



Exploration and Practice of Construction of High Level Physics Major with the Concept of "Three-Three-Through and Discipline-Driven"

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Abstract. The major is the fundamental platform for talent cultivation and the "four pillars" for building first-class undergraduate programs and cultivating first-class talents. The Physics major of University of Jinan closely integrates with the development needs of nation and Shandong Province region, taking the construction of first-class majors and disciplines as the starting point, fully leveraging the distinct advantages and leading role of local comprehensive universities, actively benchmarking against the new requirements of national construction of high-level undergraduate education such as "Six Excellence and One Top", "Double Ten-Thousand Plan", and "Certification of Normal Majors in Ordinary Higher Education Institutions". A comprehensive reform and practice have been carried out in the key links of major constructions, such as training mode, curriculum design, textbook writing, teaching staff, teaching methods, management services, and information technology applications. The major construction concept of "three-three-through and discipline-driven" has been summarized and then formed, which explores a new path to solve the problems of major construction of simplification mode and "two-skin" phenomenon in disciplinary and major construction in local universities. It has important reference significance and promotion value for the constructions of science and engineering majors in relevant universities.

Keywords: Major Construction, Double First-Class, Local University, Sustainable Development.

1 Introduction

Recently, the Ministry of Education issued documents such as the "Opinions on Accelerating the Construction of High-level Undergraduate Education and Comprehensively Improving Talent Cultivation Ability" and the "Notice on Implementing the "Double Ten-Thousand Plan" for the Construction of First-Class Undergraduate Majors", which put forward clear requirements for strengthening first-class undergraduate education, constructing first-class majors, and cultivating first-class talents. This is the major fundamental project to comprehensively revitalize undergraduate education, improve the talent cultivation ability of universities, and achieve connotative development of higher

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education [1]. The promulgation of each great measures for major and discipline construction has provided great opportunities for the development of local colleges and universities. However, the existing practical problems are that most of the local universities have a short running time, late start, low starting point, and relatively limited resources from various aspects, which brings severe challenges for how to meet the development of the times to do a good job in major construction.

Local colleges and universities should mainly cultivate innovative talents in line with the region according to the national and local development needs. In order to achieve the cultivation goal of good innovative spirit and ability, it is necessary to create conditions to ensure that students can participate in extensive and regular scientific and technological innovation activities, which is undoubtedly inseparable from the power of the discipline. Therefore, the undergraduate major is also the combination of discipline development and economic society needs [2].

University of Jinan is a comprehensive university jointly built by Shandong province and Ministry of Education and one of the "Striving for First-Class" construction of Universities of Shandong province. As a platform for cultivating talents in basic disciplines and closely focusing on the development strategy and economic society needs of Shandong province, a high-level major construction model for physics major in University of Jinan has gradually been formed. The high-level construction is driven by disciplines, which is reflected in the construction of the teaching staff with "3-high", that is, high teacher's ethics, high academic level, and high academic qualifications and professional titles, as well as the cultivation of students with "3-high", i.e., high patriotism, high academic achievement, and high innovative ability. The above collectively referred to as "Three-Three-Through and Discipline-Driven" and shall be abbreviated as "3-3" concept in the following.

In this mode, the comprehensive reforms and practices have been actively carried out for the physics major in University of Jinan in key aspects such as training mode, curriculum design, textbook writing, teaching staff, teaching methods, and information technology application. Significant achievements have been made and it has cultivated a large number of outstanding innovative talents for the country and local. At the same time, under limited resources and funding, the constructions of physics major and discipline are organically integrated and coordinated, with advantages and resources complementary and shared, forming full support for both. This has achieved a macro overall benefit of "1+1>2" [3]. The physics major was established as a national first-class undergraduate major construction site in 2021, and was also granted a doctoral degree authorization in the first level discipline of physics in 2020. Hence, the construction of high level physics major with the concept of "Three-Three-Through and Discipline-Driven" brought in this paper could solve the following teaching problems faced by other local universities similar as University of Jinan: (1) inaccurate positioning and insufficient personalization of major construction in local universities; (2) the construction of majors and disciplines has "two skins", lacking systematicity and coordination; (3) the lack of innovative spirit and ability, as well as spiritual shaping in talent cultivation.

2 Specific contents of the major construction with "3-3" concept

Disciplines and majors are two intersecting main lines in the connotation construction of universities. The "3-3" construction concept is guided by discipline construction and plans the establishment and construction of majors based on the characteristics and layout of disciplines. The Specific contents are the following.

