Exploration and Practice based on TPACK On-the-job Development System for Teachers in Vocational Education

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Abstract: The State Council of China issued the National Plan for Vocational Education Reform in early 2019, which stated that an improvement plan should be implemented for ensuring qualifications of professional teachers in vocational schools, and 100 training centers for training the "double mentors" would be established. As development of vocational education has gradually gained government's attention, there is an urgent need to achieve high-level standards for teaching, to recognize the strategic importance of the "double mentor" system in developing vocational education, and to find out how to raise the quality of trainings in the "double mentor" system. The TPACK framework can be used to help develop on-the-job training of teachers in vocational schools, to promote their idea in modern vocational education, and to strengthen their teaching skills.

Key words: teachers in vocational education, TPACK, on-the-job training and development

Building a team of high-level professional teachers is a fundamental guarantee for promoting the development of vocational education. Education is a major program for the long-lasting development of our nation, to which teachers' qualifications are the key. Only qualified teachers can bring good education. [1] Beijing Institute of Technology, one of the key training centers for teachers in vocational schools (or "center" for short), has always been sticking to the idea of serving in vocational education, and providing guiding ideology in the local economic development, in which the university has fully presented its advantages and features in education, and has stepped in a road that is led by engineering courses and is integrated with technologies, a proper balance between teaching and production, an international view and high-level vocational education.

1. Major issues facing on-the-job training of teachers in vocational education

(1) The current training mode with a focus on pre-service education and a less emphasized on-the-job training

Ever since the issue of "Decision of the State Council on Making Great Efforts to Develop Vocational Education" in 2005, there has been a great increase in the numbers of both enrolled vocational students and full-time teachers in vocational schools. There were 839,200 full-time teachers in secondary vocational schools in 2017, with a gap of 329,600 teachers from the required 1,168,800 teachers as estimated by the Plan (the ideal student-teacher ratio being 16:1). [2] Altogether only around 20,000 students are educated every year by 8 normal universities of vocational education, which are the major sources of vocational school teachers. This indicates that the channel of bringing technical experts and skilled workers from enterprises into vocational schools, which was proposed by the government, was still not clear enough. The government is still constantly promoting the universitization of vocational school teacher education and high-level development, however, the result will be at cross purposes with the effort since, from international

experience, a lack of involvement of industries and enterprises and a university-dominated teaching system could lead to failure of meeting the quality requirements of cultivating vocational school teachers. The reason lies in the fact that the long-term university curriculum is not suited to teachers for vocational education, more importantly, the academically oriented development in universities is considered to lack practicality and situationality and will result in fear in vocational school teachers.

(2) The positioning of the purpose of "double mentors" with a focus on mere formality and a lack of content

Statistics in 2017 showed that there were a total number of 326,239 teachers as "double mentors" teaching core courses at secondary vocational schools nationwide, accounting for 27.00% in professional teachers. There were 97,419 part-time teachers from industries and enterprises, accounting for 22.68% in total. These two types of teachers combined are not only far from enough in quantity, compared with the figure of 60% in developed countries, but also are insufficient in terms of scientific recognition and definition in quality. [3]

Investigation shows that teachers' understanding on the system of "double mentors" is constrained by labels and tools. Most teachers have realized that the so-called double certificates in the "double mentor" system is only a format, which can hardly solve the conflict inherent in the system. However, influenced by relevant policies and pressures from external assessment, vocational school teachers would have to achieve transformation in the "double mentor" system through a highly formalized procedure, which has caused an even bigger issue – a fake culture of "double mentors". The root cause of the problem is a lack of accurate understanding of what exactly the system of "double mentors" is and what its structure is like. Without a clear theoretical recognition of the structure of three pillars in the "double mentors" system, i.e., academic quality, technical skills, and pedagogical skills, the "double mentors" are replaced by "double certificates" in practice, which has created a patchwork of trainings provided separately and mechanically by normal universities and enterprises. [4]

