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BUILDING A SYSTEM FOR CULTIVATING EXCELLENCE IN PHYSICS TEACHER TRAINING BASED ON UNIVERSITY-SCHOOL COLLABORATION

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Abstract-**The success of basic education curriculum reform depends on the quality of the teaching staff. The quality of the teaching staff depends on the higher normal colleges and universities. Higher normal universities should actively carry out the reform of teacher education mode, organically combine teachers' pre-service education and post-service education, and improve teachers' comprehensive quality and professional level. Based on the experience of U-S (University-School) cooperation, this paper takes the physics major as an example, summarizes the teaching reform experience of the physics normal major, and builds a training system for outstanding physics normal students.**

Keywords- **University-School collaboration, Outstanding teacher, Physics teacher, Teacher professional development**

I. INTRODUCTION

Teacher education plays a pioneering and decisive role in enhancing the construction and improving the overall quality of the teaching force. In the renewed context of deepening curriculum reform in basic education, the construction of the teaching force is faced with new requirements and serious challenges, and the reform and development of teacher education is of greater strategic significance. In the new era, it is an important task for teachers college to vigorously cultivating high-quality teacher-training students, actively participate in in-service teacher training to provide outstanding teachers for basic education. In view of this, teachers colleges must fundamentally explore the reform of teacher education and organically combine pre-service and post-service teacher education to improve the overall level of teacher education and enhance the comprehensive quality and professional abilities of teachers.

The core and key for education majors in higher education institutions to cultivate a large number of excellent future primary and secondary school teachers who are highly qualified and professional, have good moral character, solid professional foundation, outstanding educational and instructional abilities, as well as self-development ability is to continuously innovate in the teacher training model and construct a comprehensive reform plan that is conducive to the cultivation of outstanding teachers.

Outstanding teachers are the core element of quality education services, the exemplary representatives of talents in education and the mainstay of innovation-driven development in education. Developed countries around the world all pay great attention to education and have put tremendous effort into constructing the teaching force. In 2011, the United Kingdom adopted Training Our Next Generation of Outstanding Teachers, which stipulated the creation of positions for outstanding teachers in primary and secondary schools to provide them with space and possibilities for career development. In 2012, Germany launched the Excellent Teacher Scheme, which aimed to improve the quality and standard of teacher education by reforming the models and methods of teacher education in universities, and to promote interstate mobility of teachers, with special emphasis on the development of practical skills. In 2014, the United States implemented the Excellent Educators For All Initiative in the hopes to provide students with quality instruction through the work of excellent principals and teachers [1]. In September 2018, the Ministry of Education of China released the Opinions on the Implementation of the Excellent Teacher Training Program 2.0 which stated that it is necessary to cultivate a group of highly qualified, professional and innovative primary and secondary school teachers who have great passion for education, solid professional foundation, courage to innovate in instruction, expertise in comprehensive talent cultivation and the ability to maintain life-long learning and development.

Taishan University has had good cooperation with several primary and secondary schools in Shandong Province and has accumulated much experience of fruitful cooperation in internship and teaching support, education and instruction research, teacher training, and their continuing education[2].

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This study provides advice for an instructional reform in cultivating excellent physics teacher-training students based on University-School (U-S) collaboration.

II. LITERATURE REVIEW

Teachers colleges play a very important role in training teachers and have trained a large number of qualified staff for basic education. However, with the scientific development of basic education and the deepening of its curriculum reform, some issues have also occurred in teacher education, which have mainly manifested in the following aspects. Firstly, issues in collaborative education. Secondary schools often only serve as internship bases for teacher-training students and have not made full use of their function in collaborative education. At the same time, colleges and universities generally have not provided enough assistance to secondary schools. Secondly, issues in curriculum development. The design of physics teacher training curriculum at the undergraduate level is not reasonable, as training objectives are disconnected from the curriculum, theoretical learning is separated from practical training, and curriculum content is disconnected from the actual instruction in secondary schools. Thirdly, issues in online and offline integration. Online instructional resources are disconnected from offline learning of teacher-training students, and their theoretical learning is disconnected from practice guidance online.

