

Research on the strategies of scientific research feeding back teaching in mechanical engineering

Shu WANG* , Fengling YANG

School of Energy and Mechatronics Engineering, Hunan University of Humanities, Science and Technology, Loudi, China

Abstract: With the increasing attention paid to the concept of scientific research back-feeding teaching in colleges and universities, the mechanical engineering has put forward higher requirements for the cultivation of applied talents in the new era. This paper analyzes the problems existing in scientific research back-feeding teaching of the mechanical engineering, and puts forward improvement measures from the aspects of policy support, mechanism operation, reward incentive and team building, so as to promote the role of scientific research in promoting teaching and improve the talents cultivation quality.

1. Introduction

As the two core functions of colleges and universities, teaching and scientific research are the key factors to cultivate high-quality talents^[1]. With the gradual implementation of the concept of scientific research back-feeding teaching in undergraduate education, many universities and teachers have carried out active exploration. Chen Baiman and others believe that the separation of teaching and scientific research should be overcome to form a mutually reinforcing relationship^[2]. Shiyan et al. pointed out that it is necessary to pay attention to the close combination of scientific research and teaching, and form a coordinated development and virtuous circle of scientific research and teaching^[3]. Zhang Xin believes that undergraduate students' participation in scientific research can cultivate professional quality and enhance scientific research ability^[4]. Zhao Qixiang et al. believed that scientific research and teaching should not be independent of each other, but promote each other, and discussed the role of scientific research in promoting undergraduate teaching of electronic information from three aspects: undergraduate teaching content, teaching effect and comprehensive ability of college students^[5]. Gao Zhaojian and others put forward the teaching mode of "integration of practical teaching and scientific research", which integrates scientific research into practical teaching^[6].

The mechanical engineering of local undergraduate colleges and universities, focusing on the cultivation of advanced applied talents to meet and serve the development needs of engineering machinery and intelligent manufacturing, should strengthen the importance of scientific research feedback teaching, establish a comprehensive operation mechanism, absorb more scientific research achievements transform into teaching resources, further enhance students' innovative practical ability, and improve the quality of talents

cultivation.

2. The importance and status of scientific research back-feeding teaching in mechanical engineering

2.1 The importance of scientific research back-feeding teaching in mechanical engineering

2.1.1 Scientific research nurturing teaching can improve the quality of talents cultivation.

On the one hand, teachers can apply theoretical analysis to field practice and carry out theoretical innovation in the process of scientific research. Introducing scientific research achievements into classroom teaching can not only enrich classroom teaching resources, but also enhance students' enthusiasm for participating in classroom interaction and improve classroom teaching effect. On the other hand, encourage students to participate in scientific research work, literature collection and collation, design experimental programs, drawing drawings, processing data, etc., can exercise students' autonomous learning ability, cultivate students' innovative practical ability, and improve the amount of personnel training^[7].

2.1.2 Scientific research nurturing teaching can promote teacher development.

For mechanical engineering, in the process of using scientific research achievements to guide practical teaching, innovative entrepreneurship projects or graduation design, teachers need to constantly update teaching concepts and teaching methods, actively participate in teaching reform, and improve teachers'

*Corresponding author: wangshu_yfl@163.com

teaching level. In addition, teachers need to continue to pay attention to the frontiers of disciplines and the latest developments in scientific research, which can also improve teachers' scientific research level.

2.2 The status of scientific research back-feeding teaching in mechanical engineering

2.2.1 Scientific research and teaching are not closely linked.

In many colleges and universities, there is a phenomenon that scientific research and teaching are parallel running^[8]. The big difference between scientific research direction and teaching content makes it difficult to apply scientific research achievements to teaching. Some colleges and universities even set up "scientific research post" and "teaching post". Scientific research teachers concentrate on scientific research work, and their professional title evaluation, promotion, evaluation and other assessments are only for scientific research work. The teaching-oriented teachers only need to complete the teaching tasks and have no scientific research assessment requirements, which makes the advanced frontier scientific research achievements unable to enter the classroom teaching.

2.2.2 Lack of incentive mechanism for scientific research to feed back teaching.

Colleges and universities have not fully realized the importance of scientific research back-feeding teaching to improve the quality of talent training, and have not established the operation mechanism and reward and punishment measures to support scientific research back-feeding teaching, which leads to the lack of effective guarantee and incentive mechanism for scientific research back-feeding teaching.

2.2.3 The scientific research platform is insufficient to guide practical teaching.

For undergraduates majoring in mechanical engineering, practical teaching is the best means to cultivate students' practical ability. At present, The obsolete experimental equipment and single experimental content used in the comprehensive practice project of mechanical specialty will seriously affect the teaching effect^[9]. When teachers carry out scientific research, they generally design and purchase the latest and most advanced experimental equipment. If these equipment can be used to guide practical teaching, it will help to cultivate students' innovative practical ability.

