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Take Energy Storage Materials Technology as an Example to Study the Internationalization of 1 + X Certificate

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Abstract: With the deepening of the economic globalization era and China's Belt and Road internationalization cooperation initiative. The "Going out" pilot enterprises are generally faced with the dilemma of the lack of localized technical skills. In this paper, taking China-Zambia Vocational and Technical College as an example, build a sharing platform suitable for the 1 + X pilot, establish a model and pilot participants in line with the localized training of technical and skilled personnel in Zambia. With the energy storage materials technology major as an example, analyzing specific measures through the integration of training objectives, curriculum certification system, curriculum module cohesion, strengthening and other extracurricular tutoring to carry out trials of internationalization of 1 + X certificates.

1. Background

Globalization and information technology are the important trends of social development [1]. The country's ability to cope with global economic development, scientific and technological revolution and industrial transformation is closely related to whether it has high-quality, highly skilled and highly adaptable human resources. Energy storage materials technology has great potential, and continuing to improve potential and existing literacy knowledge, skills and human resources is key to improving national competitiveness. With the continuous development of the world economy and the advent of the era of artificial intelligence, many traditional jobs are gradually disappearing, and the social demand for talents has undergone major changes, and there are new requirements for the adaptability, innovation quality, and the ability to serve technological progress and industrial transformation. In order to adapt to the changing needs of industrial development and technological change, service the all-round development of people, vocational colleges should not only carry out academic education, but also for students, employees, job seekers, job transfer groups to implement high quality vocational training, realize the "transformation and upgrading" of vocational colleges, in order to provide talent support to improve the national competitiveness [2].

However, the traditional academic evaluation method brings two major difficulties to the international flow of technical skills: first, curriculum performance is difficult to comprehensively

and objectively reflect the technical skills and professional quality of learners; second, education and training courses in the same vocational fields are different, and mutual recognition cannot be realized [3]. Based on 1 + X certificate system development "certificate" curriculum, can technical skills to changing market demand of scientific evaluation, break the learners of academic education as the only proof of traditional evaluation method, help unit of choose and employ persons to identify, hire suitable workers, more scientific, effective and comprehensive evaluation of technical skills of professional ability and accomplishment, through the international flow channels, promote the high quality development of vocational education and training.

Mote the development of all countries along the Belt and Road, and bring more new opportunities for the economic recovery and common prosperity of all countries after the epidemic. Based on the new concept of industry-education integration of "technology guidance, school-enterprise co-construction and talent co-education", the new platform of high-level talent training with deep-depth, three-dimensional and all-round education mode of countries along the "Belt and Road" route will be promoted [4].In service capacity partners as an opportunity, based on international standards, build a set of gradually by international recognition of technical standards, technical discourse and technical paradigm, help countries along the development, also help to improve China's technology discourse system and Chinese industrial policy system in countries along the recognition and acceptance, gradually build and improve the depth service "going out" enterprise talent training new platform, has become the era of vocational colleges mission and major responsibility.

2. The Development Status of Energy Storage Materials Technology

As the permeability of new energy and power electronic equipment increases rapidly, power system increasing demand for the flexibility of multiple time scale, energy storage technology is therefore rapid development, not only appeared such as super lead-acid batteries, metal air batteries, supercritical compressed air energy storage and other new high-performance energy storage technology, and the cost of electrochemical energy storage is falling year by year. Driven by the dual demand growth and technological progress, the application of energy storage technology in the power system has developed rapidly. As of September 2021, the cumulative installed capacity of energy storage projects already put into operation worldwide has reached 193.2GW, up by 3.8% year on year. Energy storage also provides more diverse functions. Combined with existing application engineering and demonstration projects, the global cumulative pumped storage capacity reaches 172.5GW, accounting for 89.3% of total energy storage; electrochemical energy storage capacity ranks second with 16.3GW, 8.5%, and other energy storage capacity is small, totaling 2.1%. Among all kinds of electrochemical energy storage, the lithium battery accumulative installed capacity is the largest, accounting for 92.8%; sodium-sulfur batteries and lead-acid batteries account for 3.1% and 3.0%, respectively. Over the past 20 years, the proportion of pumped storage capacity has continued to decline, while the installed capacity of electrochemical batteries has exploded [5]. As can be seen from Appendix Table 1, electrochemical energy storage gradually occupies an important position in the development of energy storage applications, and both theoretical research and engineering practice applications account for a high proportion.

3. Research Foundation

China-Zambia vocational and technical college is located in Zambia garden city, China-Zambia vocational and technical college permission is China and the zambian government reached the construction of a vocational and technical college agreement perform the results, is the non-ferrous metal industry vocational education "going out" pilot work important achievements, got the

state-owned assets supervision and administration commission, the Ministry of Education attaches great importance to. The school is jointly organized by China Nonferrous Metals Group Corporation, China Nonferrous Metals Industry Association and domestic pilot higher vocational colleges. It is a higher vocational and technical college with strong faculty team and advanced facilities in Zambia. College mainly for zambian high school graduates to carry out higher education, but also a China nonferrous group company in praise enterprise training center, is responsible for organizing and coordinating the staff of the enterprise praise fang using college teaching equipment, teachers to carry out training, by improving the level of staff technical skills, improve labor efficiency, meet the demand of human resources for the development of all walks of life in Zambia [6]. Take China-Zambia Vocational and Technical College as an example. The current professional standards of energy storage materials technology have been certified by Zambia and incorporated in the national education system. China-Zambia Vocational and Technical College will recruit educational students of this major in Zambia. Therefore, thinking in advance and promoting the internationalization of the 1 + X certificate system can effectively achieve the integration of documentary certificates, and lay a solid foundation for the internationalization of the next 1 + X certificate system [7].

This research in China-Zambia vocational and technical college, for example, build suitable for 1 + X pilot sharing platform, establish Zambia technical skills localization training model and pilot participants, with energy storage materials technology as an example, in the teaching level analysis how through training target integration, certification system integration, curriculum module cohesion, tutoring strengthen concrete measures, such as the 1 + X certificate internationalization pilot.

4. Construction of the Pilot Participants

The pilot of 1 + X certificate system needs the cooperation of government, banks, enterprises, schools and training and evaluation organizations. The five subjects perform their respective duties and are respectively responsible for education and training, certification and supervision, certificate certification and certificate issuance. Overseas pilot process need to give full play to the functions of the Zambia government and education management department, led by Zambia Technical Education Vocational and Entrepreneurship Training Authority (TEVETA), do a good job in the top design of 1 + X certificate system, leading in the pilot process, play a good certification and supervision, approval and access, evaluation and feedback management functions. China-Zambia vocational and technical college as the implementation of 1 + X certificate system pilot, to the talent training and evaluation mode into the output of professional standard construction, in order to promote the professional construction suitable for the development of Zambia industry constantly upgrade, actively cooperate with TEVETA to select a batch of urgently needed certificate of service capacity partners as a pilot. Listing China-Zambia Vocational and Technical College as a pilot institution of the 1 + X certificate system, Combined with the preliminary full investigation of the job demand of the enterprises stationed in Zambia, China-Zambia Vocational and Technical College is based on the existing professional categories, such as information and automation, mechanical and electrical equipment maintenance and management, construction engineering, mineral processing, machinery manufacturing and automation, mechanical and electrical integration, energy storage materials technology, automotive application and maintenance technology, automotive application and maintenance technology, gem design and processing technology, tourism and other 10 professional categories, Select majors with urgent social needs and shortage of technical skills for enterprise positions, Closely combining the pilot project of 1 + X certificate system with the construction of professional standards, Together with the Training Center of China-Zambia

Vocational and Technical College, Zambia Education and Training Center of China Color Group, Zambia Learning Center of the Open University of China and other universities, industries and enterprises, At the same time, drawing lessons from the successful experience of domestic 1 + X certificate system construction, Develop grade standards that can reflect the new technologies, new processes, new norms and new requirements of vocational skills, In line with strict quantity control, The principle of improving the best and the strong has been gradually promoted.

5. Energy Storage Materials Technology Pilot Analysis

5.1. Culture Target Fusion

Table 1: The Energy Storage Maintenance 1 + X Certificate Target Settings

Grade	Foundational Competences	Practical Competences	Reflexive Competences
I	● Possession of specialised knowledge of energy storage Materials	● Ability to assemble batteries ● Ability to Test the performance of energy storage batteries	● Communicate effectively ● Ability to exercise personal responsibility
II	● Possession of specialised knowledge of energy storage Materials ● Possession of specialised knowledge of Chemistry	● Ability to Use electrical equipment in energy storage applications ● Ability to assemble batteries ● Ability to Test the performance of energy storage batteries	● Communicate effectively ● Maintain batteries ● Ability to exercise personal responsibility
III	● Possession of specialised knowledge of energy storage Materials ● Possession of specialised knowledge of Chemistry ● Possession of specialised knowledge Knowledge of batteries	● Design energy storage structure ● Ability to Use electrical equipment in energy storage applications ● Ability to assemble batteries ● Ability to Test the performance of energy storage batteries	● Communicate effectively ● Maintain batteries ● Ability to exercise personal responsibility ● Ability to apply management skills

The goal of professional talent training is the basic requirement of talent training, and the goal of grade certificate training under the 1 + X system is the characteristic requirement of talents [8] Therefore, the professional training objectives and the 1 + X certificate training objectives should be integrated with each other, and then cultivate students' core professional qualities combined with the characteristic skills of 1 + X certificate, and the two should be integrated to cultivate complex skilled talents with core professional abilities. Early completion of energy storage materials technology professional teaching standards, has been included in Zambia into the national education system, including energy storage materials technology professional training target described as, energy storage materials technology professional training students should master energy storage materials technology professional knowledge and technical skills, let students have design, maintenance, recycling and management of energy storage battery knowledge, skills and accomplishment. Therefore, in the construction of the 1 + X certificate, according to the principle of

curriculum and certificate integration, the talent training scheme is fully matched, and the skill objectives and level standards of the Energy Storage Maintenance 1 + X certificate design are shown in Table 1. The 1 + X certificate target is set to I-a total of three levels, responding to different capability target values from easy to difficult. Obtaining different levels of certificates can, on the one hand, reflect the degree of students' mastery of the X certificate skills, and on the other hand, they can also be used as the basis for enterprise employment evaluation, post grading and salary in the later stage [9].

5.2. Integration of Curriculum and Certificate System

According to the professional training program, the number of professional core courses is limited, and it is impossible to cover all skill level certificates related to the major. The professional basic course involves a wide range of knowledge, and a course involves multiple knowledge modules. For example, the energy storage materials course involves multiple knowledge modules such as lithium ion battery, sodium ion battery, flow battery, as well as the preparation technology of battery materials, which can realize the organic integration of knowledge module and professional skill level certificate. To, therefore, a comprehensive analysis of energy storage industry development status, fully research energy storage related job demand, and industry enterprise research professional skills key literacy, build "basic ability training-core ability training-characteristic ability training" training path, training in the process of X certificate as characteristic ability, build energy storage materials technology, professional "certificate fusion" system [10], As shown in Table 2, for the standard professional training program and the curriculum matching degree, certificate Energy Storage Design can be pilot assessed after the completion of the second academic year, while certificate Energy Storage Maintenance and Energy Storage Recycling should be assessed after the completion of the third year [11].

Table 2. "Curriculum and Certificate Integration" System

School Year	The First Year	The Second Year	The Third Year
Train objective	Basic ability training	Core ability cultivation	Characteristic ability cultivation
Curriculum	● Engineering Mathematics I ● Energy Storage Materials ● Chemistry ● Engineering Drawing ● Communication Skills ● Introduction to Computers	● Energy Storage Battery Structure Design ● Entrepreneurship ● Engineering Mathematics II ● Quality Control ● Chemical Power Supply ● Computer Aided Design ● Electrical and Electronic Technology	● Energy Storage Battery Manufacturing Technology ● Energy Storage Battery Detection Technology ● Energy Storage System Management and Maintenance ● Energy Storage Battery Ladder Utilization and Recycling ● Technology ● Environmental Protection in Energy Storage Battery ● Studio Project
1 + X certificate		● Energy Storage Design	● Energy Storage Maintenance ● Energy Storage Recycling

5.3. Course Module Cohesion

After determining the curriculum module of the curriculum certificate integration teaching

reform, the teaching content of the curriculum module is reorganized, and the certificate examination outline content is organically integrated into the curriculum teaching content in the form of project-based teaching [12]. The content design of teaching projects is based on the capacity of a single class, and the single-hour teaching items, double-hour teaching items are designed according to the number of project content. Each teaching project should not only achieve the course teaching objectives, but also achieve the examination outline training objectives. For the projects with high examination outline training objectives, the actual requirements should be achieved by strengthening the way of extracurricular training.

For the curriculum certificate integration reform of more than two professional basic course modules, it is necessary to do a good job in the connection between curriculum modules, and analyze the focus of various course modules. In the process of teaching content design, the project-based teaching design should form a complete system from easy to difficult [13]. Take Energy Storage Recycling 1 + X certificate as an example, involving the knowledge module of Electrical and Electronic Technology, Energy Storage Battery Structure Design, Energy Storage Battery Detection Technology and other courses. This requires a comprehensive analysis of the curriculum outline, and the certificate examination outline, to find the correlation points between the two, so as to realize the teaching content reconstruction that can not only complete the curriculum teaching objectives and integrate the examination outline content. It is best to invite experts and organize the teaching team to comprehensively demonstrate the feasibility of the curriculum certificate integration [14].

5.4. Extracurricular Tutoring Strengthening

In order to realize the purpose of "curriculum certificate integration", the design of teaching content needs to be handled flexibly. Taking the Energy Storage Battery Structure Design course offered by the energy storage materials technology major as an example, the actual teaching is 100 class hours, and the course includes not only a certain theoretical knowledge learning, but also a lot of skills training and computer mapping training, and the number of class hours is far from insufficient. Therefore, it is very necessary to strengthen the courses through extracurricular tutoring [15]. Extracurricular tutoring does not belong to the routine category of teaching, the purpose is to strengthen students' knowledge and skills in a certain aspect of 1 + X certificate. If students want to achieve outstanding results in the field of 1 + X certificate skills, the extracurricular tutoring course is particularly important, which is also an important way to realize the integrated teaching of curriculum certificate.

6. Conclusion

This paper takes the energy storage materials technology major of China-Zambia Vocational and Technical College as an example to analyze how to carry out the internationalization pilot of 1+X certificate through specific measures such as the integration of training objectives, the integration of course certificate system, the connection of course modules, and the strengthening of extracurricular guidance. The analysis results show that it is feasible to carry out diversified 1+X certificate internationalization pilot based on the construction of pilot participants. At the same time, the differences in policies, laws and education systems of different countries should be taken into account, and a reasonable certificate system should be designed to facilitate the smooth progress of pilot mission.

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References

[1] Gao Bai branch. (2014) Problems and Challenges facing China's Soft Power in the Globalization and Information Age. Global Human Geography, 12, 267.
[2] Ji Shuo. (2018) Practice and Exploration of the "One Belt and One Road" joint education Service of Higher Vocational Colleges -- A case study of Liaoning Petrochemical Vocational and Technical College. Journal of Liaoning Higher Vocational Science, 24, 8, 15-19.
[3] Wu Yunchen. (2013) Exploration of Academic Evaluation Method Reform for Students in Higher Vocational Art Colleges. Education and Career, 12, 178-179.DOI:10.13615/j.cnki.1004-3985.2013.12.006.
[4] Jing Anlei, Zhou Haitao. (2021) The foundation, problems and trend of promoting the high-quality development of higher vocational education. Journal of Beijing Normal University (Social Science edition), 6, 50-58.
[5] Xie Xiaorong, Ma Ningjia, Liu Wei, Zhao Wei, Xu Peng, Li Haozhi. Overview and Prospect of Energy Storage Application Function in New Power System. Chinese Journal of Electrical Engineering: 1-12 [2022-09-07].DOI:10.13334/j.0258-8013.pcsee.220025.
[6] Hou Yang. (2020) Research on the International Practice of Higher Vocational Education in China. Foreign Foreign Affairs College, 2020.DOI:10.27373/d. cnki. gwjxc. 000173.
[7] Chen Ziqi-Ji. (2021) Accelerate the construction of a modern vocational education system. Vocational and Technical Education in China, 12, 5-11.
[8] Liu Jiafeng. (2022) Takes the study and travel management and service major as an example. Journal of Ningbo Vocational and Technical College, 26, 4, 12-17.
[9] Wang Qin. (2022) The "1 + X" certificate is integrated into the architectural decoration professional curriculum system research. Journal of Huainan Vocational and Technical College, 22, 4, 45-47.
[10] Zhang Xiaotao, Wang Fei, Li Chenbo, Hu Yazhou. (2022) Research on the Application Certificate integration of BIM Technology in Civil Engineering major under the "1 + X" certificate system. