



Science Thinking Course Cultivates Vocational Education Students' Professional Quality

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Abstract. A questionnaire survey of 316 students in civil engineering was conducted on the cultivation of scientific thinking ability in the basic course of materials science, and the comprehensive quality of their graduation and the demand of enterprises for talent thinking ability were investigated. The results show that the basic course of materials science can improve the scientific thinking ability and further improve the professional quality of civil engineering. In view of the current problems existing in the professional quality of civil engineering students: unable to reflect the professional characteristics of earthwood engineering majors, there is no curriculum for cultivating civil engineering professional quality, and countermeasures are put forward: using scientific thinking to reflect the professional characteristics of civil engineering majors, using scientific thinking methods to cultivate students' professional quality through the Secondary-Higher-Undergraduate-Master of vocational education, and setting up scientific thinking courses for cultivating civil engineering professional quality.

Keywords: Scientific thinking; Civil engineering; Professional qualities; Integrated curriculum for Secondary-Higher-Undergraduate- Master of vocational education

1 Introduction

Professional quality includes three core^[1]: professional belief: is the core of professional quality. A positive professional attitude and a correct sense of professional values are the core qualities that a successful professional must have. Professional knowledge and skills: professional knowledge and ability to do a good job. Every industry has knowledge skills for every industry. Professional behavior habits: it is a kind of comprehensive quality in the workplace that is formed and finally becomes a habit through long-term study-change-in the workplace. Professional accomplishment is a key factor

in the success or failure of a person's career. Many companies realize that in order to obtain graduates who meet the needs of the job, professional knowledge and skills are one aspect, but more importantly, graduates need to have correct and firm professional beliefs, so that graduates can actively work in the work position of the unit. Work, cultivate your own good professional behavior habits on the basis of good professional ethics, so that you can go far, walk steadily, and walk well in your career. This is the enterprise wants to obtain a good professional quality of college graduates. The cultivation of college students' professional quality is one of the important tasks of higher education, and this task needs the cooperation of college students, universities and enterprises to be effective.

2 Problems with the Professional Quality of Students in Civil Engineering Major at Present

2.1 It Cannot Reflect the Professional Characteristics of Civil Engineering

For students majoring in civil engineering, their basic qualities also include: good professional knowledge and professional skills and certain moral cultivation and ideological understanding. The professional spirit in civil engineering has strong professional characteristics, but in the actual civil engineering professional education activities, it is only a simple exposition of some professional spirit content applicable to other majors, which can not reflect the professional characteristics of the earth wood engineering specialty. At the same time, in the process of cultivating the professional quality of middle school students in civil engineering, there is only a simple examination of students' mastery of safety education knowledge, legal education knowledge and moral education knowledge, and the professional quality is not internalized in the hearts of students. as a result, there is a problem that "form is more important than substance" in the cultivation of students' professional quality, which can not improve the professional quality of high-level vocational education students.

2.2 Professional and Systematic Education in Professional Ethics is Lacking

Vocational education provides strong talent and intellectual support for my country's economic and social development^[2]. The framework of a modern vocational education system for middle and high schools has been fully established, but compared with developed countries, compared with the requirements of building a modern economic system and building an education power, there are still problems such as the vocational education series has not yet reached the master level, and the professional quality education is not enough for the professional system. With the advancement of plans such as the belt and road initiative, the demand for civil engineering talents is increasing. At the same time, the construction of civil engineering structures is becoming more and more complex, such as kilometer-level high-rise and long-span bridges, which requires very high construction quality^[3]. A slight negligence of on-site staff or unclear internal mechanism of construction requirements can easily cause safety or quality accidents.

In order to ensure the quality of the project and safety in production, the construction unit urgently needs civil engineering related talents with high professional quality.

2.3 No Courses for Cultivating Professional Qualities of Civil Engineering

There are currently no courses aimed at developing civil engineering professionalism. In order to strengthen the professional quality education of civil engineering related technical and skilled talents, we should strengthen the cultivation of scientific thought and engineering application thinking of civil engineering students in professional courses, so as to master the scientific mechanism of civil engineering, so as to maintain awe in the construction process, and avoid construction quality problems caused by jerry-building or unscientific rush and "innovation. That is to improve the scientific thinking method of civil engineering professional quality education. The civil engineering-related courses in the material science foundation is one of the courses that best reflects the scientific mechanism of civil engineering. The purpose of this course is for students to explain macroscopic phenomena through microscopic mechanisms. The essential characteristics of civil engineering are reflected, and the internal mechanism of material destruction is explained, so that students can understand that the project must be rigorous and strict construction can ensure the quality of the project. Therefore, it is currently trying to build a scientific thinking course on the basis of the basic courses of materials science to cultivate the scientific thinking of civil engineering students, and then cultivate the professional quality of students based on professional skills and knowledge and with the characteristics of civil engineering.

