Coupling Education of Professional Courses and Engineering Ethics under Emerging Engineering Construction Strategy

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Abstract Aims to cultivate the advanced engineering talents serving the society responsibly, this paper explored the coupling mode of the professional courses and engineering ethics education according to the demand of New Engineering Construction strategy. This coupling mode combines to course infiltration, practical teaching and specialized seminar are gradually implemented. By the well teaching feedback, its application on lectures and practice teaching was proved to be effectiveness.

1 Introduction

Under the background of Emerging Engineering Construction strategy, the new economy, characterized by new technologies, new industries, new forms and new mode, needs a large number of highly qualified engineers having moral and ethical quality, professional spirit, social sense of responsibility and mission\cite{1}. Thus, the engineering universities should pay more attention to engineering ethics education through further research, and actively promote the organic integration of engineering ethics education in professional courses.

By cultivation of students' engineering ethics as the core, this paper explored the coupling mode of the professional courses and engineering ethics education, aims to cultivate the advanced engineering talents with both higher humanities accomplishment and professional knowledge, in order to serve the society is a responsibility. For obtain its effectiveness, this paper designed the coupling mode which consist by course infiltration, practical teaching and specialized seminar, and applied it in lectures and practice teaching.

2 Course Infiltration Method

This infiltration education means combined engineering ethics issues with relevant subject knowledge during the theory teaching in professional courses. Based on Engineering Geology, a major course in civil engineering, this study composed teaching plans and syllabuses, adjusted the course structure and content, and further emphasized the diversity of forms in teaching methods.

2.1 Case Study

In the teaching process, case study method was adopted to discuss and analyze civil engineering accidents. Different guiding cases were arranged according to whether students have engineering practice experience or not, which inspires students to extract ethical principles and determine their ethical position\cite{2}. For the reason that undergraduate students have little professional knowledge but relatively active thinking, it requires timely guidance from teachers to ensure class participation and prevent deviation between the content discussed by students and the actual engineering situation as well. The case study method is mainly selected positive cases. By explaining the ethical decisions and engineering measures of high-quality engineering at different stages, it enables students to infiltrate the dialectical thinking of correct ethical choices into their consideration, and subtly guide their decisions and behaviors in future career. Part of selected cases in professional lectures are as follows:
1) Foundation pit construction in fault zone of Los Angeles. This case expresses the influence of geological structure on projects. The city of Los Angeles is located in the SAN Andres fault zone. It introduces the discovery, analysis and solution process of complex geological conditions based on a foundation pit construction in the city. Focusing on safety in construction technology makes students realize the importance of technical responsibility and engineering ethics that engineers should undertake.

2) Urban groundwater pollution in the Gulf of Mexico. This case describes groundwater and its engineering impacts. Analyzed the tourist city development of groundwater pollution, it introduces the distribution characteristic of groundwater and its motion form. The migration patterns of groundwater contamination into aquifer by recharge, runoff and discharge is also displayed to make students understand the interaction of engineering activities on the environment, and gained deep awareness of the environmental engineer moral responsibility.

3) Civil engineering construction in earthquake zones of Tokyo. This case introduces the adverse geological effects and prevention with the guide from construction case in Tokyo. The series work of civil engineering activities for seismic zone was explained including prior exploration, foundation pit protection, earthquake monitoring, and anti-shock design work. In order to help students to understand the possible risks and avoid methods from nature modification using professional knowledge, and cultivate students to be responsible for the social public career ethics accomplishment.

2.2 Situational Experience

Situational experiential teaching means that teachers provide specific problem situations involving value disputes in class and organize students to analyze the contradictions[3]. The participants work in groups of 3–4 and let them play the characters (such as engineering designers, construction workers, the project managers and the general public, etc.), try to use different methods to solve the problem. This is positive for students to solve a variety of value conflicts, to set up the correct values, and to develop good social behavior. The design scenario is like one student playing the role of engineer, advocating the use of safer but more expensive building materials in the design, and another student playing the role of a manager, only concerned with profit maximization and cost minimization, and believing that the former building materials are safe enough. After this kind of thinking and debate, students can learn and apply the moral decision-making mode and ethical norms preferably, so as to improve the level of moral cognition. Situational experience can enable students to participate in the whole process of real ethical and value conflicts, and make the right choice according to the knowledge learned.

3 Practical Teaching

Attaching importance to engineering ethics education not only inculcates ethical knowledge in classroom teaching, but also embodies the content of engineering ethics in practical teaching[4]. The permeates education of engineering ethics in practice teaching means integrating practical teaching resources such as course practice, course design and graduation design to actively build a platform for students to practice. Strengthen the infiltration of engineering ethics education in students' practical activities, and enhance the ability of college students to practice engineering ethics and moral behavior selection. By way of university-industry cooperation, the college invited the staff of the enterprises, research institutes related professional, technical personnel or enterprise expert for specific seminars. The topics covered ethical principles of using science and technology in the specific industries practice, to expand students' knowledge.

In college students' scientific and technological innovation practice, the content of ethics and ethics education should be added as well. Through specific engaged in innovative research of new technologies, college students can analyze ethical issues in the practical application, and experience code of ethics. In the practice, students identified the code of ethics, then conducted the transformation process of the internalization and externalization, eventually developed good moral
quality engineering ethics. By guiding students’ scientific research and community, our research expanded science and technology engineering ethics related projects or topics in the college students' club activities. With controlled experiment consequence, the micro-simulation of certain technology processes which may cause negative impact without pay attention to ethics rules were conducted, targeted to guide students to establish a sound engineering ethics idea.

4 Specialized Seminar

The adverse consequences of engineering may be caused by technical factors, social factors, environmental factors and cognitive factors. Portions of them are not intentional, but due to the limited knowledge and insufficient risk assessment of the engineers who charged design and implementation in the project. By inviting environmental protection departments and geological disaster experts to hold seminars, students’ ability of project risk assessment was improved.

For instance, a seminar selected the influence of engineering geological conditions on various engineering buildings as the theme, the lecturer introduced ethical principles of science and technology application in specific industry practices. This topic can strengthen the identification and practice of college students in the engineering ethical codes and conduct codes. And used existing accidents to warn students that, in the process of project use, when there are problems such as equipment aging, illegal operation and serious safety risks, even if exposing and stopping may cause rejection of the enterprise supervisor and colleagues, and may damage the enterprise image, they should still adhere to the bottom line of ethics and take necessary actions.

5 Conclusion

As engineering and technical personnel in future, college students trained by engineering ethics education will maintain a sense of social responsibility while serving with their professional knowledge. At present, this teaching mode combines to course infiltration, practical teaching and specialized seminar are gradually implemented. Form the well teaching feedback, it may help students set up ethical insight, judgment and engineering decision-making ability, stick to the quality of the engineering level and responsibility, security engineering, ecological effect and engineering level of integrity and responsibility clearly, effectively improve the students' science and technology ethics and the humanities finally. The research result coupled the professional courses with the engineering ethics education, which can establish the engineering ethics and social responsibility education with "responsibility" and "conscience" as the core content, and shape the future of China's engineering practice through innovative educational means and methods.

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References