(1) Based on the characteristics of the discipline, it should identify the major positioning, revise the training plan, and create outstanding and top-notch talents with "3-high". By optimizing curriculum system with the doctoral program in the first level discipline as the core, we can form a major talent training program that reflects the characteristics of the discipline, and integrate science and education to build a composite top-notch talent training system with "knowledge-skill-innovation" combination. We should guide students to have zero distance contact with research experts and high-end equipment through freshman seminars, technology open days, and other forms, to drive academic atmosphere and stimulate love for the major and patriotism.

(2) The concept of "knowledge as the bone, ability as the essence, and innovation as the spirit" runs through teaching, with attracting students through scientific research projects, and stimulating their interest and potential for innovation. Studies in class have complementary off class, and the diversified process assessment is implemented to promote teachers and students to work together. Research projects attract students for innovative training with writing papers and patents, and teacher and student interact to cultivate innovation awareness and collaborative spirit. Scientific research platform and practical teaching platform are shared to make them incubation bases for excellent talents.

(3) Deepening the innovation of teaching methods and means, stimulating classroom and shaping personality with "mutual inspiration and resonance". We should gather and improve the educational environment and resources through self-construction, introduction and sharing. Utilizing modern information technology we can construct self-directed and diverse learning models. Integrating ideological and political education into teaching through mutual support and mutual benefit, we can guide students to establish patriotism and correct values.

(4) Relying on the talent and technological advantages of disciplinary construction, combining introduction and cultivation, the construction of the "3-high" teaching staff and grassroots teaching organizations are promoted. We adhere to the combination of introduction and cultivation, and to create the innovative teaching team that deeply integrates "academic technology art" with high professional ethics by transform, supplement, and integrate scientific research and teaching teams. We will implement the system of teaching professors for undergraduates, so that there are professors in major construction and famous teachers in classroom teaching. The organizational network of teacher development center-major department-teaching research office-curriculum team will provide strong dependence and rich opportunities for teacher development.

3 Innovation and Characteristics of "3-3" Concept

3.1 Innovation of Major Construction System

The overall planning and implementation of the high-level major construction concept of "Three-Three-Through and Discipline-Driven" emphasizes the collaborative construction of majors and disciplines, activates innovative genes through mechanism reform, and integrates science and education to collaborate to cultivate talents, which will ultimately generate an internal incentive effect of " $1+1>2$ ". The physics major in University of Jinan is to build a first-class and outstanding physics talent training base and brand physics-teacher education. Based on the "four-new" economies of Shandong province and following the construction of Jinan as a national central city, we aim to cultivate outstanding talents with comprehensive development, international vision, and innovative capabilities. We will serve national strategy of Shandong province's comprehensive experimental zone for the transformation of old and new kinetic energy, and provide reserve force for physics and related discipline research to China.

3.2 Innovation of Talent Training System

With the goal of improving students' comprehensive quality, knowledge level, and innovation ability, a talent cultivation system with "3-high" is constructed through the integration of specialization and innovation, the combination of learning and application, and the combination of industry and education [4]. By optimizing the curriculum and focusing on direction of doctoral programs in the first level discipline of physics, a major talent training program that reflects the characteristics of the discipline will be formed. Integrated demonstration platforms for scientific research and teaching, training platforms for innovation and entrepreneurship, social practice platforms, etc., should be built to excellent talent incubation bases. The integration of "ability-quality-personality" into various aspects of the classroom and extracurricular activities and the comprehensive education with emphasizing moral, can solve the problem of combining the ability and spiritual literacy of science students.

3.3 Innovation of Classroom Teaching Method Reform

The reform classroom teaching methods with aim of "interaction, mutual feeding, and mutual inductance" can make classroom lively: "interaction" refers to teachers engaging in heuristic, discussion, inquiry, and participatory interactive teaching from multiple perspectives, as well as using various interactive information methods to answer questions and clarify doubts for students; "mutual feeding" refers to the integration of science and education, and the timely transformation of scientific research achievements into teaching contents to ensure progressiveness; "mutual inductance" refers to the organic integration of ideological and political elements in teaching contents and processes, and the resonance between teachers and students to form correct values.

