



Research for Innovation Mechanism of Personnel Training of Integration of Science and Education Under the Background of New Engineering

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Abstract. University is the hall of cultivating talents, scientific research innovation, serving society and the cultural heritage. The research of cultivating talents was superficial in past days, the theoretical knowledge learning was emphasized but cultivating talents of scientific innovation consciousness wasn't laid stress on. However now countries all over the world carry out deep research on science and education integration, and relevant departments in China issue all kinds of papers to encourage, support and advocate positively the science and education integration of higher education industry. This paper actively practices national policy by drawing lessons from peers and carry out multidimensional teaching reform and experience under the guidance of new engineering and science and education integration concept and with the strong support of university, college and office. Furtherly, it actively explores new talent training modes and methods of outcome-based education and competency-based education. Good result has been achieved under the science and education integration and student oriented, and in the next years educational reform should be further deepened and more talent should be cultivated.

Keywords: talent; science and education integration; mode; reform

1 Introduction

Universities are temples for cultivating talents, conducting scientific research and innovation, serving society and inheriting culture. Previously, there was not a deep understanding of talent cultivation, and only placed emphasis on theoretical knowledge learning, without emphasizing the cultivation of talents with scientific research and innovation awareness. So, is the talent cultivated in this environment in line with the needs of social development? The answer is negative.

At present, in the vast majority of universities, students mainly learn basic knowledge, and the knowledge system is the same as that of primary, middle, and high schools, and is in the same lineage. However, two-thirds of college students do not continue to roam within this system after graduation, but instead move towards society and work, facing a real society driven, hijacked, and swept by various high-tech

technologies. This mismatch actually causes great trouble for students and leads to a strong knowledge gap and knowledge blank at the beginning of entering society. Although with the accumulation of wrestling experience in this society university, students will eventually adapt to society, integrate into society, and grow and develop vigorously in their respective positions. But the experience of the discontinuity, connection and fusion of this section of knowledge system at least gives the impression that it is a flaw in the education system. Since this problem has arisen, so we need to try to solve it. The integration of science and education is the integration of science (or research) and teaching (or education) to eliminate gaps. Why do we need to integrate? Because it is impossible for college students to complete all the knowledge in their major in just a few years. If in these years, there is no deliberate emphasis on "exposure to new knowledge" and learning how to "create new knowledge", and only learning all knowledge indiscriminately, then, after entering the workforce for a few years, either he needs to exert subjective initiative and actively self-study current scientific knowledge, or he will be eliminated from his industry due to insufficient understanding of cutting-edge knowledge, failure to learn how to create new knowledge, and inability to meet the needs of his profession.

Fortunately, society has discovered this deficiency in its development and progress, countries around the world are conducting in-depth research on this issue. Relevant departments in our country have also issued various documents to actively encourage and support the integration of science and education in higher education, as shown in Table 1.

Table 1. Summary of Science and Education Integration Related Documents Issued by China (Partial)

Time	Department	File	Main content
2012.3	ministry of education	<i>Ten Year Development Plan for Education Informatization (2011-2020)</i>	Propose educational informatization, emphasizing the integration of information technology and education and teaching
2012	ministry of education	<i>Several Issues on Comprehensively Improving the Quality of Higher Education</i>	The integration of science and education needs to be carried out from multiple aspects such as innovative talent training models, improving scientific research management systems, and promoting collaborative innovation
2015.4	ministry of education	<i>Opinions on Strengthening the Construction, Application and Management of Online Open Courses in Higher Education Institutions</i>	Promote the construction of online open courses and platforms suitable for China's national conditions

2015.4	ministry of education	<i>Notice of the General Office of the Ministry of Education on Carrying out the Construction of National Virtual Simulation Experimental Teaching Centers in 2015</i>	Fully embody the principle of combining virtual and real, complementing each other, and better being realistic than virtual
2018	ministry of education	<i>Opinions on Accelerating the Construction of High Level Undergraduate Education and Comprehensively Improving Talent Training Ability</i>	Establishing a collaborative training mechanism for integrating science and education
2018.9	General Secretary Xi Jinping	<i>Speech at the National Education Conference</i>	Deepening the reform of the education system, improving the implementation mechanism for cultivating morality and talents, and reversing the unscientific orientation of educational evaluation
2020.10	The Central Committee of the Communist Party of China and the State Council	<i>Overall Plan for Deepening the Reform of Education Evaluation in the New Era</i>	Emphasis should be placed on improving subject evaluation, strengthening the center position of talent training, and downplaying quantitative indicators such as the number of papers included, citation rates, and awards

So, combining the cutting-edge achievements of scientific research with the teaching process is the best choice for cultivating industry successors. The ability to cultivate young people who understand cutting-edge knowledge and possess innovative abilities has become an important evaluation indicator for measuring the teaching level of a university.