2.2.4 The low motivation of undergraduates to participate in scientific research.

Due to the heavy schoolwork, the enthusiasm of students to participate in scientific research is not high. Lacking the ability to solve problems effectively in the process of scientific research also lead to a great increase in the

probability of students giving up halfway.

3. Improvement measures of scientific research back-feeding teaching in mechanical engineering

3.1 Update the concept of talent cultivation, establish a comprehensive operational mechanism of scientific research back-feeding teaching

Change the concept of valuing scientific research over teaching. Colleges and teachers should fully realize the importance of scientific research back-feeding teaching, actively promote the transformation of scientific research achievements into teaching resources, establish a scientific and reasonable operation and evaluation mechanism, and encourage teachers to realize the transformation of scientific research achievements into teaching resources through various paths. Establish and improve the corresponding policy system and implementation rules, for example, incorporate scientific research back-feeding teaching into the workload of teachers, and link the work results with the performance appraisal of teachers' promotion, title evaluation, performance reward, and form an effective guarantee mechanism for scientific research back-feeding teaching.

3.2 Improve the model of scientific research back-feeding teaching

Due to the diversity and complexity of scientific research results and the differences of different teaching links, the two should be matched reasonably, and combined with the characteristics of the knowledge structure of mechanical engineering students, through multiple channels to improve the mode of scientific research back-feeding teaching^[10].

3.2.1 Transformed into classroom teaching resources

Teachers can integrate the latest trends of subject frontiers into classroom teaching in the form of professional elective courses, and can also publish scientific research results as teaching materials and monographs, so as to enrich teaching resources. In the course of teaching, the teaching focus is raised to scientific issues, and then the students are further inspired how to choose the topic of scientific research projects, and all aspects of the scientific research process are integrated into the classroom teaching content, so as to achieve a good effect of transforming scientific research into teaching.

3.2.2 Transformed into innovation and entrepreneurship projects

The innovation and entrepreneurship project of college students has become an important platform for reforming education and stimulating students' enthusiasm for

innovation. In the innovation and entrepreneurship project, the deep integration of professional education and innovation and entrepreneurship education should be promoted. Therefore, teachers guide students to carry out creative scientific research project activities, which can strengthen the cultivation of students' innovative practical ability and help the transformation and application of scientific research achievements.

3.2.3 Transformed into thematic lectures

The special lecture is the second classroom for students. It is loved by students because of its novel form, lively content and broad theme. It presents the latest knowledge of the frontier of disciplines, industrial development and application in the form of lectures, which can stimulate students' interest in learning and deepen students' understanding and identity of the profession.

3.2.4 Guiding graduation design

Graduation design is an important training link for students majoring in mechanical engineering. It can comprehensively test students' comprehensive ability of theory, practice and thinking. Through the continuous output of scientific research results to students in the early stage, the corresponding topics are given in the graduation design, which can improve the quality of graduation design.

For example, the author's college has set up the course of "Advanced Manufacturing Technology" for undergraduates majoring in mechanical engineering, introducing the development and application of various advanced manufacturing technologies. In the practice teaching link, Students can visit and operate the intelligent water jet cutting machine, pneumatic lifting equipment, laser cutting machine and other experimental equipment used by teachers for scientific research, which has successfully attracted students' attention and interest in learning. Then, the teachers' scientific research content is used to guide students to participate in innovation and entrepreneurship and discipline competitions, which further deepens students' understanding and exercises their practical ability. In the graduation design stage, the corresponding topic was set up, which obtained good feedback and evaluation from students.

3.3 Building innovative teacher team

As the leader of scientific research feeding back teaching, teachers' own ability of scientific research, teaching and integration of science and teaching have an important impact on teaching quality. It is difficult to ensure the effect by one person alone. Therefore, it is suggested to choose backbone teachers with complementary teaching and scientific research ability and innovative consciousness, and form an innovative teacher team with reasonable structure.

To form an innovative teacher team, the curriculum group and the teaching and research section are generally used as the construction units, and the professional courses

are used as the construction platform. The team should have clear development goals, good cooperation spirit and echelon structure. The collocation of the old, the middle-aged and the young, the professional and technical position structure and the knowledge structure are reasonable. Team teaching should be combined with social and economic development, understand the status quo of disciplines and industries, track the frontiers of disciplines, and update teaching content in a timely manner. The teacher team should adopt scientific teaching methods and advanced teaching means, attach importance to practical teaching, guide students to carry out research-based learning and innovative experiments, and cultivate students' interest and ability to discover, analyze and solve problems.

