

# *Construction of Advanced Applied Mechanical Professional Training Mode in Independent Colleges*

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**Abstract:** In view of the lack of pertinently targeted mechanical major in independent colleges, the reform measures are put forward. Independent colleges should train senior application-oriented professionals. The paper puts forward some suggestions on reforming the existing teaching management system and points out that the reform of management and evaluation system should be strengthened. It is necessary to integrate the curriculum system and to strengthen the practical construction. Strengthening the construction of practical conditions is an important push to improve students' practical ability. It is also very important to build a scientific students' assessment and evaluation mechanism to motivate students' learning enthusiasm.

## **1. Introduction**

Since the early 1990s, with the further development of market economy and the steady advancement of higher engineering education from elite to mass, higher engineering education has faced new opportunities, and at the same time, the survival and development of higher engineering colleges have also faced new challenges. Therefore, the professional positioning and course setting of higher engineering schools also changed from passive to active[1-2]. Under the new situation, there are two major characteristics in the professional curriculum and professional positioning of higher engineering schools in China: (1) blind pursuit of leadership, and lack of personality in the professional curriculum and professional positioning. (2) Emphasizing theory over practice. This seriously affects the training of senior applied technical personnel in engineering universities.

From 2017 to 2020, Nanhu College of Hunan Institute of Science and Technology organized teams to visit 20 manufacturing enterprises in pearl River Delta Economic Zone and Yangtze River Delta Economic Zone, where graduates are concentrated, to investigate the requirements of manufacturing industry on talent training, and to visit engineering graduates[3]. The survey shows that many engineering graduates have solid professional basic knowledge and basic theory, but their

ability to solve practical engineering problems is not very strong and they are slow to get into the state. Therefore, it is necessary to adjust and reform the mechanical major in local colleges and universities.

## **2. Construct a new Training Scheme for Advanced Applied Talents**

### **2.1. Culture Objectives**

This major aims to cultivate senior application-oriented professionals who are oriented to regional economic development and actual engineering needs, have solid basic knowledge, broad professional scope, targeted service, strong practical ability and high comprehensive quality, and meet the requirements of product research and development, technical transformation and project management of mechanical manufacturing industry[4-5].

### **2.2. Culture Specifications**

Relying on the solid foundation of natural science and humanities and social science discipline platform of the university, it aims to cultivate high-quality talents with solid natural science literacy and high humanities, arts and social science literacy.

Relying on the platform of the combination of industry, university and research, to cultivate professionals with broad technical and theoretical basic knowledge, outstanding practical skills and innovative spirit;

Relying on the local machinery industry platform, training qualified talents to meet the needs of regional economic development in specialized fields.

## **3. Construct a Standardized New Teaching Management System**

### **3.1. Professional Training Program Management**

It is a systematic project to formulate the professional training plan. In order to reflect the characteristics of The Times, social needs and talent development of the plan, a school-enterprise joint meeting is held every academic year to absorb the opinions and suggestions on the quality of talent training. The professional training plan is revised regularly. Once confirmed, it must be carried out seriously and let all students understand. The following three problems should be paid full attention to when revising the professional training plan. Firstly, the guiding ideology of the professional training plan should be determined according to the actual situation and training objectives of the university. Secondly, Second, the construction of teaching staff, teaching materials, experiments and practice bases should be synchronized to ensure that the training plan is fully implemented. Thirdly, in order to make talent training to meet the actual needs of production, it is necessary to investigate the employers and related industry departments.

### **3.2. Teaching Operation Management**

In order to make teaching work orderly, stable operation, constantly improve the quality of teaching, actively carry out the following aspects of the work indispensable.(1) The formulation and modification of the syllabus;(2) Organize and manage classroom teaching links and stabilize teaching order;(3) Strengthen the management of teaching practice and pay attention to the cultivation of students' ability;(4) Strengthen the monitoring of teaching process;(5) Strengthen the

organization and implementation of the training plan, and formulate a practical, scientific and reasonable teaching task schedule, curriculum schedule, teaching calendar and examination schedule;(6) Strengthen the examination management, strict examination system, organize the proposition and marking and other links.