(3) The curriculum focused more on theories and less on practice

It can be seen from previous experience of cultivating vocational school teachers in China that most teachers are educated in universities, which can cause lack of working experience in enterprises. The general situation among existing teachers is that they do not have enough working experience, which can be summarized as "enterprises' lack of motivation to provide teachers with training opportunities, teachers' practice in enterprises turning out to be a formality, and unguaranteed quality of vocational education". [5] As is clear in the lists of curriculum in the institutions training vocational school teachers, the direct reason is that practical lessons remain a low proportion. According to a recent survey on training institutions for vocational school teachers done by the School of Teacher Education of Tianjin Normal University of Technology and Education, the phenomenon of focusing more on theoretical lessons and less on practical lessons is prevalent not only in normal universities for vocational education, but also in institutions of higher

levels. It seems clear that there is an imbalance between the proportions of lessons on educational theories and those on practice, with theoretical lessons accounting for 72.7% while practical lessons only 27.3%. In some universities which provide training lessons for vocational school teachers, the proportion of credits of theoretical lessons is as high as 75.1%, with practical lessons taking up only 24.9%.[6] A curriculum structure like this, combined with the lack of professional arrangement for vocational education, can cause doubts as to the effectiveness of trainings for vocational school teachers.

In short, the current training system for building "double mentors" teams lacks a scientific structure of fully balanced full-time and part-time faculty, it is highly necessary that the training system for vocational school teachers should be innovated and rebuilt.

2. Building a training system of on-the-job trainings for vocational school teachers with TPACK framework

In July 1999, Ministry of Education of China issued "Circular on Recommending Key National Training Centers for Vocational School Teachers". Ever since then, more than 90 national centers have been established, with a clear positioning of "being fully functional, conforming to regulations, being highly competent in trainings, teaching with high quality, with the characteristic of vocational education, and playing a leading role nationwide". These centers are under the obligations to "provide trainings for the cadre of teachers and leading specialists of secondary vocational schools, headmasters and other management members of national key secondary vocational schools nationwide and in every region, and undertake training where the base is located" [7] This is the positioning of national training centers, as well as the standard set for center construction. Beijing Institute of Technology was granted to set up a national key training base for vocational education teachers, the School of Vocational and Technical Education and Educational Technology Research Center in order to integrate research with education practice. A training system for on-the-job training vocational college teachers based on TPACK framework and standards for training bases has been established.

(1) Breakthrough in training vocational college teachers

According to a report released by the International Labor Organization (ILO) in 2015, a major challenge facing vocational education in future is the lack of a high quality training system for teachers in the Technical and Vocational Education and Training system with coherence and inclusivity. Therefore, the report made suggestions on how to establish a high quality educational system for vocational school teachers, which include providing (1) pre-service education in universities and in higher professional education for teachers (2) non-academic working experience in the industries or enterprises, (3) study on pedagogy and teaching methodology and (4) continuing education and life-long learning. [8]

At present, trainings for vocational school teachers are mainly of university-style and mostly academic, which means that there is a serious lack of non-academic working experience in enterprises, techniques and demonstrative teaching methods in this system. Professional teaching

methods for training skilled talents have not been used effectively, which leads to a failure in pre-service teacher trainings. This is shown not only in the fact that there are very few students who have graduated from traditional universities of technology and education start their career in vocational schools, but also in the serious issue of formality in terms of teachers' on-the-job practice regulations. On-the-job education for teachers seems to be the only ideal option when it comes to how to complement the non-academic experience and professional teaching method for vocational school teachers, which also meets the development rules and requirements of education for teachers in the world.

