Research on Scientific Research Results Feeding Back Teaching Resources

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Abstract: The basic functions of universities are scientific research and personnel training. Only the coordinated development of the two can promote the two-way improvement of the school's scientific research level and the quality of personnel. At present, due to related policy-oriented reasons, some colleges and universities in our country emphasize research and neglect teaching, and it is difficult to ensure the reasonable deployment of teaching resources. Through the appropriate transformation of results, the use of feedback to supplement scientific research results as teaching resources can greatly balance the contradiction of uneven resources between scientific research and teaching. Students can strengthen their practical and innovative abilities while completing the course study, and improve their scientific research literacy by making use of the rich scientific research results, optimizing teaching content and methods. The paper provides a new model for the cultivation of relevant comprehensive innovative talents in our country while promoting the transformation of scientific research results by feeding back teaching resources through scientific research results.

Key-Words: *Scientific research results; Teaching resources; Feedback; Talent training; Mechanical disciplines*

1. Introduction

Due to the relevant policy-oriented reasons, the phenomenon of valuing research over teaching is more or less common in Chinese higher education institutions, and this phenomenon is becoming more and more serious, seriously affecting teaching work and greatly reducing the quality of teaching [1]. In order to change this phenomenon, the strategy of research results feeding back into teaching resources has been tried out in some universities. The innovative thinking and practical skills of students have been enhanced as a result of Lida Zhu's team [2] in reforming the mechanics curriculum, which introduces modern information technology into the teaching of mechanics courses in a way that combines teaching and research. The research-based teaching and experiential teaching methods have been adopted by Hua Zhang's team [3] for important mechanical courses. Combining with their own research results, they achieve good effect. In order to do a good job of "Double First-Class" initiative construction, adopting the development mechanism and policy of integration of science and education is proposed by the Guangsong Chen's team [4]. The research results are transformed into

practical teaching cases, graduation guidance topics and innovation and entrepreneurship projects by Qiang Li's team [5]. The team achieves a good interaction between research and teaching.

As far as mechanical disciplines are concerned, research feeds back into teaching mainly for the characteristics of abstract teaching content and unintuitive teaching methods in the teaching process. For example, digital modelling and simulation technology can be used in mechanical engineering teaching for understand students' cognitive barriers on practical knowledge of engineering; through virtual simulation experimental teaching platform to carry out the corresponding practical teaching links; through the development of the CNC (Computerized Numerical Control) virtual machining simulation system, in the network environment, students can achieve online practical teaching, to solve problems such as practical

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training. The logic of research drives students to understand and apply their knowledge in a more rigorous way. This not only helps students to grasp and digest knowledge in a timely manner, but also enables them to grasp the meaning and extension of knowledge in a more intuitive way. Students' analytical and independent problem-solving skills are effectively improved and their creative thinking and innovative skills are strongly supported.

Therefore, in this paper, we introduce an innovative method which combines teaching content and scientific research to real engineering teaching, aiming to optimize teaching effectiveness, to maximally encourage students' learning interest, and to bring reference value for exploring new engineering education mode.

2. Method

2.1 Dialectical relationship between scientific research and teaching

Research results feeding back into teaching resources is to regard the research system and teaching system as two interrelated, interacting and mutually based aspects in the process of discipline development, and to emphasize the organic integration between them. The core of this approach is to optimize the allocation of teaching and research resources in universities so as to effectively improve the quality of talent training and the level of research output. Research and teaching have always had a mutually reinforcing and mutually restrictive relationship, as shown in Fig.1.

For mechanical disciplines, due to the progress of science and technology, changes in industry and the development of industries, etc., while bringing about technological innovation, they also put forward new requirements for school education and teaching. Therefore, it is imperative to transform the results of scientific research, which are closely following the frontiers of science, into teaching resources. On the one hand, with the rapid transformation of scientific research achievements, educational and teaching resources have been further enriched, the teaching environment has been continuously improved and optimized, and the level of education and teaching has been improved, which provides and creates a good teaching resource base and learning environment for talent training. On the other hand, this trend is reinforced and consolidated by the development of high-level personnel who enable scientific research to be carried out, which contributes to the sustainable transformation of research results into teaching resources. On the other hand, this trend is reinforced and consolidated by the development of high-level personnel who enable scientific research to proceed smoothly, which promotes the transformation of research results into the sustainable development of teaching resources. On the contrary, if cutting-edge technological achievements cannot be transformed into teaching resources, it is bound to have an impact on the cultivation of talents, thus hindering the development of subjects and restricting scientific research.