2 New Engineering Construction

The booming construction of new engineering in recent years is a strategic action taken by China's higher education to actively respond to the new round of technological and industrial revolutions. In the new engineering construction guide, it is proposed to establish a multi subject integrated education model that integrates government, industry, academia, and research. A key focus of the construction of new engineering disciplines is the reform and practice of the multi-party collaborative education model, with the aim of strengthening the connection between universities and society, and promoting higher education to better serve social and economic development and industrial upgrading.

In 2017 and 2019, the State Council issued "Several Opinions on Deepening the Integration of Industry and Education" and "China's Modernization of Education 2035" respectively. These documents all mention the need to focus on integrated development, promote the integration of industry and education, promote effective connection among talent cultivation chain, industry chain and innovation chain, and achieve deep integration and coordinated development between education and the economy society for the modernization of education in China. It can be seen that the integration of industry and education plays an important role in the talent cultivation process of higher engineering education, and also provides direction for the reform of engineering education.

The characteristics and highlights of New Engineering include:

- 1) Establishing educational goals based on multiple dimensions;
- 2) Setting up a curriculum content system that integrates literacy and abilities;
- 3) A student-centered teaching model;
- 4) Improving the practical teaching system and achieving a combination of production orientation and scientific research orientation;
- 5) Continuous following up and establishing a full-process teaching quality supervision system.

3 The Development of Integration of Science and Education

3.1 Definition of Integration of Science and Education

The integration of science and education is aimed at cultivating innovative talents, introducing scientific research elements into teaching, and achieving the teaching philosophy of research-based teaching and exploratory learning. Specifically, it is mainly reflected in the following four aspects [1].

- 1) Moral Education and Scientific Research Education;
- 2) Classroom teaching and scientific research thinking;
- 3) Experimental teaching and scientific research methods;
- 4) Talent cultivation and integration of science and education.

3.2 Exploration and Measures for Implementing the Integration of Science and Education

3.2.1 Exploration of Various Universities.

The integration of science and education is a trend, and many universities and teachers have conducted beneficial explorations and reforms. Teacher Zhuang Yifan and others proposed that cultivating talents requires the active participation of both teachers and students, achieving "mutual benefit between teaching and learning", including 1) cultivating students' interests and hobbies by teaching them according to their aptitude, 2) offering targeted courses in relevant fields, 3) regularly convening research group discussions, 4) supporting students to participate in competitions and activities in related fields[2].

Professor Wu Tian's team has implemented the integration of science and education in the course of plant tissue cultivation, adopting measures and methods such as "the integration of scientific research cases into curriculum teaching", "the experimental materials in scientific research are used for practical teaching, which in turn supplements the materials for scientific research", "discovering and solving problems in course teaching", "The expansion of curriculum teaching has formed new topic content". The integration of teaching and research not only cultivates students' innovation awareness, hands-on ability, scientific literacy and teamwork spirit, but also provides new directions and goals for the research work of the research group[3].

Teacher Huang Zhen and others have implemented some modes in agricultural vocational college courses, such as the project-based practical teaching model, research-based project teaching content and collaborative promotion of industry, academia and research. Further, they include creating project-based practical teaching, campus-based teaching internship models and research-oriented practical teaching projects based on the integration of industry and education, and constructing a practical training model that integrates agriculture, science and education. They scientifically implant practical teaching elements with revolving around cultivating virtue and talents, and building an assessment and evaluation system for practical teaching based on the integration of agriculture, science and education. They actively explore the path of high-quality development of the integration of agriculture, science and education, and the collaboration of industry, academia, and research in the field of agricultural vocational education[4].

Teacher Zheng Chao and others utilize the integration of science and education to construct a virtual simulation experiment project. That article introduces the exploration process of Shandong University's construction of a virtual simulation experiment teaching project under the guidance of the concept of integrating science and education. The main measures include: 1) paying attention to policy guidance and early planning and cultivation; 2) relying on advantageous disciplines to ensure project content; 3) building a school level management platform to ensure project openness and sharing; 4) strengthening the construction of experimental technology teams and ensuring the quality level of project construction[5].

