

Research on strengthening engineering postgraduate education through the teaching reform of specialized courses

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Abstract: In order to achieve the goal of higher education in engineering colleges and universities to train outstanding engineers, colleges and universities need to carry out targeted engineering education from different stages of undergraduate and graduate students. Strengthening the function of ideological and political education in engineering courses in the teaching of graduate courses is an important way to train excellent engineers with graduate degrees. Taking the "Practice course for technology and engineering of sudden pollution control of water source" as a case study, this paper probes into the idea of organically combining ideological and political education with engineering education in the teaching of professional courses for graduate students, and puts forward the teaching of scientific research and the combination of teaching and scientific research, educational methods and strategies to continuously improve the quality of personnel training. The research results can provide reference for strengthening the construction of graduate courses under the background of engineering education.

1. Introduction

As one of the four types of strategic talents charged with the great mission of national rejuvenation, outstanding engineers in the new era are of great significance for our country to build a socialist modern country in an all-round way and realize the second centenary goal^[1]. The Ministry of Education proposes that the education and training of outstanding engineers should be taken as the focus of the high-quality development of higher education, and the reform of education and training of outstanding engineers should be promoted in an all-round way. In order to achieve the goal of higher education in engineering colleges and universities to train outstanding engineers, colleges and universities need to carry out targeted engineering education from different stages of undergraduate and graduate students. Strengthening the function of ideological and political education in engineering courses and organically combining ideological and political education with engineering education is an important way to train excellent engineers with graduate degrees^{[2][3]}.

Starting with the teaching reform of postgraduate specialized courses, this paper explores the methods and strategies of postgraduate engineering education by taking the postgraduate course "Practice for technology and engineering of sudden pollution control of water source" of Harbin Institute of Technology as a specific case. The research results show that engineering colleges and universities should fully implement the spirit of the President Xi's important instructions on graduate education, and persist in putting the correct political direction and value orientation through the whole process of engineering graduate education and training by improving the teaching quality of postgraduate ideological and political courses, innovating the mode of ideological and political teaching, and enhancing the pertinence, innovation and effectiveness of postgraduate courses. We will promote engineering education and curriculum ideological and political construction in the same direction, resonate on the same frequency, deepen the new pattern

of collaborative education, and increase efficiency for the construction of high-level universities and the cultivation of high-level innovative talents^{[4][5]}.

2. Measures to implement the curriculum reform of environmental specialty

The course system of "Practice course for technology and engineering of sudden pollution control of water source" is an important elective course for environmental majors, and it is a highly theoretical, technical and practical course. Its course goal is from "basic knowledge reserve for solving complex engineering problems". To "the ability training of comprehensive application of curriculum knowledge", and then to "the cultivation of basic skills and innovative ability of engineering design". Finally, it is realized that "the comprehensive quality cultivation of the coordination of thought and ability", and the four core values of "innovation", "practice", "responsibility" and "responsibility" run through the whole process of teaching, along with the general improvement of the whole society's attention to environmental problems, the demand for the quality of talents in dealing with water pollution is getting higher and higher. Based on the high professional pertinence of the training process of master's degree students, when training such professionals, colleges and universities require students to master not only solid professional theoretical knowledge, but also practical skills. Its training mode is not only to acquire theoretical knowledge in the form of classroom teaching and students' autonomous learning, but also to construct a curriculum system of "stimulating interest, paying attention to ability, pluralistic cultivation and personality development" as the core. Under the premise of "student-centered", we should combine the field of ideological value with the depth of classroom teaching, while teachers and students grow together inside and outside the classroom. It has also trained high-quality graduate students with high social service and responsibility consciousness and professional ability.

In the project of "Emergency treatment technology for sudden pollution of water source in Xijiu" undertaken by Harbin Institute of Technology, Professor Dongmei Liu of the School of Environment introduced the current situation of sudden water pollution, discussed the water source situation in her hometown, and the demand for drinking water safety, combined with the group discussion on the water pollution problems that may be brought about by the large-scale eliminate virus under the epidemic of COVID-19, to make students realize overall vision, who is responsible for the treatment of water pollution in our country. It inspires students' sense of mission and high sense of responsibility to contribute to the construction of national ecological civilization, as well as the sense of honesty without fraud and the sense of innovative service to deal with the technical needs of complex and changeable water pollution treatment. And through the explanation of the development process of water quality standards and 106 indicators of current water quality standards, it makes clear the professional literacy requirements of relevant employees, the increasing demand of people for high-quality tap water and the corresponding requirements for the craftsman spirit of environmental protection engineers. Subsequently, the students were led to the water source site to conduct a detailed investigation and analysis of the polluted water body, and it was found that the main pollution indexes of Xijiu water source included algae, ammonia nitrogen and organic pollutants, after a preliminary study on the effect of conventional methods on the removal of these pollutants, the research group proposed a combination of activated carbon adsorption process and advanced oxidation treatment, such as spatial location. The two processes interact and influence each other, on the premise that they do not affect each other's treatment effect, combined with the operation purpose of the subsequent treatment section, carry out different combinations of gradient tests, so as to determine the best combination mode research scheme.

