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Research on the Experimental Teaching Method of Vibration Damping Fastener for Undergraduates Majoring in Rail Transit

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Abstract: Experiment is an important teaching link in talent training. Aiming at the current situation and problems of the experimental teaching of rail transit major, taking the experimental teaching of vibration damping fastener drop weight for railway engineering major of Central South University as an example, the specific methods of the new experimental teaching mode for undergraduates majoring in rail transit are expounded: Improve the subject experimental system, build an open experimental platform, and improve the school-enterprise resource sharing system, etc. This model is conducive to the reform and development of the experimental teaching model for rail transit majors and related science and engineering majors.

Keywords: School-Enterprise Cooperation; Rail Transit Major; College Students; Teaching Methods; Vibration Reduction Fasteners

1. Introduction

Experimental teaching is an important part of cultivating the core quality of college students. How to reform the experimental teaching method and establish an innovative experimental teaching system has become a new topic of higher education research. At the same time, the rail transit major has the particularity that it is highly suitable for engineering practice. Through experimental teaching, students can improve their practical ability and innovative thinking to serve the rapid development of the national rail transit industry[1-2]. In order to explore experimental teaching methods with professional characteristics and build a bridge between theoretical teaching and engineering practice, the new model of experimental teaching for rail transit majors has become the development needs of the times, and it is also one of the important ways for colleges and universities to achieve the goal of cultivating outstanding rail transit professionals.

2. The current situation and existing problems of experimental teaching for undergraduates majoring in rail transit

2.1 Experimental teaching system

The experimental teaching system cannot be updated in time and is out of touch with the actual development of engineering[3]. The experimental teaching materials are backward, the content is single and outdated, mainly based on theoretical verification experiments, and lack of innovative and applied experiments. For research universities, this has been unable to meet the requirements of its student training.

2.2 Faculty strength

The faculty of experimental teaching determines the quality and results of education. At present, due to the lack of teachers, most of the experimental courses in colleges and universities are still class-based, and teachers cannot give detailed guidance to every student. Some colleges and universities lack a team of teachers with strong professional level and scientific organizational structure.

2.3 School-enterprise cooperation and resource sharing

School-enterprise cooperation is progressing slowly, especially in terms of student experiments, and there is no in-depth, multi-dimensional cooperation. The lack of mutual benefit and win-win mechanism between schools and enterprises makes technical barriers exist between colleges and employers, which restricts the educational practice of colleges and universities, and college students cannot obtain experimental teaching content that conforms to engineering reality in a timely manner.

3. Construct a new experimental teaching mode for undergraduates majoring in rail transit

3.1 The construction of discipline experiment system

Build an innovative experimental system. Taking the process of theory-practice-research as a scientific guide, we will promote theoretical on-site teaching, "heuristic" teaching and other methods, and make students become the "protagonists" of experimental teaching[4]. At the same time, it is necessary to improve the evaluation standards for experimental reports and encourage students to conduct self-exploration.

3.2 Construction of open experimental platform

Use online network tools to build an open experimental platform. Teachers can upload teaching materials through the platform, and at the same time, they can display specific operations in the form of virtual simulation experiments, which is convenient for students to preview online in advance and review after class.

3.3 Construction of school-enterprise resource sharing system

Coordinate the mutual sharing of resources between the campus and the enterprise, and use the power of the enterprise to make up for the lack of teachers in colleges and universities, so that the students have the opportunity to contact the advanced rail transit professional technology and construction technology, and improve the cognitive ability and level of scientific research.

4. An example of a new model of experimental teaching - the experimental teaching of vibration reduction fastener drop hammer

Taking the experimental teaching of a new mode of this major as an example, the name of the experiment is "Research Experiment of Fastener Vibration Reduction Mechanism and Performance Improvement Technology". This experiment is mainly used to test the vibration reduction performance of a vibration reduction fastener applied to major domestic subway lines through the drop weight test, and compares the vibration reduction performance of ordinary fasteners and other vibration reduction fasteners in the existing data, and then enlightens undergraduate students come up with effective fastener damping measures[5].

4.1 Experimental purpose

(1) Through experiments, learn about the testing equipment and instruments for the impact and vibration reduction performance of fasteners, master the experimental principles of the impact and vibration reduction performance of fasteners, cultivate the style of combining theory with practice, improve hands-on ability and ability to analyze problems.

(2) Through the comparative experiment and data analysis of the vibration reduction fastener and the ordinary fastener, the influence law of the fastener stiffness on the time-frequency propagation characteristics of rail transit vibration was

obtained, and the basic concept of the rail and environmental vibration induced by the impact load of the train was deeply understood, and then lay the foundation for students to engage in rail transit vibration and control work in the future.

(3) From the aspects of simulation and field experiments, compare and analyze the vibration reduction performance of the vibration reduction fasteners and other fasteners applied in the subway, or develop a vibration reduction fastener to provide the subway track structure selection and parameter design optimization.

4.2 Experimental arrangement

(1) Preliminary preparation for the experiment. Develop experimental outline, research, experimental program design, and data collection.

(2) Experimental model making. The three-dimensional finite element simulation model of the track is established, the vertical static stiffness variation characteristics and modal characteristics of the vibration damping fasteners are studied, and the dynamic vibration damping performance of the two types of fasteners under white noise excitation is compared and analyzed.

(3) Specific experimental operations. Using the established 3D explicit finite element model, the simulation analysis of the drop weight impact was carried out, and the vibration reduction performance of the ordinary fastener track and the vibration damping fastener track, that is, the impact load attenuation performance, was compared and analyzed, and the second stage results summary report was formed.

(4) Summarize the research results and form the final report.

4.3 Experimental results

Through experiments, students can understand the requirements of urban rail transit for vibration reduction and noise reduction, and learn the methods of experimental research on the mechanical performance and vibration reduction performance of vibration reduction fasteners used in subway lines. The design and optimization of the proposed program. Finally, the experimental team formed an experimental report and applied for a utility model patent.

5. The effect of the new model of experimental teaching for undergraduates majoring in rail transit

5.1 Team spirit

The team organized group meetings for many times, agreed on the experimental division plan, and reported the progress of the experiment in a timely manner. In the face of difficult problems, the team encouraged each other, completed detailed data preparation, clear and clear experimental plan guidance, rigorous experimental operation, and huge experimental data processing. The smooth progress of the experiment benefited from the tolerance and understanding of each member and helped each other.

5.2 Professionalism

The entire team members are undergraduates, and have a certain foundation for knowledge reserve and experimental operation. During the experiment, students understand the experimental content, learn specific experimental operations, and consult their instructors for specialized data analysis software, which greatly improves the students' professional quality.

5.3 Scientific research ability

After this experiment, students generally expressed that scientific research is a kind of enjoyment. Students' attitude towards scientific research has changed, and their analytical ability and self-learning ability are also good. From the previous

rote memorization of knowledge, to seeing a paper, you will first think about what the research object is, how to research it, and why you should research it. The perspective of thinking is from the reader to the author[6].

6. Conclusion

The new experimental teaching mode for undergraduates majoring in rail transit takes the improvement of the subject experimental system, the construction of an open experimental platform, and the improvement of the school-enterprise resource sharing system as breakthrough points, and has achieved good results in practice. The current international competition in all walks of life is becoming increasingly fierce, and the rapid development of science and technology has played a powerful role in promoting it. The improvement of a country's comprehensive competitiveness requires a large number of high-quality talents with innovative thinking and scientific research capabilities.

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