Teacher Huang Ya and others introduced the five-dimension collaborative talent training model of science and education integration at China University of Petroleum, which includes faculty, platforms, projects, achievements, and systems. They concretely include the training model of integrating science and education relying on a team of high-level teachers, the model based on high level research platforms, the model based on high level scientific research projects, the model based on high-level scientific research achievements and the model improving process management and incentive guarantee mechanisms to promote the implementation of science and education integration[6].

Ming Furen's teaching team is driven by the integration of science and education, and practices it on teaching content, methods and results, carries study and exploration from four aspects: 1) paying attention to ideological and political construction, grasping cutting-edge trends, accumulating strength in teaching and stimulating interest and driving force in learning and scientific research; 2) developing logical thinking and innovative abilities, and opening up heuristic, critical, and inductive classroom modes; 3)

promoting the model of theoretical teaching, application practice and absorption and feedback, and cultivating students' general abilities in analysis, innovation, criticism and evaluation; 4) Strengthening systematic theoretical learning and scientific research training, aligning with research-oriented education and integrating undergraduate and graduate training programs[7,8].

3.2.2 Measures Taken by Our School.

From the above introduction, it can be seen that the integration of science and education has flourished and deepened in the field of higher education in China. Although my school is a private undergraduate institution, it actively practices national policies and carries out multi-dimensional teaching reforms and practices under the guidance of the concept of integrating science and education.

1) In terms of ideology

Under the guidance of national policies, teachers attach great importance to their thinking, actively explore teaching models that integrate science and education, and integrate ideological and political elements into the curriculum, teaching and educating student, and cultivating morality.

2) in action

(1) In terms of teachers

Around the principle of putting students first, and with the goal of comprehensive development of students, in terms of teaching content, we not only impart textbook knowledge about the achievements of predecessors, but also introduce contemporary technology, contemporary inventions and modern achievements. In addition to combining various teaching methods and means to achieve traditional knowledge transmission, practical teaching is also actively carried out in teaching methods, from course design to graduation project, from completing experiments in class to participation in competitions outside of class and from listening attentively in class to reading extensively outside of class. Various beneficial attempts are made in teaching reform.

(2) in terms of students

Students' endogenous motivation should be stimulated. Young people should have their own aspirations and will not disappoint the eternal flow of the Yellow River. We motivate students to use their brains and courageously study knowledge, fearlessly climb technological peaks without fear of obstacles. Various technology teams are established and the knowledge learned is flexibly applied. It not only solidifies the basic knowledge and theory, but also exercises and develops scientific research abilities, further lays a good foundation for the postgraduate entrance examination, further education and even entering the work position.

(3) In terms of school

The overall principle is clear goals, sound systems, coordinated management and mutual cooperation. Firstly, with a unified mindset and consistent goals, various methods and approaches are adopted during the process for providing various conditions and inspiring wisdom to stimulate potential. Then teachers and students work together in the same direction, with the effort of teaching and the rewards of learning. The final foothold stands on standards to rely on, results to measure and achievements to compare. Simultaneously there carries out curriculum reform, curriculum evaluation reform

and constructs a multi-dimension curriculum teaching quality evaluation system to encourage students to participate in teaching reform and management for comprehensively improving teaching quality.

In fact, for evaluating the educational achievements and teaching model of a school, in addition to using quantifiable standards, attention should also be paid to some soft indicators, such as the quality of students on campus, the quality of graduates, the learning atmosphere, etc. However, due to the fact that these humanistic factors have not yet formed good evaluation standards and are in a state of hundred schools of thought, this article will not discuss them for the time being. I hope that national policies can be reflected in this regard as soon as possible in the future.

4 Practical Effects After Integration

1)Forming a good teacher-student interaction and significant improvement in academic performance

Taking the course of hydraulic and pneumatic transmission as an example, this course is a compulsory foundational course for mechanical design and near mechanical engineering majors. By gradually implementing the teaching model that integrates science and education, The final exam scores for hydraulic and pneumatic transmission of students have steadily increased, and displayed good trends and effects. The summary table of academic performance for the past three years is shown in Table 2.