(2) Building TPACK-based on-the-job training system for vocational school teachers and improving teachers' quality

In the "Made in China 2025" strategic plan aiming for a powerful nation, it is proposed that the integration of the new generation of information technologies and manufacturing technologies should be boosted. Affiliated to the Ministry of Industry and Information Technology, Beijing Institute of Technology possesses an apparent advantage in the fields of information technology and machinery manufacturing. With the support of first-rate professionals, top-level lectures and the best platform for experiments and practice, the Educational and Training Center plays a critical role in teaching, research and in serving the community. The center engages in trainings for vocational school teachers with subjects in computer science, automotive engineering and mechanical engineering. Based on the TPACK (i.e. Technological Pedagogical Content Knowledge) framework which is a requisite tool for every teacher of modern times, we consider the positioning of trainings for vocational school teachers to be "promoting the idea of modern vocational education and improving teaching capability". Teachers are provided with courses featured in the three-dimensional teaching model and a plentiful supply of MOOC courses and are trained in the training complex jointly supported by Engineering Training Center, virtual simulation platform, enterprises and vocational schools. A multi-level and multi-step development path is designed for trainees. The center provides national-level trainings for vocational school teachers nationwide, supports the professional development for skilled talents in Beijing, maintains international cooperation and exchanges in vocational education, and helps with trainings in industries and enterprises. The center cultivates leading specialists and the cadre of teachers who can take a leading role at the critical moment when China is going through economic transformation and upgrade.

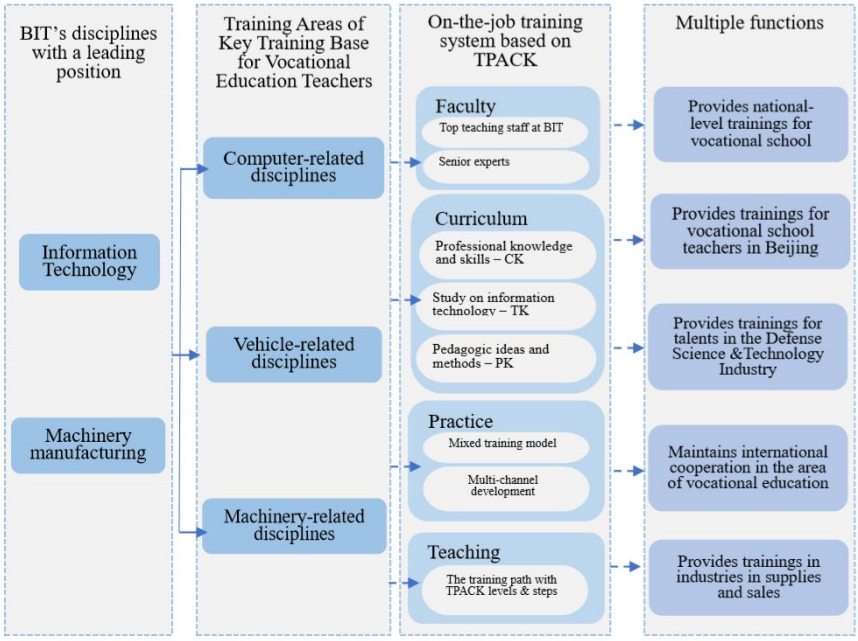

Figure 1 BIT's TPACK based on-the-job training system for teachers in vocational education

(3) Refine the triad vocational teaching training framework to develop academic, techniques, normal features of vocational teachers in balance

The connotation of the Triad Vocational School Teaching Training is that the core of training must revolve around three dimensions of technical, normal, and academic than offer forums and lectures or curriculum modules like visit or investigation freely based on strengths and preferences of experts and teachers. [9] See Figure two for details.

