics education for professional degree graduates is to establish students' awareness of engineering ethics, enhance their sensitivity to ethical issues, master the professional ethics and norms that engineers in the new era should possess, and cultivate and exercise their decision-making ability when facing complex engineering ethics issues. Due to the significant differences in cultural, ethical traditions, and legal systems among different countries, the establishment of engineering ethics courses in China should be based on China's cultural traditions and actual national conditions, critically absorbing the experience of foreign engineering ethics education, and conducting teaching practices appropriately, pragmatically, and tailored to local conditions.

Continuously Strengthen the Cultivation of Teaching Staff, Strengthen the Construction of Textbooks and Case Libraries

Engineering ethics is a discipline that intersects and integrates philosophy, humanities, and social sciences with science and engineering, and has high requirements for the overall quality of the lecturer. Our school's selection of engineering ethics course teachers has been adjusted from the previous professional ideological and political teachers at the Horse Academy to full-time teachers with outstanding professional and technical abilities and rich teaching experience at the Engineering College. A virtual teaching and research team composed of professors from other universities, teachers from engineering colleges, horse racing academies, and management and technical personnel from cooperative enterprises conducts centralized training, collective lesson preparation, builds communication platforms, and shares teaching results and experiences through seminars in a planned and organized manner. Typical hot topics are discussed, and a case library suitable for various majors is constructed. Continuously strengthening industry university research cooperation and carrying out engineering ethics teaching practices, Efforts will be made to cultivate a team of engineering ethics teaching teachers with both composite and dual qualifications.

Vigorously carry out the compilation of core textbooks that meet the characteristics of our school's professional degrees, and strengthen the construction of an engineering ethics case library that is suitable for China's national conditions. By learning from various excellent

textbooks, continuously refining, summarizing, and building a case list suitable for our school's majors, we will compile core textbooks that conform to the characteristics of our school's professional degrees, and integrate the school's own characteristics, in order to better adapt to the actual situation of engineering disciplines for our school's professional degree graduate students.

Innovative Educational and Teaching Methods, Case-Based Integrated Teaching

The appropriate use of educational methods and means directly affects the actual teaching effectiveness and affects the quality of curriculum teaching. We are based on the characteristics of our school's disciplines, absorbing advanced teaching experience, and focusing on the training goal of the "consciousness norm ability" trinity of the curriculum in teaching practice. We are student-centered, flipped classroom, and integrated learning. It is no longer about teaching and listening, but about interaction and participation between teachers and students. Before class, online learning textbooks are equipped with MOOC video materials, while using mind maps to sort out the context of knowledge points, making it easier to quickly grasp the knowledge framework and improve learning efficiency. Video learning and mind map notes are given certain learning scores, and students are also willing to complete them. This way, students have a certain understanding of the relevant content before class, and can better apply relevant ethical theoretical knowledge during classroom discussions. Classroom teaching focuses on discussions, utilizing rich resources such as news videos, special lectures, and video animations to enhance teaching effectiveness and stimulate students' enthusiasm. Everyone speaks enthusiastically and the classroom atmosphere is lively. Adopting various forms such as case guidance, group discussions, summary speeches, scenario plays, and on-site debates. In terms of case selection, emphasis should be placed on the timeliness, relevance, and representativeness of the case, closely integrating it with students' majors, lives, or experiences, such as artificial intelligence, big data, autonomous driving, biopharmaceuticals, nanomaterials, gene editing, environmental governance, and other fields for in-depth case analysis. The on-site debate competition selects the best debater and winner through cloud class voting. The classroom interaction has greatly stimulated students' enthusiasm for learning, and their expression, organization, communication, communication, and critical thinking abilities have been improved to varying degrees, enhancing their sense of achievement and enhancing their sense of social responsibility.

Improve Course Design and Optimize the Assessment Process

Surrounding students' confusion, not avoiding problems, and facing students' concerns directly. Through classroom surveys and questionnaires, it is common for students to pay insufficient attention, lack social experience, and lack practical experience. Students may also believe that ethical decision-making is a matter of leadership and management, and that they should follow the work instructions of their superiors.

Ethical decision-making is far from themselves. What students are concerned about is the purpose of this course? What is the relationship with one's major? Engineering graduate students will face multi-dimensional ethical issues in their future studies and work, including scientific ethics, technical ethics, experimental ethics, environmental ethics, and professional ethics. Targeted teaching should be carried out based on the practical problems that engineering graduate students may face. Starting from specific industry case studies, what would you do? Specifically, what is the background for future research topics? Is there an ethical

issue involved? Is there any academic misconduct during the research process? Is there any plagiarism? Are there any untrue data? What risks or ethical issues may be encountered? How to avoid or overcome it? How to carry out responsible innovation? What public ethical events have occurred in this professional field? A series of closely related issues to oneself.

Continuously optimize scientific, diverse, and full process assessment methods, self-study on the front line of class, organize mind maps, discuss in class, analyze case studies, conduct final assignments and exams, and comprehensively assess students' learning effectiveness.

SUMMARY AND OUTLOOK

Modern engineering practices are becoming increasingly comprehensive and complex, with significant risks and uncertainties. How to accurately grasp and solve the ethical issues involved in modern engineering practice is highly challenging. Our country's engineering ethics education should advocate an integrated teaching mode based on the actual situation of their respective universities, which closely links to the profession, case teaching, and flipped classroom. It should be student-centered, strengthen the combination of theoretical and practical teaching, guide students to use the basic principles, principles, and tools of engineering ethics to analyze and solve practical engineering ethics problems, and focus on cultivating students' critical thinking ability, so that engineering ethics awareness truly enters students' hearts, Continuously improving one's own values and sense of social responsibility, establishing correct professional virtues, comprehensively improving the comprehensive ability to solve complex ethical problems in engineering practice, and becoming a professional and versatile engineering talent with profound ethical literacy.

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