### **3.3. Teaching Quality Management and Evaluation**

The quality of teaching is promoted and ensured by regular inspection, supervision and evaluation measures. It is essential to establish the teaching quality management and evaluation system, and to carry out the following work. (1) formulate the work responsibility system of all kinds of teaching staff, guide and standardize the teaching behavior of teachers; (2) Establish a teaching supervision system. Experienced, responsible and energetic experts are invited to form the teaching supervision group to carry out the work independently. Shall assist the administrative supervision and inspection of department training plan implementation, by not regularly held in-depth classes, teachers and students on behalf of the symposium, random check the implementation of teaching plans, teaching calendar and homework, in-depth on-site inspection students practice, focus, communication and other forms of teaching and teaching management work for inspection, supervision, guidance and monitoring, objective, timely, Effective implementation of teaching quality management; (3) Establish a student evaluation system. Further strengthen two-way communication between teaching and learning, improve teachers' teaching work, and enhance students' enthusiasm in participating in teaching activities. Students' evaluation of teaching follows the principle of combining scientific, feasible and guiding, including teaching attitude, teaching content, teaching method and teaching and educating people. (4) The establishment of teaching and research section director, department director and teachers of mutual listening and evaluation system, enhance teachers' sense of responsibility, improve the overall teaching level; (5) Establish a young teacher tutorial system. New teachers are guided to ensure their teaching quality by experienced teachers; (6) Establish an evaluation system for part-time teachers to ensure the teaching quality of part-time teachers; (7) Establish a double tutor system for students' graduation projects to improve the closeness between graduation projects and engineering practice; (8) Mid-term teaching inspection is carried out in each semester, and teaching work assessment and evaluation are carried out at the end of each semester.

## **4. Constructing a new System of Curriculum and Teaching Materials**

While strengthening the course construction of mechanical subjects, this major increases the proportion of basic subjects, such as advanced mathematics and university physics, so that the proportion of these courses reaches 30% of the basic subjects. At the same time, the proportion of social humanities courses such as philosophy and religion, history and culture and arts, increase to 20% of the discipline foundation course. The results are shown in Fig.1. In the past, the knowledge structure of personnel training with single subject background, narrow professional scope, poor social application ability and insufficient development sustainability has been effectively improved, and the application ability and development potential of talents have been enhanced. In order to meet the needs of students' personality development, the proportion of elective courses should be moderately increased, so that the proportion of elective courses and compulsory courses should be adjusted from 3:7 to 4:6, shown in Fig.2. According to the special requirements of papermaking, electromagnet, chemical industry, agriculture and fishery in Yueyang district, and construction machinery industries or enterprises with high student employment rate in Hunan Province, such as

Hunan Sany Heavy Industry Co., LTD., Changsha Zoomlion Heavy Industry Technology Development Co., LTD., Hunan Shanhe Intelligent Machinery Co., LTD., New system of curriculum Strengthen the practical teaching of "electromechanical transmission control", "hydraulic and pneumatic transmission control", "mechanical CAD/CAM technology" and other professional courses. On the other hand, the relevant courses required by the industry or enterprises are added, such as "Analysis and Design of Electromechanical and Hydraulic Control System", "Construction Machinery", "Agricultural and Fishery Machinery", "Facility Fishery", "Agricultural Machinery Automation", "Process Fluid Machinery", "Biochemical Engineering" and other courses. In addition, the cutting-edge research results of the major should be appropriately incorporated into the course content to expand students' professional vision.