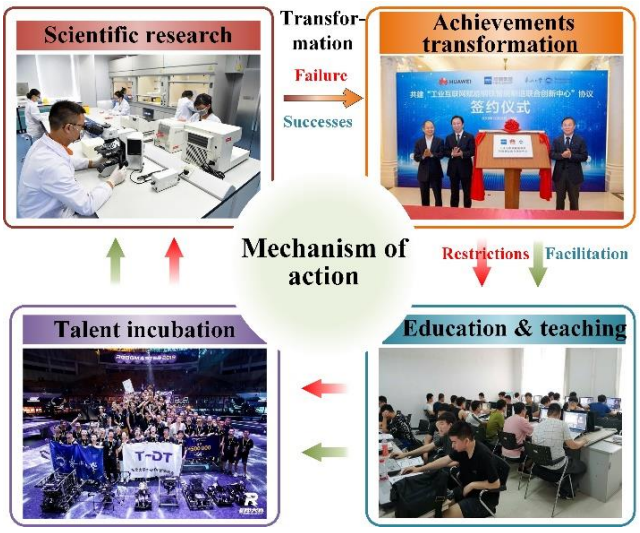

Fig.1 Mechanisms of interaction between scientific research and teaching

2.2 The necessity of scientific research feeding back into teaching

2.2.1 A new model for improving school quality

Teaching and research complement each other, promote each other and develop together. Through the way that scientific research results feed back into teaching resources, the two are deeply combined to promote the coordinated development of teaching and scientific research resources allocation in universities, and effectively improve the quality and level of school running. For universities, in order to promote the construction and long-term development of disciplines, the allocation of resources is usually inclined to research, which will inevitably lead to a shortage of teaching resources. However, undergraduate education is fundamental to the university. Therefore, in order to effectively improve the level and quality of education, discipline must support specialty and scientific research must feed back into teaching.

2.2.2 A new carrier for cultivating high-level talents

It is the theme of the national strategic layout of "Made in China 2025" to cultivate top-notch innovative and complex professional mechanical professionals, and is also an inevitable requirement for building China into an advanced manufacturing power. In today's world of endless research achievements, the goal of education is not only limited to solid theoretical basic knowledge, but also requires students to learn new knowledge, master new skills, have the ability to innovate and deal with practical problems, which is also the fundamental difference between higher education and basic education. As the main battlefield of scientific research in China, universities have the unique advantage of having a large number of scientific research achievements, such as high-end instruments and equipment, advanced scientific research platforms, good academic atmosphere, etc., which all facilitate the training of high-level talents. Therefore, it is of great importance in the training process of mechanical disciplines that research results are effectively integrated into the teaching content by means of positive and direct integration. In addition, through the reverse integration, the more difficult major topics are dissected into various sub-topics, and the scientific research sub-topics are assigned to various practical projects of students, which is not only conducive to improving students' scientific research quality and stimulating their interest in scientific research, but also laying a good foundation for their further studies, as well as enabling the screening and discovery of excellent scientific research talents and expanding the strength of the scientific research team for the future.

2.2.3 A new breakthrough in improving one's own research standards

As for mechanical disciplines, there is still a long way to go before universities can fully match their teaching content with industry developments and research trends. However, when the identity changes from teaching to research, this problem is almost non-existent. As a research scholar, the research of university teachers in the field of scientific research is generally advanced and novel. It is closely related to actual production activities as well as to hot topics. If scientific research projects can be introduced into teaching activities, whether through the introduction of results or the dismantling of the project, the purpose of cultivating excellent talents can be realized. The development of these talented people will certainly be of great benefit to the development of university research itself. Fig.2 gives a good comprehensive instance about the deep integration mechanism of scientific research, teaching and talent, wherein the left part depicts any scientific research project can be divided into several subprojects, like high precision machining of turbine as an overall subject always including model design, module analysis, machining stability, etc. Hence, the implementation of any subproject can be integrated into teaching module and they may be of real significance to

supply teaching content. Besides, no matter positive integration or reverse integration is a king of promotion to the accomplishment of the origin scientific project, meanwhile it plays a vital important role in talents cultivation because the big difference between undergraduate and postgraduate is project experience. Consequently, bringing more chance to students to participate in subproject and combining the scientific research and teaching is beneficial to cultivate outstanding talents.

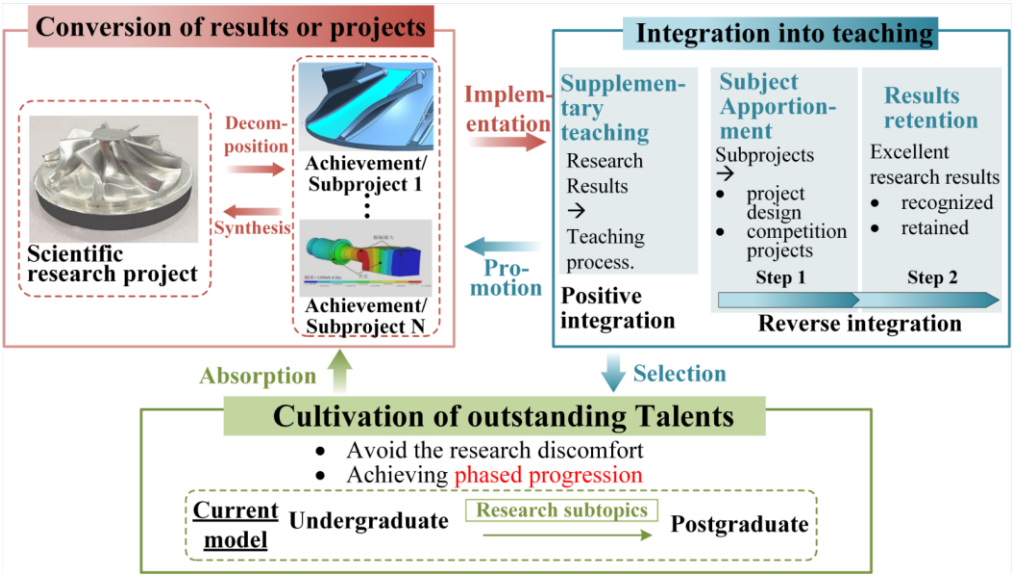

Fig.2 The deep integration mechanism of scientific research, teaching and talent

3. Results

This paper takes the research feeding back into teaching model of Northeastern University as the object of research. After the preliminary practice, it is found that through the conscious application of scientific research results in teaching, the comprehensive scientific research quality and scientific research innovation ability of mechanical major students have been greatly improved. The following are the specific innovation points.

3.1 Optimizing teaching content in line with enterprise need

Taking the basic course Interchangeability and Measurement Technology for example, the course combines the requirements of enterprises for high dimensional accuracy of parts and components, and solves the problem of abstract and obscure traditional teaching by developing a software that can carry out virtual measurement and combining it with actual measurement. Usually, after completing the course Interchangeability and Measurement Technology, students only have a theoretical understanding of the dimensional tolerances and fitting relationships of parts. However, students' understanding of dimensional accuracy, shape accuracy and positional accuracy of components can be easily improved when they perform virtual measurements on the development software platform according to the drawing requirements, complete various parameter settings to obtain predicted values and then carry out practical operations. In addition to deepening the understanding of the theoretical knowledge points, it also strengthens the students' practical skills and avoids safety problems caused by improper operation of the instruments. As shown in Fig. 3, the teaching of virtual measurement and actual measurement of form and position accuracy is demonstrated. Students can complete the dimensional accuracy measurement of the structure based on the virtual web environment. This process becomes more convenient and effective to link the design and manufacture of complicated mechanical parts and gives more explicit and vivid understanding on related operation.

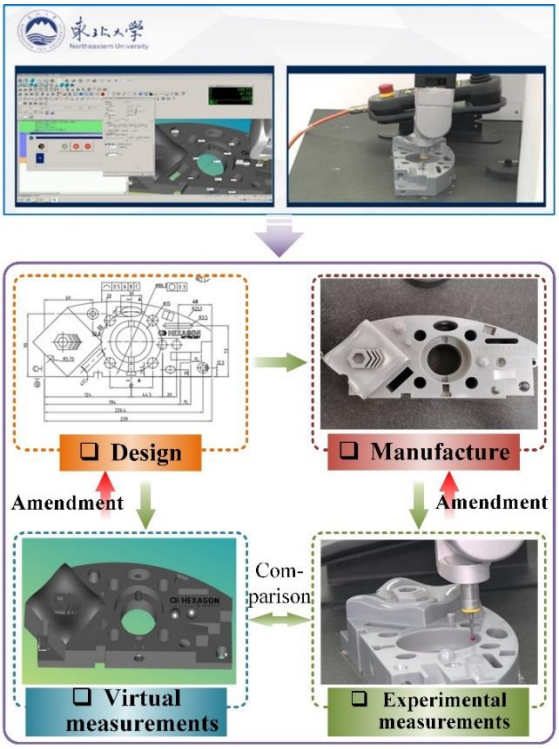

Fig.3 Virtual measurement and actual measurement of shape and position accuracy

3.2 Relying on scientific research platforms to strengthen practical teaching

Mechanics is a discipline that emphasizes both theory and practice, and teaching must be based on practice as the starting point and the landing point [6]. Relying on research platforms to carry out innovative and practical teaching, students are guided to use experiments as a base to cultivate the spirit of innovation, with students as the main body, so that students can change from passive to active in the whole learning process. As shown in Fig. 4, a virtual machining research platform for the School of Mechanical Engineering and Automation, Northeastern University, the practical teaching of the Internet environment to increase students' practical skills and innovation awareness training. Scientific research results are transformed into teaching resources to build a web-based platform for NC virtual simulation systems. Five groups of practice teaching (mechanical engineering innovation training) have been carried out. More than 3000 students from outside the school have completed the practice teaching operation under the Web environment, which provides good conditions for strengthening students' ability to solve complex engineering problems.