Table 2. Summary of achievements in hydraulic and pneumatic transmission in the past three years

class	total number of people	number of failed students	of failure rate	number of medium and above	me-medium and above rate
2017mechatronics class 1	61	9	14.75%	3	4.92%
2017material class 1	46	5	10.87%	1	2.17%
2018material class 1	52	3	5.77%	7	13.46%
2018mechanical class 1	58	2	3.45%	15	25.86%
2018mechanical class 2	61	3	4.92%	14	22.95%
2019mechanical class 1	49	4	8.16%	26	53.06%
2019mechanical class 2	47	3	6.38%	23	48.94%
2021mechanical special	30	2	6.67%	16	53.33%

The defect rate is showing a downward trend, while the excellent rate is showing an upward trend. As shown in Figures 1 and 2.

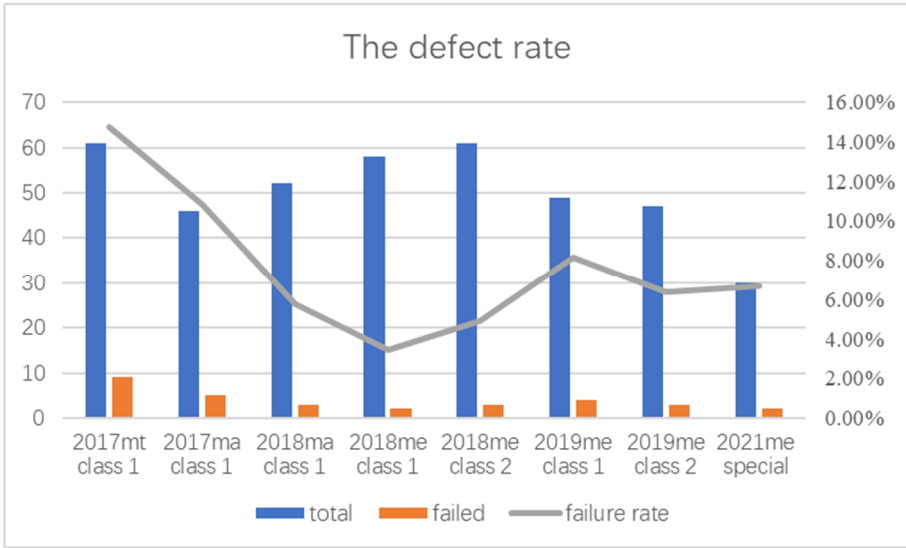


Fig. 1. The defect rate trend

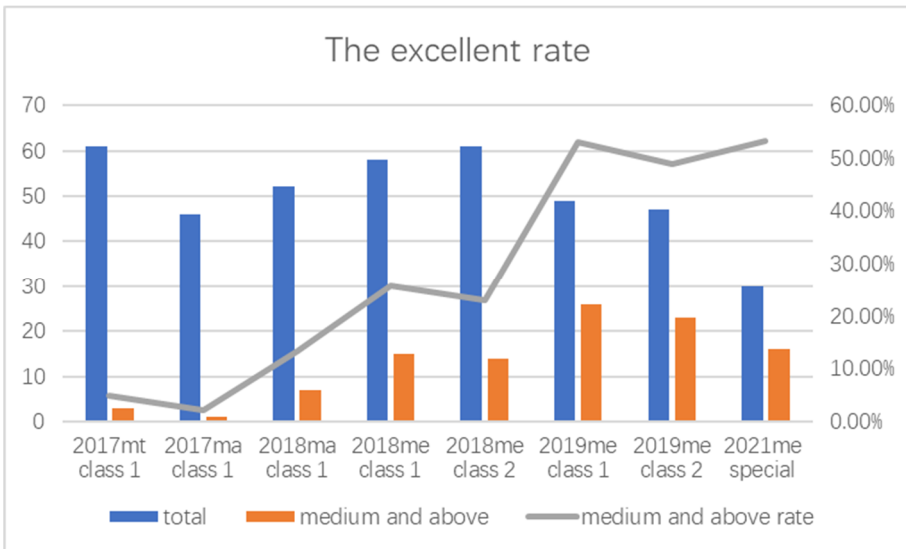


Fig. 2. The excellent rate trend

2) Preliminary establishment of students' scientific research literacy and abilities

Teachers and students work together to actively participate in various college student competitions, and by participating in competitions and projects students can gain exercise and further apply for patents and publish papers. In recent years, our school has organized students to participate in the Rehabilitation Industry Innovation and Entrepreneurship Competition, the 15th "Challenge Cup" Henan Province College Students

Extracurricular Academic and Technological Works Competition, national Simulated Steelmaking and Rolling Competition and national 3D Digital Innovation Design Competition and so on, and has received awards or achieved good rankings.