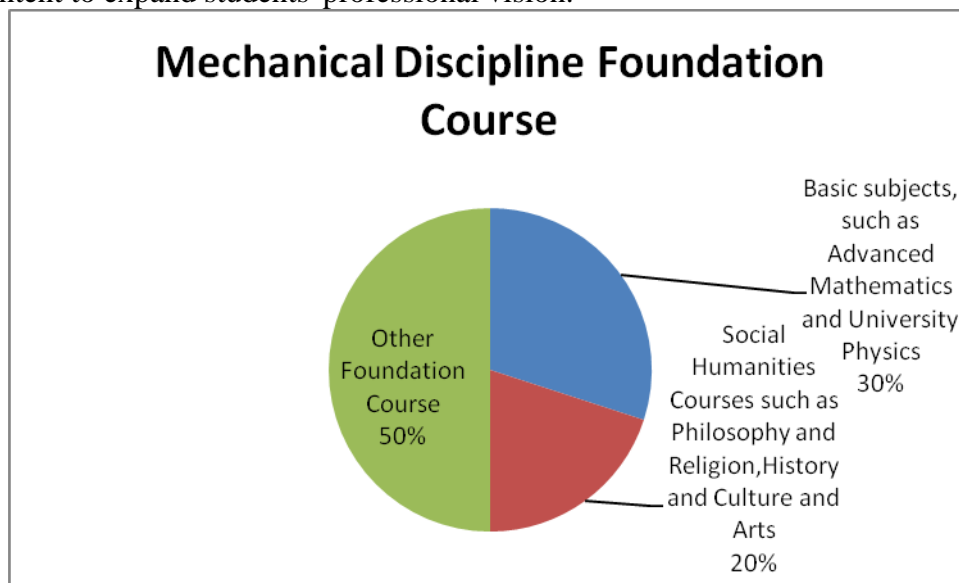


Fig.1 Mechanical Discipline Foundation Course

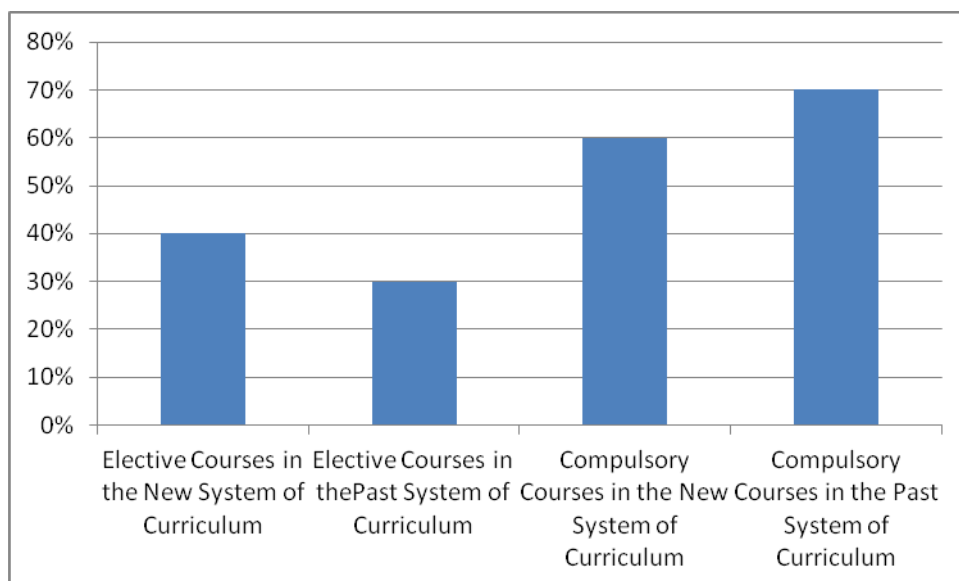


Fig.2 Elective Courses and Compulsory Courses in the two Systems of Curriculum

In order to avoid unnecessary repetition and separation, the basic courses of the subject and the basic courses of the major have been integrated, and the relevant links between the teaching contents in a crisscrossing manner have been clarified. An organic knowledge structure is established for students. "Principles of Machinery", "Mechanical Design", "Tolerance fit and Technology" have been integrated into "Principles and Methods of Mechanical Design". "Mechanical Manufacturing Technology", "Mechanical Equipment Design" and "Advanced Manufacturing Technology" have been integrated "Modern Manufacturing Technology Theory and Method". The "Numerical Control Principle and System", "Numerical Control Programming" have been integrated into "Numerical Control Principle and Technology"; "Microcomputer Principle and Interface Technology", "Computer Control System" have been integrated into "Control Principle and System" and so on. The system structure of knowledge can be completed by the integration and reconstruction of the course content, and the longitudinal penetration of the course can be adjusted to sufficient class hours. In the course content reconstruction, attention should be paid to the absorption of the cutting-edge knowledge and the latest research results of the subject, and the problems in modern manufacturing industry should be widely absorbed to stimulate students' learning enthusiasm and innovation desire.