In the aspects of modern vocational education method and PK module, vocational educational experts of Minister of Education of PRC, headmasters of secondary vocational normal schools, and professors of base are employed to make excellent theme reports, which makes students recognize

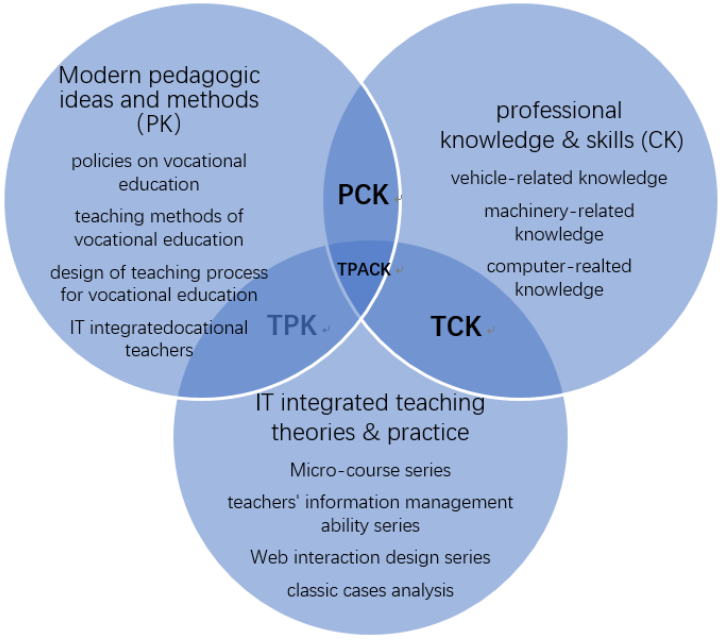

Figure 2 The Triad Vocational Teaching Training Framework

the responsibilities of vocational educational teachers, understand the historical tasks of vocational education, make clear of the direction of vocational educational reform, and gain the TPK abilities about integration skills of vocational educational subjects from macro- middle- micro level, the depth of training persons needed in economic society, and the aspect of teachers' morality and information technology integration teaching.

In the module of CK, experts and professors in top subjects and majors pay attention to the application of knowledge while teaching. They do their best to stress main points; they give considerations to height and prospect, as well as cultivating operation methods and skills. Students are organized in college and enterprise training base to practice their professional skills; they are also organized to attend observation lessons, visit professional trainings, take part in teaching and research, communicate with professional teachers, and have practical experience on teaching skills. Teachers can promote their ability of PCK through abundant practices, teachings, and visits.

Skill learning and the unity of knowing and doing are strengthened in TK module. Both knowledge and skills should be grasped. The basis offers series of project about micro-lectures training, teacher's information processing ability, web-interaction design and network video courseware. In the training module,

The teaching ideas and methods about practical training in every module of lectures make students inspired. Students have high learning motivation and turn and combine the core module knowledge into vocational educational teacher's TPACK ability combining leading processing selected majors and vocational training contents.

(4) Set up five training modules of "cognition, imitation, connection, conquest, and combination" and cultivate stronger teaching practice ability

The practical trainings on computer, automobile, numerical control etc. majors live through five compound stages of "cognition, imitation, connection, conquest, and combination". Cognition applies sense activities to watch online video, cognize the action orientation, and finally make preparations of skill training; imitation is that teacher demonstrates decomposition actions on the training basis and students imitate and have a try to achieve precision; connection is that repeat the personalized skill training, save training cost, and guarantee training safety to achieve continued and skillful decomposition actions; conquest means that teacher guide students to overcome their bottleneck period in person to achieve automatic actions; combination refers to enhancing practice ability of vocational educational teachers in every aspect based on ways of vocational educational teachers training community in real workplace or created situations.