Based on the above research content and the actual operating conditions of the waterworks, the members of the group also considered the pilot plant connected to the subsequent treatment process, and designed the pilot plant for activated carbon adsorption and advanced oxidation emergency treatment section. They stayed in the Jiubin waterworks for on-site commissioning and operation, to ensure the normal operation of the whole process. In addition, the members of the group, combined with the pretreatment process, reasonably arrange the role of emergency treatment technology and pretreatment process, optimize the role of the corresponding treatment section to the maximum

extent, take process simplification as the principle, and avoid repetition and mutual interference.

In this practical teaching, students personally participate and express their own views, diverge their thinking, abandon the traditional "just talking but not practicing", and let students discover and solve problems themselves in practice, which not only cultivate students' ability of independent thinking and innovation, but also organically combine theoretical knowledge with scientific research, stimulate students' enthusiasm for scientific research, cultivate students' interest in scientific research, and strengthen students' consciousness of scientific research. In the process of the transformation between teaching and scientific research, it not only promotes the reform of teaching methods and the formation of students' consciousness of scientific research, but also makes students realize the important task of being an environmental protector in practice. It also makes students have a concrete understanding of the craftsman spirit of excellence, the mission consciousness of environmental protection engineers, innovation consciousness and innovation spirit. It realizes the high standards and strict requirements of water treatment engineers on professional accomplishment and professional ethics, and defines the arduous mission, responsibility and responsibility of environmental protection people in the future.

Centering on the fundamental task of establishing morality and cultivating people, we should take the ideological and political classroom teaching as the main body, select the best teachers of ideological and political courses, open all ideological and political courses, enrich the contents of ideological and political courses, innovate the carriers of ideological and political courses, and excavate the ideological and political elements and ideological and political functions of various courses. Besides, selecting demonstration colleges, demonstration majors, demonstration mentors and demonstration courses to play an exemplary and leading role in improving the depth, breadth and validity of ideological and political work, and to create an ideological and political force driven by graduate students' "academic salon", "discipline competition", "social practice" and "the power of example", and constantly enhance the ideological, theoretical and pertinence of ideological and political courses can also help. We should build a full-process and omni-directional pattern of ideological and political education, and promote the ideological and political education work of graduate students to go to the heart, to the deep, and to the reality. It is a long-term mechanism of coordinating research teaching with discipline construction, promoting classroom teaching revolution through research teaching reform and innovation, organizing teachers to participate in scientific research and teaching research activities and constantly improving teaching skills, so as to realize the mutual growth of scientific research back-feeding teaching and teaching and scientific research continue to improve the quality of personnel training.

Through theoretical research and practical summary, it is found that in order to improve the current teaching situation of engineering graduate students, in view of a series of problems existing in the teaching process, we should do the following^{[6][7][8]}:

1) Perfecting the "integrated, multi-level and open" experimental teaching system

Through the "basic-comprehensive-research" three-level experimental teaching operation mode and laboratory management system, the scientific research achievements are timely transformed into teaching experiments, and research experiments are set up to integrate with the frontiers of the discipline. While carrying out the reform of curriculum system and teaching content, the opening mechanism of various laboratories of "promoting-encouraging-early intervention in scientific research" has been vigorously promoted, which has effectively promoted the broadening of students' horizons and the cultivation of personal interests.

2) Improving the innovative training system and cultivate students' academic research ability

Supported by the ability improvement project of the engineering talent base, relying on the key laboratory of the State and the Ministry of Education, and taking the topics covering the main frontiers of water pollution treatment as the carrier, we should set up a student free innovation and exploration project, combined with the graduate innovation plan, strive to cultivate students' innovative consciousness and research ability. The colleges should regularly organize forums for scientific research reports of graduate students to cultivate their academic communication ability, to actively encourage and subsidize students to carry out international exchanges in a variety of ways

to cultivate students' international academic vision. It has formed a mechanism for comprehensively cultivating graduate students' research ability, innovative consciousness and comprehensive quality.

3) Constructing an interdisciplinary platform and cultivate students' multidisciplinary vision

Based on the interdisciplinary research laboratories of our institute and the relevant research platforms of other departments, interdisciplinary research topics are set up in the engineering talent base capacity improvement project and innovation research plan. Cooperating with relevant colleges and universities and adopting the "double tutor" model to cultivate students' cross-scientific research ability and broaden their academic horizons are encouraged, so as to lay a foundation for their work in interdisciplinary fields after graduation.

4) Promoting the reform of practical teaching contents, methods, means and assessment methods

Changing the traditional concept of practical teaching for graduate students, reforming the contents, methods, means and assessment methods of practical teaching, and cultivating students' practical ability and innovative spirit are necessary. Carrying out research combined with the actual situation of colleges and universities, and applying the research results in practice in the corresponding semester, summing up experience, modifying the plan, applying again, and finally summarizing the results should also be involved. The idea of subject reform are to pay more attention to practicality, comprehensiveness, openness, the application of modern teaching means and simulation experiment teaching means, increase the amount of experimental teaching information, pay attention to experimental examination and so on.

5) The combination of professional accomplishment and historical mission teaching and education will bring to life that "environmental protection people should have the accomplishment and ability of 'innovation, practice, responsibility and responsibility'."