4 Stage Effectiveness Since the Implementation of Major Construction with "3-3" Concept

(1) The mutual promotion and development of majors and disciplines have achieved remarkable results. A series of achievements in the construction of the two are presented as follows: the establishment of a first level master's degree program in physics in 2010, the smooth passing of the undergraduate teaching review and evaluation in ordinary higher education institutions in 2016, the entry into the provincial key construction discipline of doctoral programs in 2018, the establishment of a first-class undergraduate major construction site in Shandong Province in 2019, and the establishment of a national first-class undergraduate major construction site in 2021, and in the same year it was granted a doctoral degree in the first level discipline of physics.

(2) The constructions of majors and disciplines have enhanced the comprehensive quality and innovative ability of students, and the quality of training has steadily improved. Since 2014, students majoring in physics have won over 600 provincial and ministerial awards in various science and technology innovation competitions. In the past three years, they have published nearly 80 academic papers indexed by SCI/EI and nearly 30 patents, with an average further education rate of 44.5%. Among them, about 80% have entered universities of "double-first-class" or "985", and Chinese Academy of Sciences. The education model of "full staff education, full process education, and all-round education" cultivates a sense of patriotism of students.

(3) The development status of the graduates is good, the employers have high satisfaction, and the social recognition of the major is high. In recent years, tracking surveys have shown that employers are satisfied with the overall evaluation of graduates' moral literacy, professionalism, knowledge structure, professional skills, adaptability, communication ability, team collaboration, and cultural literacy, including young domestic and foreign professors, winner of the National Outstanding Youth Fund, and industry leaders. The feedback from students is with high social recognition.

(4) The construction of teaching resources effectively promotes the construction of majors, and the development of online quality resources benefits all directions. At present, all compulsory courses in the physics major in University of Jinan have realized online teaching functions through software platforms. During the covid-19 pandemic, "suspension of classes without suspension of learning" has been successfully achieved. As of 2023, the physics major in University of Jinan has 1 national first-class course, 5 provincial-level premium courses and 8 provincial-level first-class courses, 5 provincial-level ideological and political demonstration courses.

(5) The physics major has established a high-level teaching team, with teachers fully devoted to education and teaching and achieving remarkable results. There are currently 37 full-time teachers in the physics major, including 12 professors and 29 persons with doctoral degrees, 2 winners of the National Outstanding Youth Fund, 3 "Taishan Mount" scholars of Shandong province, 9 young teaching experts, and 5 visiting professors with high domestic popularity. The teaching staff not only has a high academic level, high academic qualifications and professional titles, but also has a high professional ethics. For example, Professor Song Shixue was once praised as a "Gold Medal Class Teacher" by Shandong United Front Network.

5 Discussion and Conclusion

With the goal of "building the first-class and outstanding physics talent training base and brand physics-teacher education", the next development plan of the physics major in University of Jinan is to adhere to the requirements of the national comprehensive improvements of education quality and promotion of comprehensive education reform, and the dual track parallel direction of teacher education and applied research. In the direction of teacher education, we will establish a training concept of "integration of top and bottom" (that is, based on national strategies, major standards and regional realities), follow the construction of Jinan as a national level central city, and meet the diverse needs of the central urban area and surrounding townships. In the field of applied research, the concept of "hierarchical classification and individual development" will be established with focusing on cultivating basic professional qualities and core competencies of students, to create outstanding and top-notch talents with comprehensive developments, international perspective, and innovative abilities.

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References

1. Long Fenjie: On the Exploration and Practice of the Integrated Construction of "Discipline-Specialty-Platform-Team" in Newly-built Undergraduate Colleges and Universities. *JOURNAL OF NATIONAL ACADEMY OF EDUCATION ADMINISTRATION*, (13):50–55 (2018).
2. YE Hui, DING Fei, WANG Zhaohui: Practice and Exploration for the Integrated Construction of Characteristic Specialty and Key Discipline. *Journal of Anhui Agri. Sci.*, 40 (23):11885–11887 (2012).
3. SUN Guojin, REN Taian, ZHENG Xianfeng, GUO Yan, CUI Guoming: Discussion on Key Discipline Construction Leading First-class Specialty Construction for Newly-established Universities. *Journal of Henan Institute of Technology*, 28(6):50–53 (2020).
4. Gao Xiu-mei: On the Relationship Between Discipline Construction and Program Construction in Higher Education. *Journal of Guangdong Ocean University*, 29(5):79–82 (2009).

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