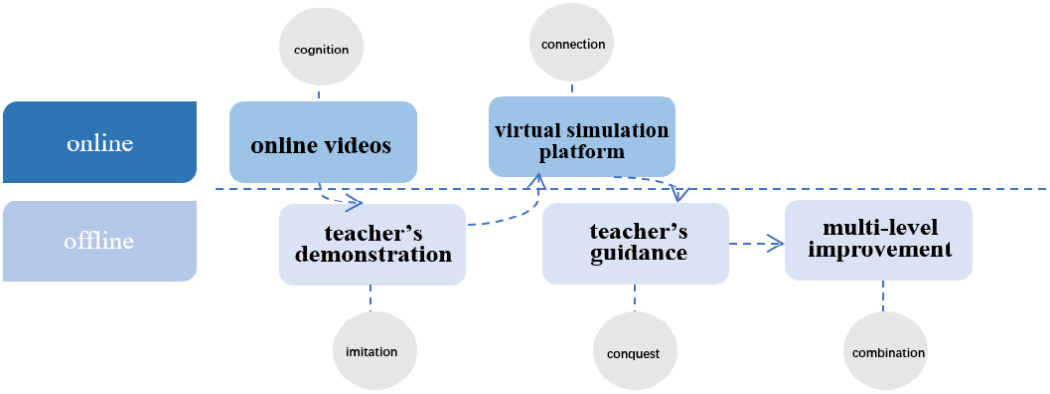

Figure 3 Five Training Modules of "Cognition, Imitation, Connection, Conquest, and Combination"

Research-oriented universities have difficulties in cultivating theory and practice teachers met the needs of vocational education because it is restricted by teaching background, training conditions and so on. The cultivation of "double mentors" relies on enterprise support as it can only promote their major practice ability by enterprise practice. In addition, the cultivation of "double mentors" can't be separated from real teaching practice while the best teaching circumstance is vocational college. All in all, vocational educational teachers training in research-oriented universities must set up a training community of university- industry- enterprise- vocational college to cultivate teachers so that their overall vocational ability can be improved.

Beijing Institute of Technology gains the advantages of strong majors about automobile, numerical control, computer etc. on experiment and training in engineering training center. Besides, there are professional experiment training rooms like Minister of Education cloud environment key open invented laboratory, Ministry of education high end simulation open laboratory and so on to do experiment and training teachings. The base cooperates with National Supply and Marketing Cooperative General Agency Vocational Education Research Center and carries out practical trainings by making best use of universities, industries, enterprises and vocational college resources. Students were organized to deeply practice among 20 excellent enterprises like Beijing Changzhi automobile repair factory.

(5) Design hierarchical progression based on TPACK and strengthen cultivating technology integration teaching ability of teachers in vocational education

The design aims at making tacit knowledge explication, explicit knowledge systematic, systematic knowledge digitalized, and digital knowledge internalization based on TPACK grading training. Students can set up learning progress as them like online while practice more underline. The online courses are well-designed and the underline trainings are vivid and interesting.

