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Original Paper

Exploration and Research on the Training Mode of Professional Degree Graduates-taking Civil Engineering and Water Conservancy as an Example

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Abstract

With the rapid development of the social economy, the demand for talents is increasing. It is necessary to have a solid theoretical foundation and good hands-on and creative abilities. How to cultivate graduate students majoring in civil engineering and water conservancy is the most important issue for people. The exploration of the training mode for master's students majoring in civil engineering and water conservancy mainly includes: establishing training objectives in the planning stage, formulating training plans, and developing evaluation indicators; the implementation phase includes teaching, research guidance, internships, and other stages; the assessment stage is to evaluate the academic level and teaching quality of graduate students majoring in wood water conservancy; in the improvement stage, based on the assessment results, adjust the training plan, improve the teaching methods for graduate students in the field of wood and water conservancy, and enhance the discipline construction; on this basis, through continuous PDCA(Plan-Do-Check-Act) cycles, the overall quality and professional ability of talents have been further improved to meet the needs of social and industrial development. Group 1 (experimental group) scored 85 points in time management, 90 points in resource allocation, and 88 points in risk control. Four groups (control group) scored 75 points in time management, 78 points in resource allocation, and 72 points in risk control. This article aims to assist students in quickly integrating into the workplace and serving socio-economic development.

Keywords

professional degree, postgraduate training mode, civil water conservancy, time management

1. Introduction

The graduate training model for civil engineering and water conservancy majors is aimed at providing students with systematic and in-depth professional knowledge and skills training for a certain major. The emergence of this talent cultivation model is due to the changing and increasing requirements for talents in Chinese higher education, especially the urgent need for high-quality applied talents in various professional fields. The exploration and research on the professional degree graduate training model, taking civil engineering and water conservancy as an example, is a supplement and improvement to traditional undergraduate education. It is in line with the needs of social and economic development after China's higher education has reached a certain stage of development.

This article first provides the background of exploring the training mode for graduate students majoring in civil engineering and water conservancy, and points out the necessity of the current training mode for graduate students in civil engineering and water conservancy. Secondly, it explores the training mode for graduate students. Graduate education also has the characteristics of highlighting the guidance of mentors and guiding teachers to determine the learning content and main tasks of students. This has certain constraints on the independent choice of civil engineering and water conservancy graduate students, but is beneficial for improving their research abilities. At the same time, it also demonstrates characteristics such as equal emphasis on scientific research and teaching, standardization, and specialization. Finally, explore the project-based training model, by conducting theoretical teaching in the classroom and combining it with specific engineering examples, so that students can have a deeper understanding of the theories they have learned and be able to apply them to solve practical problems.

2. Related Work

Postgraduate education mode is a complicated and diversified system, which should be constantly adjusted and optimized according to the development of the times and the requirements of reality, so as to better provide high-quality talents for social development. Han Shengli explored the reform and innovation of the training mode of professional degree postgraduates in the new era (Han, Sun, & Bai, 2023). Hao Zhouhua studied the training mode of professional postgraduate students in cardiac surgery (Hao, Zhong, Meng et al., 2020). Chen Wenxing explored the training mode of professional degree graduate students with deep integration of production and education (Chen, 2023). Zhang Hongyan explored the "one core and three dimensions" postgraduate training mode and practiced and explored it (Zhang, Yang, & He, 2023). Wen Xiaoxia takes the graduate students in the direction of rail transit vehicles as an example to study the interdisciplinary vehicle engineering graduate training model (Wen, Cui, & Du, 2021). Xu W. X. discusses the current full-time postgraduate training mode (Xu, 2022). McCarthy C. studied the influence of novel coronavirus epidemic on medical postgraduate education in China (McCarthy, 2020). Erumeda N. J. analyzed the current situation of family medicine postgraduate training resources in China universities (Erumeda, Jenkins, & George, 2022). McCallum M studied the

relationship between the socio-economic status of general practitioners and the certification of postgraduate training practice (McCallum, Hanlon, Mair et al., 2020). Ray S. explores the research progress of master's degree education in pharmacy in colleges and universities from the perspective of postgraduate training. But their research is not good for the cultivation of graduate students (Ray, Johnson, Lokken et al., 2023).