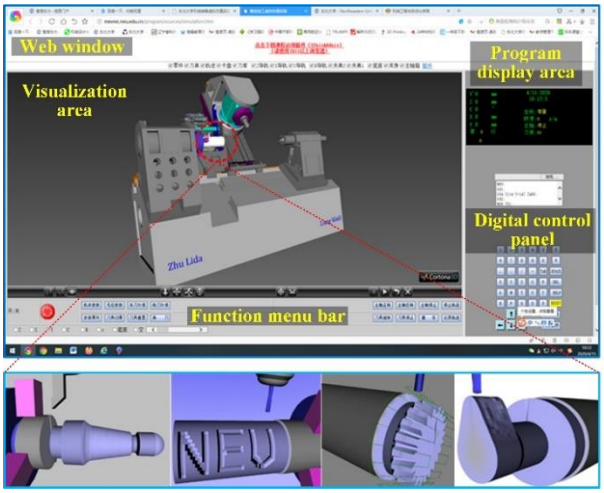

Fig.4 Virtual machining research platform

Through virtual practice teaching, students have a high degree of recognition of this training mode, and receive good feedback. We also constantly implement regularly learning investigation and more than 90% students think such teaching approach is attractive and effective and most of students express their interest can be motivated through similar learning environment. It is generally reflected that they have not only mastered the basic knowledge of part processing in practice, but also stimulated their interest in continuing learning, and at the same time, cultivated their innovative thinking and practical ability.

4. Discussion

4.1 From the perspective of "New Engineering Disciplines", broadening the teaching content with the achievements of scientific research

In order to meet the national strategic layout of "Made in China 2025", it is extremely important to cultivate and build a team of high-level talents in the field of mechanical engineering. However, in the face of the country's urgent demand for innovative talents, there is a huge talent gap in the field of new economy industry in China, which indicates a serious disconnect between the current education and industry development. In this context, in order to proactively respond to the new round of technological revolution and industrial change, to support the service innovation-driven development, the emergence of a teaching model aimed at transforming research results into teaching resources, must be aimed at being able to

meet the new needs of society and industry for mechanical students, and to promote the quality of the new engineering construction. Therefore, based on the current situation of Emerging Engineering Education development in China, some advanced scientific research achievements, such as artificial intelligence technology, information science technology, biological science, etc., can be scientifically and rationally introduced into the teaching of machinery, so that the emerging engineering majors can better meet the development of the times.

4.2 Promoting a deeper integration of scientific research and teaching by thinking in terms of "Hands-on Inquiry Based Learning"

The link between what is taught and the frontiers of science and technology is often easily overlooked in traditional teaching. The teaching content is scripted and unchanged for many years, which is seriously divorced from scientific research. The students trained can neither meet the requirements of enterprises nor easily adapt to scientific research tasks. Therefore, in order to realize the deep integration of scientific research and teaching, relevant policies can be formulated. On the one hand, students are encouraged to take the initiative to participate in scientific research projects. Teachers declare and recognize their achievements, and give appropriate rewards to cultivate their interest and ability in scientific research. On the other hand, the policy should also include a mechanism for the transformation of research results, so that the research results of researchers can be evaluated and reviewed, and some of the results that can be applied to teaching can be reasonably transformed to supplement teaching resources, thus promoting the improvement of teaching quality.

5. Conclusion

In this paper, an innovative approach of engineering education particularly concerning mechanical disciplines is introduced. We mainly explored the effectiveness of the dynamic transformation between scientific results and teaching resource under similar discipline, and employed such way in actual teaching and research part.

Based on analysis of existing problem in present engineering education, and the feasibility of the proposed approach, the idea of scientific research results feeding back teaching resources is demonstrated that has great effect on optimizing teaching content and methods, and it can greatly balance the contradiction between the novelty of scientific research and conservative teaching.

Moreover, after early stage implementation, from the perspective of students, the approach which combines novel teaching platform also gets positive evaluation. It is helpful to arouse students' learning passion, and promote to cultivate innovative engineering talents especially for the ability of solving complicated engineering problem and practical capability. Therefore, the method could be a reference in engineering teaching and we hope explore more valuable and impactful teaching mode based on current inspiration.

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