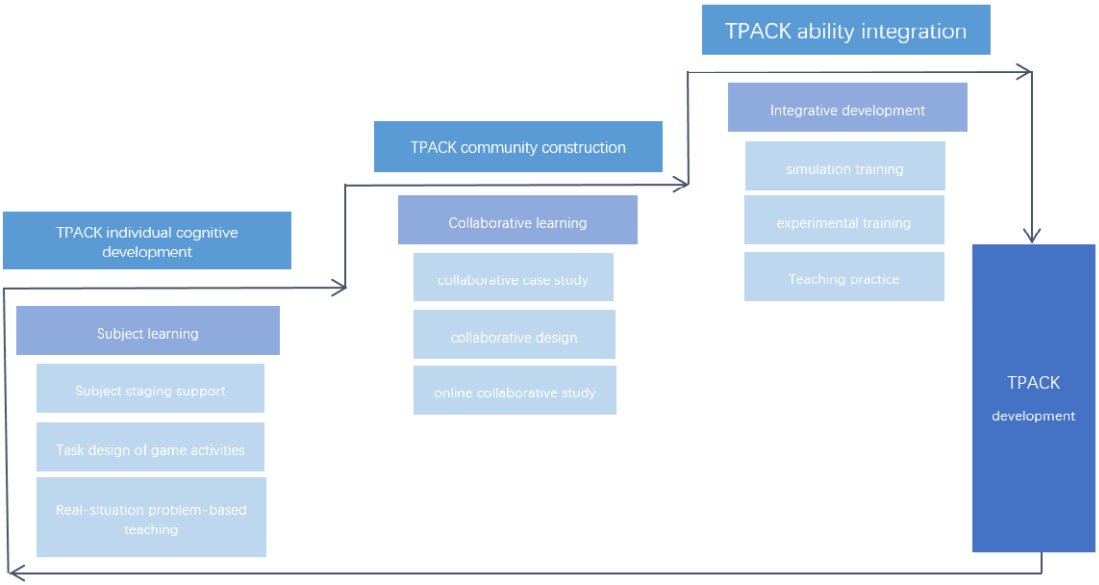

Figure 4 The stage of hierarchical progression based on TPACK

Besides teaching underline, there are also abundant online courses in the course. There are rich ways of learning of online course, such as routine chapters learning which applies to students used to sequence learning according to the law of behaviorism learning theory; passing through games learning which provides scaffolding instruction according to constructivism; fuzzy fault tree learning which connects tightly with students' real work and provides immediate enter learning style.

During the training, students can work together to design and report items, or do some works. Online learning provides platform of coordination and communication. Students can make their effects better in major learning by communicating with others.

Practice training and teaching students can promote TPACK ability and make it integrated application.

3. The innovation practice of on-the-job vocational education teachers

Constructing Beijing Institute of Technology vocational education teacher training base can help correct cognitive bias about existing vocational education teaching training, inspire new research perspectives, break the limitation of putting technique into teaching knowledge system directly, correct the cognitive about separating TK and CK, and integrate TK, CK, and PK.

(1) Set up a vocational education teachers on-the-job training system of "high, new, true, strong"

Beijing Institute of Technology Base proposes the training guidance ideas about "innovation motivation, higher guidance, prospected viewpoint, provide method, regard ability" and sets up the

on-the-job vocational teaching training system of “high, new, true, strong” (High means that the contents of teaching training are at the higher lever; new means that students can enjoy new technology and modern vocational education teaching knowledge and method; true means that the base will put the training into true practice; strong means that famous international vocational schools will connect together to achieve strengthen combination.) that will show the features of engineering. In the base, we cultivate the subject leaders and core teachers who can be normal during the important period when the nation economy transforms and upgrades.

(2) Established the triad vocational education training ability and course framework based on technique integration

The vocational education teaching training should particularly lean on “improve modern vocational education methods and expand the channels for promoting professional teaching ability” on the base. There are three core modules of knowledge about training --- TK, PK, and CK. Put the integrated core module knowledge into vocational education teaching TPACK ability by ways of discussing and teaching practice, training practice, enterprise internship and visit, and discussing online teaching and learning.

(3) Constructed five compound stages of “cognition, imitation, connection, conquest, and combination”

There is a vocational education training community of “university-industry-enterprise-vocational colleges” established in the basis and the four sides of community cultivate together. To enhance students’ comprehensive practice ability, the base lives through five compound stages of “cognition, imitation, connection, conquest, and combination”. The practice and teaching module about “combine training and teaching in universities with practice in industry and enterprises; combine improvements of teaching ability with trainings in vocational colleges teaching; combine technique cultivation with assessment.” has formed.

4. The development direction of vocational education on-the-job training in the future

(1) Cultivate large amount of good-quality teachers and serve “quality improvement plan of teachers in vocational colleges”

The base began to have masters of vocational education enrollment in 2008. There are 639 vocational education masters majored in Computer, Mechanical Manufacturing, Vehicle Engineering, Modern Education Technology, Science and Technology, Education Management and so on.

There are 927 students of 6 national training majors about Application of Numerical Control Technology, Automobile Operation and Maintenance, Computer Application, Application of Digital Media Technology, Computer Animation and Game Making, and Website Construction and Management. There are 123 students getting Senior Technician Certificate (National Level I) and 410 students getting Technician Certificate (National Level II). During three years from 2011 to 2013, there were 53 trainees in senior headmaster course. The trainees had perfect improvements in their major while getting back to their positions.