In today's rapidly developing science, technology, and economy, the requirements for professional talents in various industries have also changed accordingly. Traditional undergraduate education has become difficult to meet the industry's requirements for professional talents, leading to the emergence of a professional degree training model centered on professional knowledge and technology. The rapid development of technology has constantly updated people's knowledge, while traditional teaching has fallen far behind the development of industries. With the continuous development of information technology, the cultivation of graduate students majoring in civil engineering and water conservancy is increasingly emphasizing the cultivation of their hands-on ability, innovation ability, and problem-solving ability, so that they can adapt to the ever-changing knowledge structure. The development of many industries has become increasingly interdisciplinary, requiring versatile talents with knowledge and skills in multiple fields. Graduate education in civil engineering and water conservancy usually focuses more on interdisciplinary integration, cultivating students with the ability to solve problems across fields.

3. Method

3.1 Postgraduate Training Mode

The graduate training mode of civil engineering and water conservancy refers to a series of educational measures taken in the implementation process of civil engineering and water conservancy graduate education to achieve the training objectives and corresponding standardized quality. It includes postgraduate admission, course teaching, scientific research, social practice, thesis writing and other educational stages, as well as the specific methods of thesis defense. It consists of many factors, such as training purpose, training process and training method, and is influenced by many factors, such as social needs, economic development level and students' characteristics.

At the same time, graduate student in civil engineering and water conservancy also has the characteristics of highlighting the guidance of tutors and guiding teachers to determine students' learning content and main tasks, which restricts graduate students' independent choice to some extent, but is beneficial to improving students' scientific research ability. At the same time, it also shows the characteristics of equal emphasis on scientific research and teaching, standardization and specialization.

Compared with foreign countries, China's postgraduate training mode has certain advantages in the field of training and theoretical connection, but there are still some disadvantages, such as focusing on theoretical study, less practical links and tutorial system. However, drawing lessons from the experience

of the United States, foreign graduate education models put more emphasis on the improvement of students' independent thinking, scientific research, practical ability and employment competitiveness.

It is assumed that the quality of graduate student in civil engineering and water conservancy education Q is determined by many factors, which may include the quality of tutor's guidance M, the quality of curriculum C, the quality of scientific research practice R and students' own ability S. These factors can be regarded as variables with different weights, which jointly affect the quality of culture. Therefore, we can establish a weighted linear model to evaluate the quality of postgraduate education:

$$Q = w1 * M + w2 * C + w3 * R + w4 * S \quad (1)$$

Among them, w1, w2, w3, w4, are the weights of various factors, which can be adjusted according to the actual situation. This formula expresses a basic view that the quality of postgraduate education is the result of multiple factors.

In the process of cultivating graduate students majoring in civil engineering and water conservancy, there is a certain relationship between the input cost t_b and the output benefit B. Costs may include teaching expenses, investment in scientific research equipment, tutor's salary etc., while benefits may be reflected in graduate students' scientific research achievements, employment competitiveness and social contributions. In order to analyze the cost-effectiveness of postgraduate education, we can establish a simple proportional model:

$$x_z = B / t_b \quad (2)$$

x_z is a benefit index. This formula is used to measure the benefits per unit cost in the process of postgraduate training. The higher the benefit index, the better the cost-effectiveness of the cultivation process.

3.2 Explore the Project-oriented Training Mode

Project design and implementation: First of all, according to the actual needs of civil engineering, water conservancy and other industries, design a challenging topic that includes many important links such as scheme design and construction management. Secondly, guide students to carry out research, and cultivate students' practical ability and problem-solving ability in hands-on operation.