3) having improved the teaching ability and research level of teachers

The teachers in the teaching and research department actively update their concepts and deeply participate in educational reform, and publish research and educational articles. Taking the teachers responsible for hydraulic teaching as an example, in 2023, the average number of publicly published papers per person is 3 and 1.5 patents per person have been approved, and participated in the construction of one provincial-level first-class course, etc. The teaching and research department where the author works has made significant progress in the final comprehensive evaluation of the entire college.

Of course, the author's university is positioned as a private applied type, there is still a significant gap in research and teaching levels compared to high-level universities. The benefits and impacts of these measures are not yet ideal and not high enough, the practical results are not 100% satisfactory and not all students agree to cooperate. I hope to further communicate and learn from peers in my future work, exchange knowledge, learn from each other's strengths and weaknesses and make greater progress.

Additionally, there is another issue worth paying attention to. Although the teacher's enthusiasm for teaching reform is high, however, there are still a few students who are not very satisfied and stand on the sidelines, are very Buddhist like, losing the vitality that college students should have. Especially for college students in ordinary universities, who lack the halo of prestigious universities and do not work hard on their academic studies, they tend to be lazy, they move around every time they are told. Let's call it lazy learning, even after graduation, they are deeply lost in confusion. The essence of this phenomenon is that students are willing to be mediocre and lie flat. Why did their psychological activity state reach this stage? And the theory how to effectively ignite their enthusiasm for learning, work and life needs to be researched further.

4)Reflection

Whether it is the parallel development of science and education in the past, or the integration of science and education that has progressed to the present, and whether it is the separation of industry and education in the past or the integration of industry and education advocated now, we all need to put people first. That means putting students first and teachers first, students are the goal of education and teachers are the means of education. The ultimate goal is to cultivate talents who meet the needs of social development.

At the same time, there is also room for improvement in school management. We need to focus on both sides and be firm in both hands, one hand is on scientific research and the other is on education. In the past, we only focused on teaching, and teachers were all buried in their teaching without hearing anything outside the window. Later, scientific research is advocated vigorously, achievements are made the king and heroes are awarded based on achievements. These all have problems. The narrow viewpoints need to be updated, for example, closed education focuses on basic education, there are no needs to contact with the outside world and international and domestic technology are ignored and so on. We should advocate putting people first, transforming from

closed to open, transforming narrowness into inclusiveness and transforming academic focus into a balance between theory and practice.

It can be said that the integration of science and education conforms to the characteristics of educational development, transforms educational concepts, expands educational paths and promotes the transformation of talent cultivation models. However, there are still many issues that urgently need to be solved in the integration of science and education, including which science is to be integrated, is it a world-class science today, or a science that teachers are working on? Will there be a huge knowledge gap to be filled when integrating first-class science into teaching? Do students rely on self-study to make up for it? Or should the teacher explain or introduce this intermediate knowledge? Is the teacher familiar with this science? If the teacher is working on science, is the science included in the research project leading? Is it leading domestically or internationally? Is the project that the teacher is working on necessarily high-tech and specialized? How can teachers integrate without suitable projects on hand?

5 Conclusion

The talent cultivation model of integrating science and education under the background of new engineering has achieved some results in teaching reform, and students have also benefited a lot, but teaching reform is always on the way. The next step is to consider continuous improvement and learn from the six integrated teaching models of peers, such as online and offline integration, virtual and real integration, international integration, science and education integration, theory and practice integration and industry education integration [9-11] to achieve a multi-dimension, multi-vision and multi-level teaching model. We should build a friendly space for students to learn, innovate, and apply knowledge. Further we plan to enhance cooperation with enterprises, making practice an important learning process. In addition to the existing metalworking internships, cognitive internships, and production internships, it is also necessary to expand the internship and practical training for corresponding enterprises, so that what is learned can be guided and verified.

It can be said that whether it is the integration of science and education, the integration of industry and education, innovation and entrepreneurship education, or a combination of these methods, they are all a type of educational model. All of them are aimed at changing the existing or traditional talent cultivation mode, achieving an organic combination of knowledge education and value shaping, a combination of theoretical and practical abilities, and improving the quality of talent cultivation, meeting the demand for high-quality, innovative, applied, and versatile talents in today's rapidly developing society. It can be foreseen that talent cultivation in China is increasingly tending towards rationalization, humanization, and scientificity, maintaining an empty cup mentality, aligning with international education, and embracing all aspects. It will inevitably lead to a path of education reform with Chinese characteristics.

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