Based on the existing Provincial Excellent Courses "Electromechanical Transmission and Control" and "Engineering Mechanics", the management and evaluation mechanism of excellent courses have been improved. A batch of excellent courses have been built at the institute level, which absorb the latest achievements of professional development and teaching reform, and reflect the modern educational thought. The overall level of course construction have been promoted. "Modern Manufacturing Process Theory and Method" and "Control Principles and Systems" are expected to be provincial quality courses.

Textbooks of national, ministry and national planning were selected as the main textbooks. Reference and self-compiled auxiliary teaching materials, student teaching materials, including experimental instructions, electronic teaching plans, electronic problem solving instructions, electronic model library, electronic hanging picture library, electronic problem solving library and so on, are reasonable supplements for classroom teaching. At the same time, the appropriate introduction of original foreign language teaching materials, effectively promote bilingual teaching. To meet the needs of the industry, actively explore and compile relevant training materials.

## **5. Constructing a new Practical Environment for Cultivating Students' Extended Application Ability**

### **5.1. Building an Experimental Teaching Center with Comprehensive and Design Projects as The Main Teaching Content**

According to the principle of "optimizing the allocation of resources, strengthening centralized management, comprehensive independent opening and improving the level benefit", the mechanical laboratory, basic laboratory of electronic and electrical engineering and professional laboratory are integrated into the mechanical experiment teaching center. According to the undergraduate teaching training plan, all the experiments are conducted in accordance with the syllabus. To cultivate students' scientific experiment quality and design experiment ability as the core, the experiment content is updated by increasing the comprehensive and design of the experiment for students understanding the knowledge and carrying out a comprehensive intelligence and skills training for students.

## 5.2. Creating an Open Engineering Training Center On Campus

The machinery basic laboratory, the machinery manufacturing technology laboratory, the national Vocational Skill Certification institute, the national INFORMATION technology ATA test center, etc., are optimized and integrated to form an open engineering training center, which is shared by the students of machinery. Open practice teaching is carried out, and students' comprehensive application ability is cultivated in the open experiment. Open practice teaching pushes students to the main position of the experiment. In the process of experiment teaching, students gradually try to choose the experiment subject, design the experiment plan, choose the equipment, formulate the experiment steps, process and analyze the experimental results and experimental data. Lab teachers provide services to students in terms of providing lab equipment, answering lab questions, and evaluating lab process and results. At the same time, the engineering training center also provides more perfect practical teaching conditions for students to conduct vocational skills training, curriculum design, graduation design and innovative practice.

## 5.3. Setting up an in-School and Out-School Practice Base to Cultivate Students' Comprehensive Application Ability

Strengthen the contact with the manufacturing industry and related industries, establish a wide range of joint, cooperative and co-construction relations. On the basis of the existing 17 off-campus practice bases (2 Provincial Excellent Teaching Practice Bases and 1 Modern Manufacturing Technology Practice Base with Advanced Facilities), 2~3 off-campus practice bases will be established.

## 6. Constructing a Scientific Student Assessment and Evaluation Mechanism

The reform of assessment mode is not only the reform of education and teaching, but also the reform of talent evaluation standards[6]. It is an inevitable need and an important means to train innovative talents. It is necessary to carry out comprehensive, flexible and scientific assessment on students to promote their all-round development. The examination of students should be able to develop people's potential, promote the harmonious development of personality and carry forward people's subject spirit. Establish the following assessment and evaluation mechanism.

### 6.1. Establishing a Multi-Faceted Evaluation Mechanism

Evaluation of professional theoretical knowledge. It mainly evaluates the professional theories and knowledge that students should have. The written test is combined with the oral test, with the written test being the main one.

