IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388, p- ISSN: 2320-737x Volume 13, Issue 6 Ser. II (Nov. – Dec. 2023), 24-29
www.iosrjournals.org

The function of multi-discipline cross-fusion in practice teaching under the background of production-study-research combination talent training pattern — taking the undergraduate mechanical major as an example

Yong Wang[1]，Lili Ma[2]，Kenan Kang[3]
[1]*Lecturer,School of Mechanical and Automotive Engineering, Qingdao University of Technology,Shandong Qingdao,China*
[2]*Lecturer,School of Mechanical and Automotive Engineering, Qingdao University of Technology,Shandong Qingdao,China*
[3]*Lecturer,School of Mechanical and Automotive Engineering, Qingdao University of Technology,Shandong Qingdao,China*

Abstract: *As an engineering discipline closely combined with the production practice, the undergraduate major of machinery needs to be integrated with the industrial demand in the practical teaching process of this major, so as to guide students to participate in the actual production problems of enterprises, deepen their understanding of mechanical theoretical knowledge in the process of industry-university-research practice, and improve their hands-on ability to solve and analyze problems. At the same time, with the development of society and industry, mechanical discipline and electronic information, control engineering, artificial intelligence, material science and other disciplines continue to cross and merge. Therefore, this paper focuses on the mechanical undergraduate education in the context of the combination of production, study and research personnel training model, analysis and study of the role of interdisciplinary integration in practical teaching. Based on this, the paper analyzes the current stage, the combination of production, learning and research personnel training model background, multi-disciplinary cross-integration in the practice of teaching problems and deficiencies. At the same time, we analyzed the necessity of multi-subject cross-integration in practice teaching under the background of the talent training mode of combination of production, teaching and research. Finally, in order to better develop the practice teaching under the background of the combination of production, university and research, the author puts forward the corresponding teaching improvement measures.*

Keywords: *industry-university-research; interdisciplinary integration; practical teaching; mechanical undergraduate*

Date of Submission: 13-11-2023 Date of Acceptance: 23-11-2023

I. INTRODUCTION

Background

In the report of the 19th National Congress of the Communist Party of China, it is clearly proposed to realize the connotative development of higher education.Among them, deepening the integration of industry, education, research, and cooperation between schools and enterprises is the only way for the high-quality development of higher education, especially applied higher education (Shu 2023). In 2012, the Ministry of Education and other departments of China issued several opinions on further strengthening the practical education work in colleges and universities in order to fully implement the Outline of the National Medium and Long-Term Education Reform and Development Plan (2010-2020).It is clearly pointed out in the "Opinions" that practical teaching is an important part of school teaching, an important link to deepen classroom teaching, and an important way for students to acquire and master knowledge. At the same time, the relevant state departments have clearly pointed out that the cross-integration of various disciplines is encouraged to promote innovation-driven development. The policy document proposes to support scientific and technological innovation, interdisciplinary research projects and other related content, and encourage cooperation and exchanges between different disciplines. In terms of personnel training policies, the government has introduced a series of personnel training policies to encourage cross-disciplinary training. For example, measures such as the establishment of interdisciplinary research centers, the implementation of dual doctoral degrees, and the promotion of interdisciplinary courses have been taken to cultivate high-level innovative talents with interdisciplinary research ability and comprehensive quality.

As an important form and method of application-oriented professional education, practice teaching needs to be more problem-oriented in the teaching process, allowing students to learn with problems and theoretical knowledge of problem analysis (Yao et al. 2023). As a modern applied major, the undergraduate major of machinery should pay more attention to the application of practical application teaching in student training (liu et al. 2022;Liu et al. 2023). More importantly, with the continuous development of industrial automation, as well as the vigorous progress of new generation information technology, artificial intelligence and other high-tech, the machinery industry continues to introduce new technologies to improve the degree of mechanical automation and intelligence (Chu 2022). With the advent of the era of information and intelligence, more and more problems in the machinery industry are no longer simple mechanical discipline problems, but closely combined with automatic control, electrical engineering, artificial intelligence and other interdisciplinary integration problems.