With "student as the center", in the highly practical and innovative classroom activities, we should practice the curriculum core values of "innovation, practice, responsibility and responsibility" and understand ideological and political thinking; through the collaborative training of innovation-practice training and ideological value guidance, curriculum teaching is closely integrated with industry needs-social services, inside and outside the classroom-online and offline, bit by bit, and teachers and students grow together.

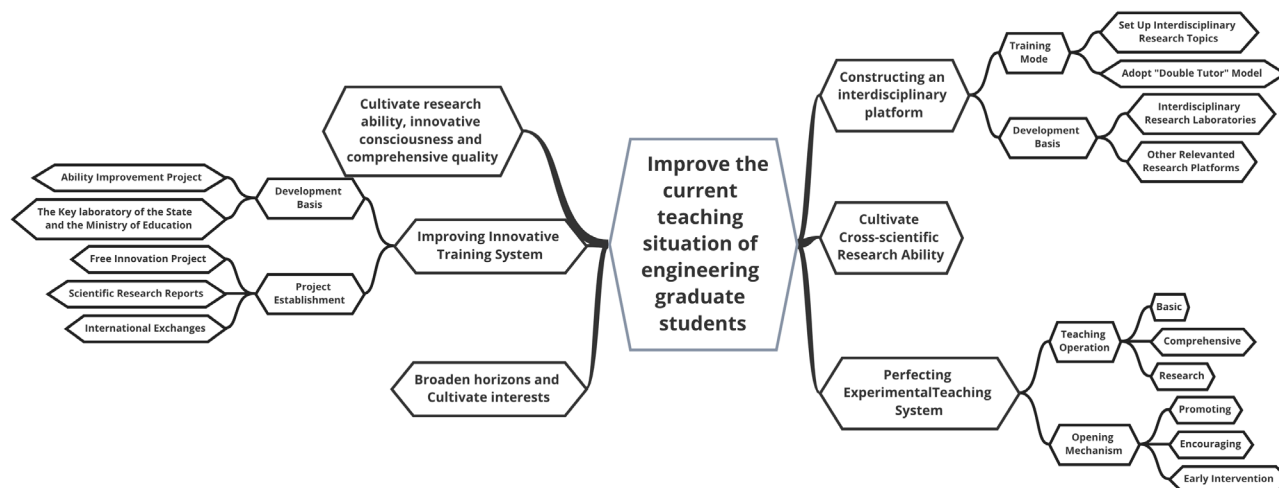


Figure 1 Ways to improve the current teaching situation

3. Conclusion

This paper carries out research work on the requirements of strengthening ideological and political education in the teaching reform of engineering graduate education, and makes up for the shortcomings of the current higher education model, in addition to changing the existing teaching contents, teaching methods and hardware facilities, it is also necessary to strengthen the construction of practical teaching staff, strengthen the management and monitoring of practical teaching, and promote the linkage construction of ideological and political courses. To promote the

high-quality development of ideological and political education, it can not only improve the existing teaching practice programs, but also scientifically predict the effect of practical teaching reform, which plays a significant role and significance in promoting higher engineering education. The research results can provide reference for strengthening the construction of graduate courses under the background of engineering education, play a strong guiding role in the training of excellent engineers, and have a very important reference value for the research of related problems in colleges and universities at home and abroad.

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References

- [1] Liang Yuegan, Li Hui & Chu Gang. (2022). Exploration on the cultivation of engineering practice ability of water treatment course under the background of new engineering. *Science and technology horizon* (29), 121-123.
- [2] Wei Taoyun, Guo Shaodong, Xie Shiwei, Fan Jie & Song Hongjiao. (2022). Research on the teaching reform of water treatment microbiology under the background of new engineering. *Experimental Science and Technology* (02), 67-72.
- [3] Wang Jie, Wu Yun, Zhao Xuehui, Zhang Yang & Zhang Chao. (2021). Reform and exploration of practical teaching of membrane technology in environmental engineering major under the background of new engineering. *Journal of higher Education* (S1), 116-120.
- [4] Song Xiaohong, Li Yanhong & Zhang Lihao. (2021). Discussion and practice of Teaching Reform highlighting Professional characteristics under the background of New Engineering-- taking the course of Water treatment Biology experiment as an example. *Education and Teaching Forum* (18), 88-91.
- [5] Song Peixue, Wang Mantang & Yuan Danqing. (2020). Research on teaching reform of water treatment biology under the background of new engineering. *University Education* (09), 99-101.
- [6] Wang Zhangxia, Cui Juntao & Li Mingtang. (2012). A preliminary study on the Teaching Reform of Water supply Engineering in Agricultural Colleges and Universities. *China Electric Power Education* (22), 77-78.
- [7] Wang Xinwen, du Yuchen & Wang Yanhong. (2021). Ideological and political construction of engineering courses in applied universities. *Theoretical Research and practice of innovative Entrepreneurship* (23), 102-104.
- [8] Sun Min, du Bing & Zheng Xiaoying. (2008). On the experimental teaching mode of engineering courses. *Laboratory Science* (01), 26-28.