Evaluation of thinking and judgment ability. It mainly examines students' thinking and analysis and judgment ability, combining written test with practical assessment.

Evaluation of innovation ability. It is the main assessment of students' creative thinking, mainly to practice assessment.

Design and production practical ability evaluation. This is a comprehensive assessment of the above three kinds of ability, is a summary of students' ability training results, is the basis for assessment and evaluation of students' comprehensive ability, with practical results as the main.

Comprehensive quality evaluation. Expression and communication is the most intuitive

embodiment of the ability, and it must be one of the evaluation standards of students' ability, which can be comprehensively assessed by oral test and written report.

## 6.2. Establishing Diversified Evaluation Mechanisms

Establish a student assessment and evaluation mechanism with the participation of schools, employers and industry departments, shown in Tab.1. The school examines students' professional theoretical knowledge. The school and the practice base jointly examine students' practical ability; With the participation of schools and industry departments, students' thinking and judgment ability and innovation ability are evaluated. The comprehensive quality of students is evaluated mainly by employing units and participating schools.

*Tab.1 Students' Assessment and Evaluation Mechanism.*

	Schools	Practice Bases or Employers	Industry Departments
Professional Theoretical Knowledge	100%		
Practical Ability	40%	60%	
Thinking and Judgment Ability and Innovation Ability	60%		40%
Comprehensive Quality	30%	70%	

## 7. Conclusions

Through three years of practice, the project adopts school-enterprise cooperation and school-enterprise interaction, and makes full use of enterprise resources to cultivate students' engineering practice ability and improve students' comprehensive quality. It has achieved great benefits in talent training and won social recognition and high evaluation. Mechanical engineering students have complete 5 undergraduate research and creative experiment projects at the Provincial level, National level 1, 4 national patents, published 12 papers, in the mechanical innovation contest, college students challenge cup at or above the Provincial level subjects such as scheduled events, winning more than 30 items in a national level 2 item, participate in 16 teachers' scientific research projects. The admission rate of fresh graduates in the postgraduate entrance examination reaches more than 40% every year. The tutors of the admission units have a high evaluation on the professional quality of the students majoring in machinery in our college. Many students are admitted to the mechanical disciplines of double first-class universities such as Jilin University and Northeast Forestry University every year. The annual employment rate of graduates is 98.8%, and the signing rate is 89.9%. Among them, 215 were recruited by the integrated internship and employment base, accounting for about 55%. With the further strengthening of the implementation measures, the mechanical major in our school will surely train more high-quality applied professionals for the motherland.

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## References

- [1] Ren Ming, Jiang Rui, Zhou Chen. *Exploration and Practice of Cultivating Applied Innovative Talents of Mechanical Specialty*[J]. *Education Teaching Forum*, 2020(35):125-128.
- [2] Wang Chunli, Sun Dandan, Xu Yao. *Research on the construction of the new mode of "five integration" modern industry college*. *Modern educational science* [J]. 2021, (04): 149-156.
- [3] Tan Jingying, An Weike, Zhou Yong. *Research and Practice of production-education Integration Mechanism for Engineering application-oriented undergraduate students -- Taking mechanical majors in Hunan Institute of Science and Technology as an example* [J]. *Journal of Higher Education*, 2016(19): 28-29.
- [4] Wu Yan, Zhang Ke, Zheng Gang. *"Integration of production and education, Concentric and far-reaching" -- Exploration and practice of cultivation mode of intelligent Manufacturing graduate Innovative talents* [J]. *University Education*, 2021, (05): 157-159.
- [5] Gu Dongwei, Li Qihan, Cui Gaojian. *Exploration of Teaching Mode of Integration of Production and Teaching Based on Case Teaching / R & D Process*[J]. *Research and Exploration in Laboratory*, 2020, 39(07): 207-210.
- [6] Zhang Bing, Zou Yiqin, Jiang Huifeng. *Construction of industrial College in local universities based on symbiosis theory* [J]. *Research in Higher Education of Engineer*, 2021,(04): 125-132.