3 A Survey on the Cultivation of Professional Ethics and Scientific Thinking Ability among 319 Students

To investigate the current situation of professional quality training and the needs of enterprises, a questionnaire survey was conducted to examine the views of 106 students in two majors on the qualities that professional application personnel should possess, as well as the views of 213 students in two grades and two majors on the cultivation of scientific thinking skills in the basic courses of materials science. The results of the survey on students is as follows:

3.1 Ability to Propose Research Directions

There were a total of 80 people in professional 1, and 43 thought it was necessary to master it proficiently, while 37 had general understanding. There were a total of 28 people in professional 2, and 17 thought it was necessary to master it proficiently, while 9 had general understanding, and 2 were uncertain.

From Figures 1 and 2, it can be seen that the proportion of students who think they should master the ability to propose research directions proficiently is significantly higher in major 2 than in major 1.

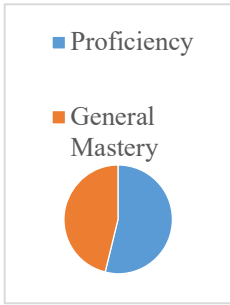


Fig. 1. The professional 1 proposed research direction ability survey situation

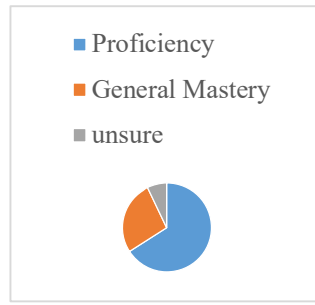


Fig. 2. The professional 2 proposed research direction ability survey situation

3.2 Ability to Design Research Plans

In professional 1, there were a total of 80 people, among whom 39 thought it was necessary to master it proficiently, 37 had general understanding, and 4 were uncertain; in professional 2, there were a total of 28 people, among whom 15 thought it was necessary to master it proficiently, 10 had general understanding, and 3 were uncertain.

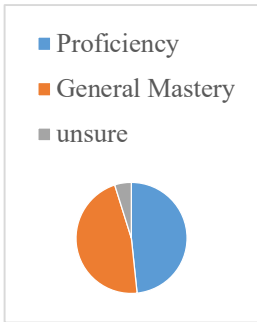


Fig. 3. The situation of professional 1 design research scheme ability survey

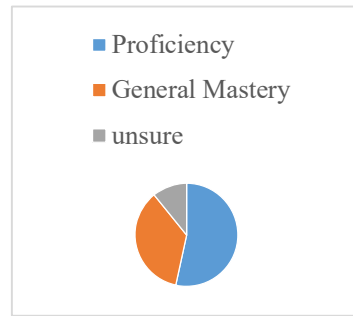


Fig. 4. The situation of professional 2 design research scheme ability survey

As shown in Figure 3 and Figure 4, the proportion of students who think that they should master the ability to design research schemes proficiently is significantly higher than that of professional 1.

3.3 Innovation and Creation Ability

In professional 1, there were a total of 80 people, among whom 39 thought it was necessary to master it proficiently, 37 had general understanding, and 4 were uncertain; in

professional 2, there were a total of 28 people, among whom 18 thought it was necessary to master it proficiently, 9 had general understanding, and 1 was uncertain.

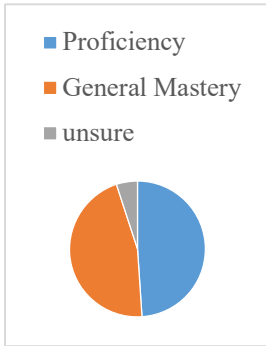


Fig. 5. The situation of professional innovation and creation ability investigation

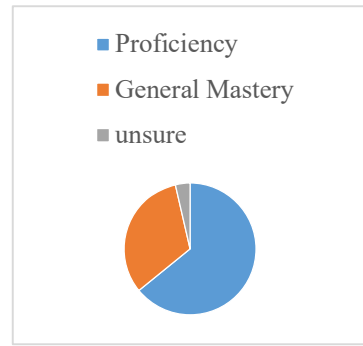


Fig. 6. The situation of professional innovation and creation ability investigation of professional 2

As can be seen from Figure 5 and Figure 6, the proportion of students who believe that major 2 should be proficient in innovation and creativity is significantly higher than that of major 1.

4 The Effectiveness of Scientific Thinking Courses and the Graduation Direction and Enterprise Investigation Results

Judging from the average score of basic courses and scientific thinking courses in materials science, major 1 has an average of 66.63 points and major 2 has an average of 76.46 points. The average scores of students in major 2 were significantly higher than those in material testing. Judging from the direction of graduation, there are 80 people in major 1, 39 of whom are influential enterprises in the industry, such as China Construction and Sichuan Road and Bridge, accounting for 48.8 percent, while there are 28 people in major 2, of whom 21 are influential enterprises in the industry, such as China Construction and Sichuan Road and Bridge, accounting for 75 percent. From the previous survey, it can be seen that the number of students in major 2 who think that they should be proficient in the ability to propose research directions, the ability to design research programs, and the ability to innovate and create is significantly higher than that of major 1. That is to say, the degree of attention and understanding of the basic course of material science in major 2 is higher than that of major 1, so the average score of the basic course of material science in major 2 is much higher than that of the students in major 1. It is also because of the cultivation of scientific thinking ability and professional quality through the basic courses of materials science, the proportion of students in major 2 in employment from professional counterparts to influential enterprises in this industry is much higher than that in major 1.

The survey of enterprises shows that all the enterprises surveyed believe that they need to master scientific thinking ability (analyze the problems on the construction site according to scientific thinking and propose solutions).

5 Countermeasures for Cultivating Students' Professional Qualities

5.1 Adopt Scientific Thinking to Reflect the Professional Characteristics of Civil Engineering

First, it is to cultivate the ability to solve problems. Scientific thinking methods emphasize observation, experiment, reasoning and verification, which can help civil engineering students better understand complex problems and learn how to draw conclusions from data. Introducing scientific thinking methods in professional ethics education can help students better solve practical engineering problems and improve their professional abilities^{[4]-[5]}.

Secondly, enhance innovation awareness: scientific thinking methods encourage innovation and exploration. The field of civil engineering requires continuous technological innovation and improvement. By improving scientific thinking methods, civil engineering students can better cultivate their own innovative awareness and abilities, laying a solid foundation for future career development.

Third, improve comprehensive quality: scientific thinking methods are not only a way of thinking, but also an embodiment of comprehensive quality. Introducing scientific thinking methods into civil engineering vocational ethics education can help students improve their comprehensive quality, including observation ability, analysis ability, judgment ability, communication ability, etc., which are all very important for future career development.

5.2 Cultivate Students' Professional Qualities through a Progressive and Integrated Approach Using Scientific Thinking Methods from High School to Undergraduate, Master's Degree, and Doctoral Programs^{[6]-[7]}

According to the teaching standards and training programs^{[6]-[7]} stipulated by the Ministry of Education of the People's Republic of China, we have sorted out the main points of professional quality required by civil engineering in secondary vocational schools: safety awareness, civilization awareness, environmental awareness, conservation awareness and innovative spirit. The main points of professional quality required by civil engineering in higher vocational colleges are: quality awareness, environmental protection, safety awareness, information literacy, craftsman spirit and innovative thinking. There are no relevant regulations for vocational education undergraduate and vocational education professional degree graduate students. We put forward the main points of professional accomplishment required for vocational education undergraduate civil engineering major categories in combination with the previous requirements: quality awareness, environmental protection meaning, safety awareness, information

literacy, craftsman spirit, scientific and innovative thinking. The main points of professional accomplishment required by the major categories of civil engineering for graduate students majoring in vocational education are: quality awareness, environmental protection, safety awareness, big data integration, craftsman awareness in big countries, and scientific innovation and creative thinking. The professional qualities that reflect the characteristics of the training of civil engineering major categories are: innovative spirit (secondary vocational)-innovative thinking (higher vocational) scientific innovative thinking (vocational education undergraduate)-scientific innovative creative thinking (vocational education professional degree graduate)(As shown in Table 1).

Table 1. Secondary-Higher-Undergraduate- Master students’s career development through integrated training.