Professional Development Schools (PDS) are an effective model of collaborative education for the training of outstanding teachers[3-6]. The practical nature of the teaching profession dictates that teacher training cannot be completed in university classrooms alone but must adopt a model of "theory combined with practice". It must be rooted in real-life teaching scenarios in primary and secondary schools, in order to achieve continuous professional development of teachers from the vivid practical teaching experiences. PDS, which originated in the United States, is a typical U-S partnership and one of the most typical and effective models of teacher education, which has become a trend in teacher education reform worldwide. PDS in the United States has achieved significant results in preparing new teachers, and in the professional development of in-service teachers as well as student achievement. The National Council for Accreditation of Teacher Education (NCTE) considers the main missions of PDS to be preparing new teachers, professional development for university teachers, inquiry into improving teaching practices, and enhancing student achievement.

Many Chinese universities have conducted instructional reform experiments adopting PDS and have achieved good results, including Capital Normal University, East China Normal University, Northeast Normal University, Hangzhou Normal University, Yulin Normal University and Hebei Normal University of Science and Technology[7, 8] . The teacher education model based on U-S cooperation has the following advantages: (1) it can optimize the teacher training model in teachers colleges and promote capability development of teacher-training students; (2) it effectively promotes the integration of teacher cultivation, training, practice and research, which can promote the professional development of teachers when they are in service; (3) it enhances the level of education and management in primary and secondary schools.

III. STRATEGIES FOR CULTIVATING EXCELLENT PHYSICS TEACHER-TRAINING STUDENTS

A. Optimizing the curriculum of undergraduate physics education majors

We built a physics teacher training system that solidifies foundation, strengthens abilities and emphasizes integration in accordance with the relevant regulations and requirements of the "Excellent Training Program" of the Ministry of Education of China, and adapting to the reform and development of curricula in basic education and the needs of society. Firstly, based on the concept of "student-centered, result-oriented, and continuously-improved", we revised the undergraduate training plan of physics teacher training, and built a curriculum that has teacher training characteristics and connects with basic education. Secondly, while improving the system of major curriculum, we increased the number of courses and hours on education theory specific to each subject so as to timely reflect the reform and development trend of basic education, make teacher education more relevant and effective, and connect it well with basic education. The design of education theory courses specific to each subject should fully consider the reality and future needs of basic education curriculum reform. For example, while offering public courses in education such as Introduction to Pedagogy in Secondary Schools and Curriculum and Teaching Theory, we also offered courses in physics education such as Theory of Physics Curriculum and Pedagogy. Thirdly, we introduced additional courses in humanistic and scientific literacy, as well as physiological quality education. By building a curriculum that combines professional ideals and identity, humanistic and scientific literacy, and education theory and experience, we enhance the humanistic literacy of physics teacher-training students, thus enabling them to have a deeper understanding of life and society. This will give them a new understanding of their own professional development as a future teacher, and deeper passion for the teaching profession, which will lay a solid foundation for teaching students the emotional beliefs and values when they are in service, thus helping them grow successfully into excellent and outstanding teachers.

B. Optimizing the practical teaching system

Firstly, strengthen the top-level design and reinforce the practice-oriented nature of the curriculum. In the latest version of the training plan for physics majors, the

percentage of practical learning hours reached 30% in forms including experiments, practicum, apprenticeship, research study, internship and thesis writing. The curriculum design paid great attention to actual issues in the reform of basic education physics curriculum, focused on reflecting the requirements it has placed on physics teachers, and strengthened its connection with basic education through practical teaching, instructional skills, course content, credit recognition.

Secondly, strengthen the integration of theory and practice. Having a grasp of the subjects and the scenarios one is teaching is indispensable for transmitting subject matter knowledge and educational theory, and teacher-training students' knowledge on education theory should be developed in dynamic teaching practice. In this process, we should guide them to participate in and study the physics curriculum reform in basic education, actively acquire knowledge about physics education and develop practical skills to discover and solve real issues in physics education and gain practical wisdom for teaching physics.