(2) Serve to district economy development and cultivate high qualified teachers for capital vocational education

There are Beijing Municipal Education Commission, District Education Commission, and some junior vocational schools investing and taking meetings to the base, which drives a large number of teachers from vocational education in Beijing to Beijing Institute of Technology to promote teaching ability and degree. Till now, we have vocational education masters 282 graduated and 77 on study, totally 359 in the field of Beijing vocational education.

(3) Construct the training courses to provide motivation for the base inner development

There are 4 courses of National network excellent course Award, 5 courses of National excellent course Award, 2 National excellent sharing course Award, 11 Beijing excellent course Award, 8 copyrights issued by State Copyright Bureau, and 1 first prize of excellent practical teaching software and device. There were two items permitted by Ministry of Education national key construction of teacher training base of professional construction project, and put into construction and usage about high end animation simulation laboratory and key open virtual laboratory in cloud environment. Above all, they passed the assessment of Minister of Education about base.

(4) Have continuous improvement of service capacity and radiate more areas of vocational skills training

The base Supports capital professional and technical personnel training; in the aspect of national defense, improves the ability of serving professional and technical talents of national defense science, technology, and industry; among international, cooperates and communicates with international about vocational education; serves to cultivate teachers of supply and marketing profession as to industry. The base cultivates 597 technicians and senior technicians in total among Beijing Municipal Bureau of human resources and social security, driving, vehicle repair and dispatching, eyeglasses, NC machining technology of industrial and information systems and over 4000 to China Construction Bank Beijing Branch; undertakes to develop EMBA senior training courses of Department of vocational education and adult education, Ministry of Education, cultivates master of international education cooperation on " vocational education and human resources development" , and signs to cooperation with American League for International Education；cultivates over 80 teachers majored in marketing management in Systematization and specialization from senior vocational colleges of supply and marketing industry around the nation as well as takes them into enterprises to investigate and study.

References:

[1]教育部关于进一步完善职业教育教师培养培训制度的意见[R]教育部.2011-12-24. (Opinions of Ministry of Education on further improve development and training rules for teachers in vocational education) [R] Ministry of Education. 2011-12-24

[2][3]陈灵超,涂三广,董宏建.数据视域下中职师资培养的现状、成因及发展策略——基于教育部 2010-2017 中职校(机构)教师队伍状况分析[J].职教论坛,2019(01):74-82. (Chen Lingchao,

Tu Sanguang, Dong Hongjian. Current situation, causes and development strategies of secondary vocational education from the data perspective --- based on the analysis on teaching staff of secondary vocational school done by Ministry of Education 2010-2017)

[4][9]曾茂林.“双师型”教师三维一体培训原理与实践研究[J].中国职业技术教育，2015，（32）：18-23. (Zeng Maolin. Study on “double mentors” three-dimensional training theories and practice [J] *China Vocational Technology and Education*)

[5]董琴.职业院校教师企业实践现状及应对路径研究[J].辽宁经济干部管理学院.辽宁经济职业技术学院，2016，（3）：65-67. (Dong Qin. Study on current situation and solution path for vocational college teacher in enterprise practice [J]. School of Economic Cadre Management of Liaoning. Liaoning School of Vocational Education in Economics and Technologies)

[6]天津职业技术师范大学编著(published by Tianjin Normal University of Vocational Technologies).中等职业教育教师发展报告 (Report on development of teachers in secondary vocational education) [M].北京：北京高等教育出版社 (Beijing: Beijing Higher Education Press)，2016，206-207.

[7]供给侧改革视阈下职教师资培训基地建设的实践探索——以 S 大学为例 (Case study on University S about practical exploration on construction of training bases for vocational school teachers from the perspective of innovation of supply side)[J].职业教育研究 (*Vocational Education Research*)，2017，（3）：41-47.

[8]Michael Axmann, Amy Rhoades and LeeNordstrum. Vocational teachers and trainers in a changing world: the imperative of high- quality teacher training systems [R].International Labour Office(Geneva)，2015：11-16.