Stage Elements	Key points of professional ethics	Professionalism through cultivation
Vocational education	with safety awareness, civilized awareness, environmental protection awareness, saving awareness and innovative spirit	Innovation spirit
Vocational College	Quality awareness, environmental awareness, safety awareness, information literacy, craftsmanship spirit, innovative thinking	Innovative thinking
Vocational education undergraduate	Quality awareness, environmental protection awareness, safety awareness, information literacy, craftsmanship spirit, scientific innovation thinking	Scientific innovation thinking
Vocational education professional degree graduate	Quality awareness, environmental protection awareness, safety awareness, big data integration, national craftsman awareness, scientific innovation and creation thinking	Scientific innovation creates thinking

5.3 Open a Scientific Thinking Course for Cultivating Professional Qualities of Civil Engineering

The course of Materials Science Foundation is one of the courses that best reflects the scientific principles of civil engineering, and can cultivate students' scientific thinking. We believe that the recognition of the ability to cultivate scientific thinking and the results reflected in the course as well as the actual improvement of scientific thinking ability reflected in professional qualities are mutually influencing and complementary.^{[8]-[9]}

And the vocational education of civil engineering needs to conduct courses such as basic material science (innovative thinking), academic ethics and academic norms, literature review and scientific paper writing, and new progress in civil engineering.

Promoting reform of engineering education: With the development of science and technology and the progress of society, traditional methods of engineering education are no longer able to meet the needs of modern engineering practice. Improving the status of scientific thinking methods in civil engineering professional ethics education

can promote the reform of engineering education, making it more in line with the needs of modern engineering practice, improving the quality and efficiency of education^[10].

6 Conclusion

Therefore, in order to strengthen the vocational quality education of technical and skill-oriented talents related to civil engineering, it is necessary to strengthen the cultivation of scientific thinking and engineering application thinking among students majoring in civil engineering in professional courses. This will enable them to grasp the scientific principles of civil engineering, thereby maintaining a sense of reverence during construction processes, avoiding problems caused by shoddy workmanship or unscientific rush jobs and "innovations". That is, using methods to improve scientific thinking for civil engineering vocational quality education. A course based on the scientific thinking foundation course of material science can enhance scientific thinking ability and further improve civil engineering vocational quality.

Acknowledgments

This paper studies the training mode and practice of high-level professional talents in vocational education-takes the training of civil and water conservancy postgraduates in vocational education as an example to GZJG2022-471 and explore the practical significance and practice of high-level and high-level professional literacy education in civil engineering-based on the basic curriculum construction 23018 of scientific innovative thinking, the construction and research of high-level and high-level professional curriculum system based on "post competition certificate"-takes the construction engineering technology major as an example 2023JY13 project support.

References

1. <https://baike.baidu.com/item/%E8%81%8C%E4%B8%9A%E7%B4%A0%E5%85%BB/10564718>.
2. Jiang Dayuan. Essentials of vocational education [M]. Beijing: Beijing Normal University Press (BNUP), 2017:143.
3. Zeng Wei. Research Report on Talent Demand of Architectural Engineering Technology Professional [J]. Ability and Wisdom, 2012, (06):44.
4. Yan Shengnan; Gu Guanghua; Jing Nan; Exploring the Teaching Reform of Deep Integration of Scientific Thinking Methods and Specialised Courses--Taking Signals and Systems Course as an Example[J]. Journal of Higher Education, 2023, 9(33):125-128. DOI: 10.19980/j.CN23-1593/G4.2023.33.030.
5. hao Hui; Li Maohua; Wang Guodong. A Study on Constructing the Guting Model of Innovative Thinking System of College Students [J]. Today's Mass Media, 2024, 32(02):140-143.
6. Ministry of Education of the People's Republic of China. Teaching Standards for Secondary Vocational School Professions [EB/OL]. http://www.moe.gov.cn/s78/A07/zcs_ztzt/2017_zt06/17zt06_bznr/bznr_zzjxbz/.

7. Hu Jin; Jiang Guangming. An Initial Study on the Feasibility of Conducting Professional Degree Graduate Education in Vocational Education in Vocational Institutions--Taking the Civil Engineering and Water Conservancy Major of a Higher Vocational Institution in Sichuan as an Example [J]. Education Science Forum,2023,(03):27-30.
8. Dong Hansong;Hu Jin;Liu Guichun;Li Wentao. Improvement Research on the Curriculum of "Fundamentals of Materials Science" in Higher Vocational Education under the Background of "One Belt and One Road"--Taking Sichuan College of Construction Vocational Technology as an Example[J]. Education Science Forum,2023, (18):37-41.
9. Zhu Yujun; Wang Xiangfeng. Scientific Thinking: Connotation, Elements and Methods[J]. Chinese Journal of Chemical Education, 2024, 45(01):9-14. DOI: 10.13884/j.1003-3807hxjy.2022120198.
10. Zhu Yujun, Wang Xiangfeng. Scientific Thinking: Connotation, Elements, and Methods [J]. Chemistry Education (Chinese and English), 2024, 45 (01): 9-14.

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