Therefore, the development of mechanical discipline can not be separated from other disciplines and relatively independent development. Similarly, the practical teaching of mechanical undergraduate also needs to keep up with the development needs of The Times, and give full play to the key role of interdisciplinary integration in practical teaching in the process of industry-university-research practical teaching. Using the advantages of cross-integration of many disciplines, the quality of undergraduate teaching of mechanical major is constantly improved, so that students can improve their ability to analyze and solve practical problems in the process of practical teaching.

II. THE PROBLEMSAND DEFICIENCIES OF INTERDISCIPLINARY INTEGRATION IN THE PRACTICAL TEACHING OF MECHANICAL UNDERGRADUATE

Deepening the integration of industry, education, and research, as well as cooperation between schools and enterprises, is an effective way to achieve high-quality undergraduate practical teaching in mechanical engineering. In the fields of mechanical automation and intelligence research, there are a large number of deep interdisciplinary integration problems (Ran et al.2021;Duan et al.2019). Based on the above analysis, it can be concluded that in order to achieve high-quality undergraduate practical teaching tasks in the field of mechanical engineering, teachers need to master a large amount of practical research foundation and be familiar with other disciplines besides mechanical engineering. However, at present, there are still many problems and shortcomings in the practical teaching of undergraduate mechanical education in China, especially in the interdisciplinary integration of multiple disciplines.

Insufficient practical teaching ability of teachers

As an important teaching link for cultivating high-quality undergraduate mechanical students, practical teaching in the undergraduate field of mechanical engineering can effectively enhance students' understanding of theoretical knowledge during the training process. At the same time, practical teaching can also enhance students' ability to analyze and solve problems. However, practical teaching also puts forward higher requirements for teachers' abilities. It not only requires teachers to master solid theoretical knowledge, but also requires teachers to have rich practical research experience.

At present, many domestic universities still pay insufficient attention to undergraduate practical teaching. Some universities use metalworking internships as a substitute for practical teaching. Due to the fact that metalworking internship mentors are often hired by schools as mentors by experienced production operators. However, the guidance teacher for the metalworking internship lacks theoretical knowledge and is unable to effectively integrate production practice with theory. More importantly, metalworking internships cannot to some extent replace the essential value of the integration of industry, academia, and research in the practical teaching of undergraduate mechanical engineering. Similarly, teachers with rich theoretical teaching experience sometimes lack practical experience in scientific research projects and enterprise production. In practice teaching, we can only insert some case analysis related to production practice into the courseware as a supplement to practice teaching. The above two kinds of practical teaching of mechanical undergraduate can not fully reflect the value of interdisciplinary integration in the background of integration of production, study and research in mechanical practical teaching. Therefore, relevant colleges and universities need to closely combine the construction of the teaching staff of this major and this discipline, optimize the practical teaching ability of teachers, and effectively improve the practical teaching effect of mechanical undergraduate.

Rigid teaching mode

The theoretical study of undergraduate mechanical majors is an important way for mechanical students to acquire professional knowledge reserves during their school years. At present, many universities still focus on theoretical teaching with practical teaching as a supplement for undergraduate mechanical education. However, with the continuous development of mechanical intelligence and automation, this teaching mode can no longer adapt to the new model of mechanical development that integrates multiple disciplines to a certain extent.

Therefore, teachers should closely combine the background of the current integrated talent cultivation model of industry, academia, and research, adopt various innovative teaching methods such as "new methods" and "new models", actively guide students to learn with problems, learn theoretical knowledge in the process of analyzing and solving problems, and continuously improve students' understanding of theoretical learning.

At the same time, in the process of theoretical teaching, teachers often use theoretical exams as the main assessment method for students, which leads to the problem of a single teaching inspection method. At the same time, theoretical exams to a certain extent cannot comprehensively assess students' mastery of theoretical knowledge, and may even lead to situations of coping exams(Pang et al. 2022). The examination mode also needs to be combined with the development background of the interdisciplinary integration of machinery and multiple disciplines, and innovated by combining various forms such as process assessment and problem-solving ability

Insufficient interdisciplinary integration

The function of interdisciplinary integration in the practice teaching process of mechanical undergraduate is not only reflected in the teaching of mechanical theory, but also includes the introduction of the application of knowledge of other disciplines. The cross integration of mechanical major and other disciplines should be reflected in the comprehensive application of mechanical discipline and other related disciplines, and solve a practical problem in detail. Some teachers do not fully understand the interdisciplinary integration of mechanical subjects and multi-disciplines, resulting in the practical teaching of mechanical undergraduate students, can not accurately grasp the meaning of it, just simply pile up the knowledge of several disciplines, and do not really realize the integration of disciplines.

For example, the firefighting robot studied by the author, as a typical highly integrated mechatronics product, integrates mechanical structure design, intelligent control, electrical, sensing technology and artificial intelligence algorithm into the structural composition of the firefighting robot. f the knowledge of autonomous intelligent braking of vehicles needs to be explained in mechanical practice teaching, only the composition and principle of each part of the fire robot can not reach the purpose of interdisciplinary integration. For this reason, it is necessary to integrate the functions of fire fighting robots with the knowledge of various disciplines. In the process of walking, the fire robot needs to realize the independent judgment and decision braking of obstacles, and the above functions need to be broken down into: identification technology for obstacle judgment (involving sensing technology, machine vision and artificial intelligence algorithm), and autonomous decision braking technology (involving intelligent control and mechanical braking). Therefore, in the process of autonomous decision braking of fire fighting robot, it is necessary to analyze the basic principle of vehicle braking and related mechanical structure, and analyze how to realize autonomous decision braking of this process for students. At this time, it is necessary to closely combine the obstacle recognition principle and the autonomous decision control method. Through the analysis of relevant theoretical and practical problems, to improve students' understanding of the interdisciplinary integration of the problem.

Teaching organization is difficult and teaching evaluation standards are different

Interdisciplinary integration needs more teaching resources and teaching teams. Due to the multiple disciplines involved, more specialist teachers may need to be brought in, and limited teaching resources may result in insufficient depth and breadth being provided. Secondly, interdisciplinary integration needs to integrate the knowledge of different disciplines, but the content of different disciplines may conflict or be difficult to integrate. Teachers need to spend more time and energy to design suitable teaching content. At the same time, interdisciplinary integration also has the problem of blurred disciplinary boundaries, which may lead to blurred disciplinary boundaries, and it may be difficult for students to understand the positioning and characteristics of each discipline. They may not be able to deeply learn the core knowledge of a subject, which affects the cultivation of professional ability. Moreover, there are problems of different standards in the teaching evaluation process of interdisciplinary integration. It is difficult to adopt traditional evaluation methods such as examinations or tests in the practice teaching of interdisciplinary integration, because it involves interdisciplinary knowledge and skills. Assessing students' comprehensive ability and practical application ability becomes more complex.

From a comprehensive analysis, the interdisciplinary integration in mechanical undergraduate practical teaching faces some challenges and shortcomings. To solve these problems, schools and educational institutions need to provide sufficient resources and support, train and select suitable teacher teams, design scientific and reasonable teaching content and evaluation methods, and pay attention to student feedback and acceptance to ensure that interdisciplinary and integrated teaching achieves good results.

III. THE SIGNIFICANCE OF INTERDISCIPLINARY INTEGRATION IN PRACTICAL TEACHING OF UNDERGRADUATE MECHANICAL EDUCATION

The interdisciplinary integration is of great significance in the practical teaching of undergraduate machinery, as it can provide students with a more comprehensive and comprehensive learning experience, and cultivate their interdisciplinary thinking and problem-solving abilities. At the same time, the multi-disciplinary integrated teaching mode, through the combination of practice and theory, cultivates comprehensive ability, promotes innovative thinking, improves problem solving ability, promotes interdisciplinary cooperation, explores emerging fields, enhances career competitiveness, and lays a solid foundation for students' comprehensive development and future career development.

Stimulate students' desire to explore new knowledge

Theoretical learning is often boring, but once theoretical knowledge is combined with practical application, it will increase the interest of knowledge. At the same time, with the help of real practice cases, it can stimulate students' interest in exploring unknown knowledge and improve their enthusiasm for learning (Zheng et al. 2022). Through the study of specific practical cases, we can arouse students' enthusiasm for learning, stimulate students' determination to solve difficult problems, and exercise students' ability to analyze and solve problems. The great scientist Albert Einstein said, "Interest is the best teacher." As for the application cases of mechanical theoretical knowledge provided by teachers, once students become interested in mechanical theoretical knowledge, students will take the initiative to learn, changing "forcing me to learn" to "I want to learn actively".

Guide students to cultivate creative thinking

The interdisciplinary integration problem involved in the mechanical discipline is usually closely related to people's production practice. Therefore, in the process of practical teaching of mechanical undergraduate, teachers can provide students with corresponding practical production problems, guide students' divergent thinking and stimulate students' creativity in combination with the research direction of specific mechanical disciplines in their universities. For example, the intelligent fire fighting equipment studied by the author can provide students with the mechanical multidisciplinary integration of intelligent fire fighting robots. Guide students to innovate the mechanical structure design of fire robot chassis based on the mechanical structure ontology of fire robot, and to innovate the mechanical structure design of fire robot chassis on how to improve the unstructured ground passability of fire robot. At the same time, based on this specific issue, students will consult relevant knowledge in multiple disciplines such as intelligent control, artificial intelligence algorithms, and innovative design of mechanical structures, fully mobilizing their creative thinking. Through the analysis of this specific problem, students not only provide relevant solutions to this problem, but also stimulate the creativity of students' learning of mechanical theoretical knowledge.

Improve teachers' teaching ability

As an important role in subject teaching, teachers are not only the imparts of students' theoretical knowledge learning, but also the important cultivators of students' innovative thinking ability, analysis and problem-solving ability. Therefore, the practice teaching of multi-disciplinary integration under the background of production, study and research combined with talent training mode requires not only the active participation of students, but also the corresponding ability of teachers. In the practice teaching of interdisciplinary integration, it is necessary for teachers to continuously improve their theoretical teaching ability, and more importantly, they need to extend the practical teaching research content corresponding to the specific theoretical teaching content. Therefore, in order to realize the cross-integration of multiple disciplines and improve the effect of mechanical undergraduate practical teaching, teachers need to carry out relevant practical research work in combination with specific teaching subjects, and continuously improve their practical teaching ability in the process of practical research. Therefore, to improve practical teaching ability, teachers need to have a solid foundation in classroom theoretical teaching, and more importantly, teachers need to carry out relevant practical research with enterprises and scientific research institutes, accumulate relevant practical teaching cases in the research, and improve their practical teaching ability.

IV. IMPROVEMENT MEASURES OF INTERDISCIPLINARY INTEGRATION IN MECHANICAL UNDERGRADUATE PRACTICE TEACHING

Encourage undergraduate students to participate in scientific research and practical work

With the rapid development of science and technology, the industrial structure is constantly optimized and adjusted. More and more practical engineering application problems in production need to be integrated with basic scientific theories. Meanwhile, relevant studies have shown that most of the technological talents who have achieved breakthroughs in original theoretical innovation in history are between the ages of 20 and 35,

which also means that in the undergraduate stage, students have greater innovation potential (Zheng et al. 2021). In September 2018, the Chinese Ministry of Education issued the "Opinions of the Ministry of Education on Accelerating the Construction of High Level Undergraduate Education and Improving the Ability to Cultivate Talents", which pointed out that it is necessary to promote the opening of national and provincial research bases to undergraduate students, create conditions for undergraduate students to participate in scientific research, promote students to enter projects, laboratories, and teams early, and timely convert the latest scientific research results into educational and teaching content, Supporting high-quality undergraduate talent cultivation through high-level scientific research.

To this end, teachers can guide undergraduates to actively participate in the research work of related topics based on their actual scientific research conditions, so that students can explore new knowledge in specific scientific research projects, cultivate students' creativity, and provide new innovative methods and approaches for the practical teaching of mechanical undergraduate.

Encourage interdisciplinary/interdisciplinary teams of academic mentors

The mechanical undergraduate practice teaching under the background of interdisciplinary integration needs to involve many different professional disciplines and research directions. At this time, the team of full-time teachers who only rely on a certain discipline or research direction is sometimes not competent for interdisciplinary/cross-professional teaching tasks. To this end, for the interdisciplinary mechanical undergraduate practice teaching, interdisciplinary, cross-professional and even cross-college teachers can be selected throughout the university to form a "crossover" academic mentor team. In this way, when students encounter the problem of interdisciplinary integration of mechanical majors, the tutor team can give students more targeted answers from different disciplines and different research directions. More importantly, the team of academic tutors from different professional backgrounds will consider problems from different perspectives in the analysis of problems, which has a positive guiding role in cultivating students' divergent thinking ability and creativity.

Strengthen cooperation between school enterprises, industry, academia, and research

Schools are the main carrier for cultivating theoretical knowledge in the field of mechanical science, while enterprises are the main source of practical application problems in the cross integration of mechanical science. They are also the experimental ground for testing the transformation of mechanical theoretical knowledge into practical productivity. Therefore, schools should actively connect with relevant local enterprises and units to build a platform for students to practice and learn. At the same time, through school enterprise cooperation, it not only provides students with the opportunity to truly participate in practical application research learning, but also provides teachers with the opportunity to improve their practical teaching abilities. On the one hand, teachers participate in scientific research projects commissioned by enterprises through school enterprise cooperation, accumulating rich practical teaching cases for classroom theoretical teaching and improving their own practical teaching abilities; On the other hand, students deepen their understanding of relevant professional theoretical knowledge by participating in school enterprise practical internships. Through practical internships, students can think in practical learning and cultivate their creative thinking ability in practical learning.Through the above improvement measures, the interdisciplinary integration in mechanical undergraduate practical teaching will be better promoted and developed. Students will be able to gain a more comprehensive learning experience, cultivate stronger comprehensive abilities and innovative thinking, and be more fully prepared for future career development. At the same time, schools and teachers also need to work together to provide better support and resources, and promote the successful implementation of interdisciplinary integration in practical teaching.

Acknowledgements

This work was supported by 2022 Qingdao University of Technology Undergraduate Teaching Reform and Research General Project (W2022-032), 2022 Qingdao University of Technology (Linyi) Teaching Reform and Research Project (JM22-6)

REFERENCES

[1]. Chu W.B. (2022). Research on application of mechanical automation based on the development of intelligence and informatization.China's high and new technology, (14):98-100.
[2]. Duan J.J.,Dong J.Z.,Zhao F.W. (2019). Research on the Teaching Mode of Textile Machinery Modeling Design Based on Interdisciplinary Integration. Industrial Design, (5):38-39.
[3]. Liu A.Q.,Wang Y.P.,Hou Z.G., Liu J.G. (2022). Discussion on the construction of practical teaching system of mechanical majors in applied undergraduate universities.Equipment Manufacturing Technology, (10):178-181.
[4]. Liu X.B., Xu H., Liu J.Z., Li T.X. (2023). Reform and Exploration of Practical Teaching System of Mechanical Specialty under the Background of New Engineering .The Theory and Pracice of Innovation And Entreptrneurship, 6(3):59-61.
[5]. Pang C.J.,Fan C.Y.,Li Y.T.,Bian J. (2022). Research on engineering curriculum teaching reform based on the training of new

engineering talents Educational Informatization Forum,(4):51-53.
[6]. Ran Y.,Zhang D.F.,Li C.B.,Tang B.P.,Xiao G.J. (2021). Research on the cultivation mode of mechanical engineering talents for intelligent manufacturing.Journal of Architectural Education in Institutions of Higher Learning, 30(3):37-44.
[7]. Shu Q. (2023). The responsibility orientation and effective practice of colleges and universities under the deep integration of production, university and research. Chinese Journal of Social Sciences.
[8]. Yao W.L., Liu Y.X., Sun T., Mu R., et al. (2023). Construction of innovative practice teaching platform for postgraduates majoring in civil engineering under the background of emerging engineering education. Journal of Architectural Education in Institutions of Higher Learning, 32(1):31-38.
[9]. Zhen Y.H.,WangYang C.X.,Li X.D.,Wang J.Y. (2022). Some thoughts on cultivating top-notch innovative talents by integrating production, university and research.Research on science and education development,2(1):94-108.
[10]. Zheng Q.S.,Xu L.P.,Bai F.S.,Zhang L.,Wang M.S. (2021). From Single Spark to Prairie Ablaze -Exploring New Paradigm to Cultivate Top Innovation Talents[J].Bulletin of Chinese Academy of Sciences ,36(5):580-588.