The practice shows that team teaching can not only make up for the shortcomings of single teaching, but also more comprehensively impart the latest and most cutting-edge subject professional knowledge to students, enrich the teaching form and content, and cultivate good team cooperation ability. In the process of scientific research project work and teaching, it can continuously accumulate teaching materials and further improve the quality of teaching.

3.4 Enhance students' enthusiasm to participate in scientific research

Undergraduate participation in scientific research is an active learning. On the one hand, targeted work should be carried out according to the characteristics of different grades of undergraduates. For lower grades, it should focus on publicity to arouse students' interest in participating in scientific research, then gradually arrange reading literature and assist in basic work such as experiments. For senior students with a certain professional foundation, they can arrange professional work such as processing experimental data, drawing drawings, and writing reports. At the same time, through the formation of experimental groups, regular organization of learning seminars, out of research practice, etc., to form a good atmosphere of scientific research and learning.

On the other hand, we can establish a reward system for undergraduate scientific research. For students participating in scientific research, we can give corresponding bonuses in various aspects such as scholarship selection, merit evaluation, joining the league and joining the party, and give certain scientific research subsidies and rewards, so that students can truly feel the value of participating in scientific research. In addition, teachers should actively pay attention to the latest developments in the field of this subject, integrate the frontier knowledge and progress of the subject into the teaching content, further stimulate students' interest in learning in the classroom, guide students to think, ask and solve question, and integrate the inspiration obtained in the classroom into scientific research work to form a good interaction between scientific research and teaching.

4. Conclusion

In summary, scientific research back-feeding teaching is an important way to enrich teaching resources, improve teaching effectiveness, and improve the quality of talent cultivation. However, at present, the emphasis on improving the teaching quality of scientific research achievements of mechanical engineering is not enough, the implementation and the guarantee system are not enough. It needs to be improved from the aspects of policy support, mechanism operation, incentive and team building, so as to meet the needs of talent cultivation.

Acknowledgements

This research was supported by the Hunan University of Humanities, Science and Technology Teaching Reform Project (RKJGY2125), and the Hunan Provincial Department of Education Project (21A0555, 21C0783).

References

- 1 ARong G.W. (2022) Research on the strategy of transforming scientific research achievements into teaching resources for materials chemistry specialty. *Papermaking Equipment & Materials*. 11: 224-226. <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=FLZZ202211072&DbName=CJFQ2022>.
- 2 Chen B.M., Lin Y.S. (2021) Exploration and Analysis on the Way of Scientific Research Feedback Teaching in Colleges and Universities. *The Theory and Practice of Innovation and Entrepreneurship*. 03: 114-117. <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=CXYL202103049&DbName=CJFQ2021>.
- 3 Shi Y., Zhao S.Y. (2020) Coordinated Innovation of Scientific Research and Teaching in the Construction of "High-level Majors with Special Characteristics". *Journal of Jilin Engineering Normal University*. 09: 21-23. <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=JLGC202009007&DbName=CJFQ2020>.
- 4 Zhang X. (2019) On Promoting Undergraduate Teaching through Scientific Research. *Theory and Practice of Contemporary Education*. 06: 28-31. DOI:10.13582/j.cnki.1674-5884.2019.06.007.
- 5 Zhao Q.X., Lv Y. (2020) On the Promotion of Scientific Research on Electronic Information Undergraduate Teaching. *Education and Teaching Forum*. 39: 371-372. <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=JYJU202039170&DbName=CJFQ2020>.
- 6 Gao Z.J., Zhang J.P. (2021) Exploration on Innovative Teaching Mode Integrating Practice Teaching with Scientific Research in Bioengineering Specialty. *Journal of Anhui Agricultural Sciences*. 09: 273-275. <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=AHNY202109074&DbName=CJFQ2021>.
- 7 Rong M.H., Chen G. (2020) The present situation and path of transforming scientific research achievements into teaching resources of university teachers. *Survey of Education*. 46: 40-42. DOI:10.16070/j.cnki.cn45-1388/g4s.2020.46.013.
- 8 Duan Z.X., Huang Y.Y. (2019) On the Route of Transforming Research Fruits to Teaching Practice from "Case Research" to "Case Teaching". *Tribune of Education Culture*. 04: 132-136. DOI:10.15958/j.cnki.jywhlt.2019.04.023.
- 9 Xia S.X., Zheng S.Y. (2020) Study on the Promoting Effect of Scientific Research on the Teaching of Materials Majors. *Education and Teaching Forum*. 38: 213-214. <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=JYJU202038100&DbName=CJFQ2020>.
- 10 Li L., Huang H. (2019) Construction of teaching and research office in colleges and universities based on the positive interaction between teaching and scientific research. *Heilongjiang Education*. 05: 48-49. <https://kns.cnki.net/kcms/detail/detail.aspx?FileName=HJLL201905023&DbName=CJFQ2019>.