Thirdly, enhance students' educational and instructional skills through practices such as teaching internships. In the fifth semester, students undertake a teaching internship in a secondary school. In addition to regular aspects of classroom instructions and work as a classroom teacher, the internship includes the completion at least one secondary school physics instruction research and a topic of instructional reform with the guidance from a secondary school supervisor and the completion of at least one research paper. Through this internship, students will strengthen their subject matter knowledge and exercise their creative and practical skills in order to improve their interpersonal skills, organizational and coordination skills, expressive language and communication skills, and sense of teamwork, so as to lay a solid foundation for becoming outstanding teachers.

Fourthly, actively participate in various subject competitions to develop students' practical instructional skills. Develop students' education and capabilities using various subject competitions and projects at all levels, as well as DIY competitions as an entry point, and promote growth of these students in diverse teaching practice activities. Instructional skills can be acquired mainly through regular studies and continuous training, so daily training should be strengthened to make them regular. Students' daily training includes classroom teaching training, practical activities such as extra-curricular activities and club activities, various competitions on specific instructional skills, such as mandarin, writing using chalk, pen and writing brush, slide making, DIY instructional equipment, school-based physics curriculum development and physics micro-lesson production. Instructional skill competitions are one of the important ways for teacher-training students to develop professionally. Competitions promote teaching, DIY instructional equipment and fun physics lab skill training. Through these competitions, students complement each other and thus improving their instructional skills comprehensively. Through reading books, watching videos, conducting literature review and other learning activities, physics teacher-training students strengthen the application of norms in their classes, while combining other specific training such as mock teaching and impromptu speech. Through class-level selection, college-wide instructional skill competition, provincial instructional skill competition for teacher-training students, and the national physics instructional skill competition for university students, physics teacher-training students can eventually gain wisdom in learning, examine their behaviors in training, and learn to reflect on competitions. Through mass learning-practice-competition activities, we can lead more physics teacher-training students to participate in their own professional development as teachers.

C. Building online open courses to promote online professional development of teacher-training students in all aspects

In the era of "Internet Plus Education", the role of data-supported and data-driven systems are becoming increasingly clear[9] . We made full use of various information technology tools to build online open course platforms for physics majors and promote the professional development of physics teacher-training students in all aspects. Relying on online platforms such as Chaoxing, Treenity and Nails, each course in the physics department has built online component such as MOOC and SPOC. In online teaching and learning, we fully utilized Yuketang, Xuexitong and Tencent Classroom to assist in the process and strengthen process assessment. By optimizing curriculum design, teachers rearrange online and offline instructional resources and elements, and give full play to their respective advantages to achieve the integration of online virtual environment with physical classroom environment, online learning resources with paper-based teaching materials, and independent learning with collaborative learning[10]. As students learn through online open courses, the platforms can automatically record and count their learning behaviors. Analyzing diverse process assessment materials including students' classroom reports, learning statistics, grades and learning monitoring enables teachers have a timely sense of students' learning progress and provide targeted guidance to promote their quality of learning. On top of providing intelligent academic support, teachers contact students through qq, WeChat, phone calls and email to provide non-academic support such as emotional communication, consultation and interpersonal skills.

D. Enhancing the physics education studies and training of teacher-training students through online course platforms

Compared with traditional teacher education and training, MOOC-based online teacher training has the following characteristics: clear development goals, expert leadership, multi diverse resource sharing, and timely interactive sharing [11, 12]. We make full use of the various resources related to physics teacher education provided by the National Smart Education Platform to train physics teacher-training students. Learning content includes physics curriculum standard training, research on new physics textbooks, and physics instructional design. Through online training, physics teacher-training students constantly learn from and promote each other, improve their professionalism, promote professional development and enhance their professional capacity through interaction and learning. By making full use of modern information technology and sharing quality educational resources, training outstanding teachers not only will not bring about the issues of educational inequity, but it will also bring about improvement and enhancement of the overall quality of teacher education.

IV. CONCLUSIONS

In the process of cultivating outstanding physics teacher-training students, their knowledge, abilities and qualities should be continuously improved. At the same time, through the innovation in the talent training methods, curriculum and teaching model, the focus should be on building a training system for outstanding teachers on the basis of paying attention to enhancing their professional knowledge and education and instructional abilities.

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