Practical guidance and feedback: Establish a full-time teaching team to provide targeted internship guidance for graduate students majoring in civil engineering and water conservancy, to ensure that students can receive effective guidance during the internship period. At the same time, timely feedback and evaluation should be provided on the actual operation of the trainees, identifying existing problems and providing improvement suggestions, so that they can continuously improve their abilities.

Integration of theory and practice: In the implementation process of the project, attention should be paid to the combination of theory and practical application. By conducting theoretical teaching in the classroom and combining specific engineering examples, students can have a deeper understanding of

the theories they have learned and be able to apply them to solve practical problems.

Team collaboration and communication: in engineering teaching, emphasis should be placed on cultivating the team collaboration and communication skills of graduate students majoring in civil engineering and water conservancy. Through methods such as group discussions and communication, students have improved their collaborative abilities in group activities.

3.3 Combining PDCA Research to Cultivate

PDCA (Plan Do Check Act) is a continuous improvement management method that can be applied to the design and implementation of graduate training models for civil engineering and water conservancy majors. The following are the specific steps for combining the PDCA method:

Step 1. Plan:

Clear training objectives: To define the professional knowledge, skills, and cultural literacy of the talents to be trained.

Develop training plan: Based on the teaching objectives, determine the curriculum, internship stage arrangement, and graduation thesis requirements.

Develop evaluation index: to provide evaluation indicators for evaluating students' academic performance, research ability, practical experience etc.

Step 2. Do (Implementation):

Course implementation: According to the training plan, carry out teaching activities such as classroom lectures, experiments, and internships.

Responsible for scientific research of graduate students majoring in wood water conservancy, guiding their research plans, improving their scientific research level, and enhancing their innovation awareness.

Provide internship opportunities: arrange internship, internship and other internship stages to enable graduate students majoring in wood water conservancy to apply the knowledge and skills they have learned to practical engineering projects.

Step 3. Check:

Academic evaluation of graduate students majoring in wood water conservancy: Regular evaluation of the academic performance and progress of graduate students majoring in wood water conservancy, including tests and paper progress.

Teaching quality evaluation: Collect feedback and teaching effectiveness from graduate students majoring in wood water conservancy, evaluate teaching quality, and identify existing problems and shortcomings.

Step 4. Act (improvement):

Adjust the training plan based on the assessment results: Adjust and optimize the training plan according to the problems and defects found during the assessment.

Improving educational methods: Based on the evaluation of teaching quality, improve educational methods, teaching methods, and educational outcomes.

Strengthen professional construction: Based on the needs of graduate students majoring in wood water conservancy and the development dynamics of the industry, adjust the professional structure and research direction, and continuously improve the competitiveness of the profession.

4. Results and Discussion

4.1 Evaluation Scores and Comprehensive Scores of Different Groups of Civil and Water Conservancy Graduate Students from Different Perspectives in Team Collaboration Ability Assessment

The evaluation scores and comprehensive scores of different groups of civil engineering and water conservancy graduate students from different perspectives in team collaboration ability assessment are shown in Figure 1.

Diversity of evaluation angles:

It is evaluated from three perspectives: classmates, tutors and students' self-evaluation, which can provide a relatively comprehensive and multi-dimensional evaluation perspective. Each angle may capture different aspects of students' teamwork ability, thus reflecting students' actual situation more accurately.

Score:

Judging from the scores, the scores of 1, 2 and 3 (experimental group) are generally high, and both peer evaluation, tutor evaluation and self-evaluation show relatively high teamwork ability. The scores of 4, 5 and 6 (control group) are relatively low, which implies that the students in the experimental group may perform better in teamwork ability.

Comprehensive score analysis:

The comprehensive score is calculated through the evaluation scores from different angles, which helps to reduce the deviation of single-angle evaluation. Judging from the comprehensive score, the average comprehensive score of the students in the experimental group is higher than that of the students in the control group, which further proves the advantages of the students in the experimental group in teamwork ability.

Intra-group differences:

Within the experimental group, there are some differences in scores among students, but they are at a high level as a whole. Similarly, there are differences in scores within the control group, but the overall score is low. This shows that even in the same group, students' teamwork ability will be different.

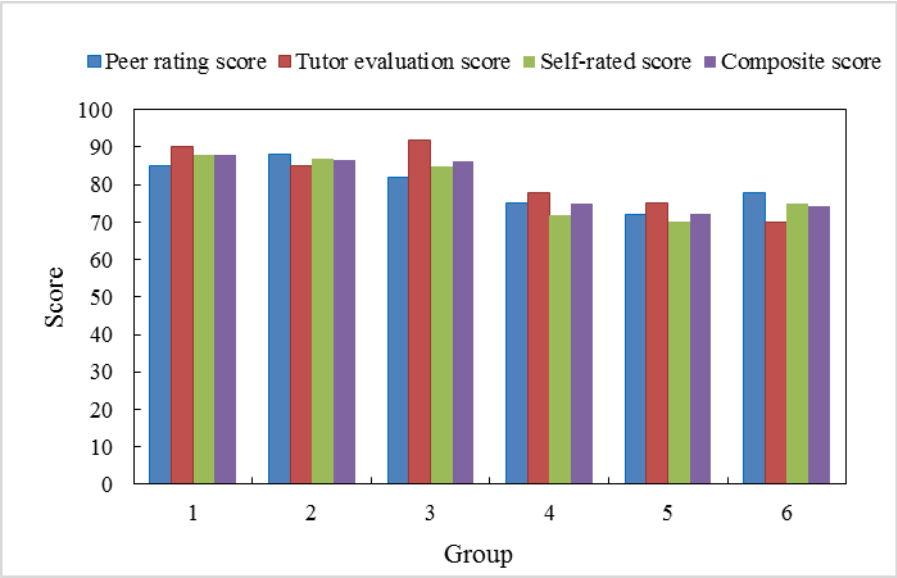

Figure 1. Evaluation Scores and Comprehensive Scores of Different Groups of Civil and Water Conservancy Graduate Students from Different Perspectives in Team Collaboration Ability Assessment

4.2 Employment Competitiveness Survey

By tracking the employment situation of graduates majoring in civil engineering and water conservancy, including indicators such as employment rate, starting salary, and job level, a comparative analysis is conducted on the employment competitiveness of students in the experimental group and the control group. In addition, through enterprise follow-up and questionnaire surveys, comprehensive evaluations of graduates by employers are collected to further evaluate the impact of project-based training mode on the employment competitiveness of civil engineering and water conservancy students.

Groups 1, 2 and 3 are experimental groups, and groups 4, 5 and 6 are control groups, with a full score of 100. Group 1 scored 85 points for time management, 90 points for resource allocation and 88 points for risk control. The time management score of the two groups is 82, the resource allocation score is 85 and the risk control score is 92. The three groups scored 90 points for time management, 88 points for resource allocation and 85 points for risk control. The four groups scored 75 points for time management, 78 points for resource allocation and 72 points for risk control. The time management score, resource allocation score and risk control score of different groups are shown in Figure 2.

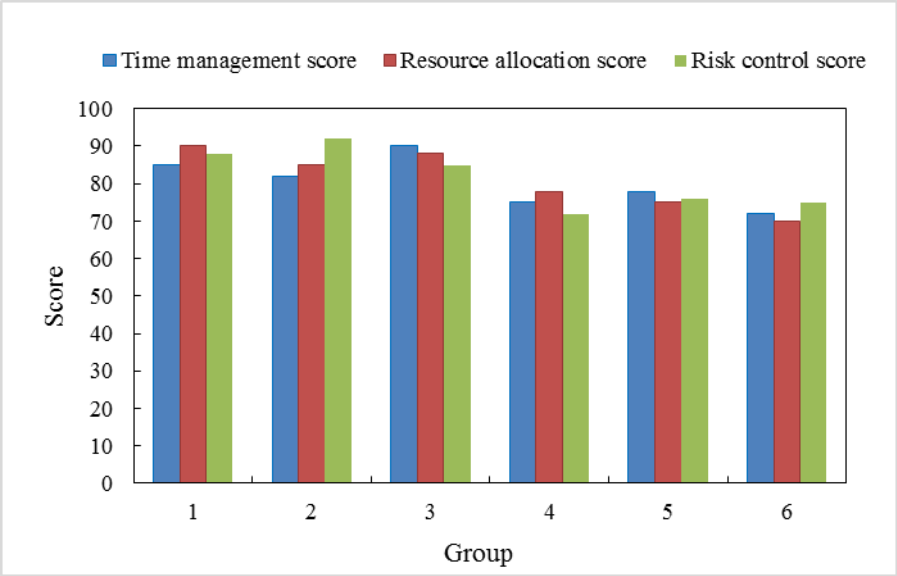

Figure 2. Time Management Score, Resource Allocation Score and Risk Control Score of Different Groups

4.3 Employment Situation and Enterprise Evaluation of Graduates Majoring in Civil Engineering and Water Conservancy

The employment situation and enterprise evaluation of graduates majoring in civil engineering and water conservancy are shown in Table 1. Table 1 is used to demonstrate the comparative analysis of the employment competitiveness of the experimental group and the control group students by tracking the employment situation of graduates and enterprise evaluation.

Table 1. Employment Situation and Enterprise Evaluation of Graduates Majoring in Civil Engineering and Water Conservancy

Group	Employment rate	Average starting salary (yuan/month)	Job level distribution	Employer comprehensive evaluation score (out of 100)
Experiment group	95%	8000	Junior position: 30% Intermediate position: 50% Senior positions: 20%	85
Control group	85%	7000	Junior position: 50% Intermediate position: 40%	75

	Senior position: 10%

The employment rate represents the proportion of students in the experimental group and the control group who successfully find employment after graduation; the average starting salary represents the average salary level of students at the time of their first employment; the distribution of job levels lists the proportion of positions at different levels to reflect the job positions of civil engineering and water conservancy students in the job market; the comprehensive evaluation score of employers is a comprehensive evaluation of civil engineering and water conservancy graduates collected through enterprise follow-up and questionnaire surveys, with a maximum score of 100 points.

It is possible to evaluate the impact of project-based training mode on the employment competitiveness of students. For example, the employment rate and average starting salary of students majoring in civil and water conservancy in the experimental group are higher, and the proportion of senior positions is higher. This may indicate that the project-based training model has certain advantages in enhancing the employment competitiveness of students. Meanwhile, the employer's comprehensive evaluation score can also serve as a reference indicator for evaluating the comprehensive quality and adaptability of students.

In practical research, the accuracy and reliability of data can be improved by expanding the sample size and increasing tracking time. In addition, other employment competitiveness evaluation indicators such as graduate employment satisfaction and career development can be combined to comprehensively evaluate the impact of project-based training mode on student employment competitiveness.

5. Conclusion

Against the backdrop of optimizing the structure of higher education and improving the quality of talent cultivation in China, the country and academia have paid high attention to professional degree graduate education and introduced multiple policies to promote the development of this model. This article believes that in engineering teaching, emphasis should be placed on cultivating students' teamwork and communication skills. Through group discussions and communication methods, students have improved their collaboration and collaboration abilities in group activities. The employment rate of students in the experimental group is higher, the average starting salary is higher, and the proportion of senior positions is higher. This may indicate that the project-based training model has certain advantages in improving the competitiveness of students in employment. In the future, innovative models of graduate training can be explored to promote the employment and further development of graduate students.

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The 2023 Graduate Education Reform and Quality Improvement Project of Nanyang Normal University (2023ZLGC11);
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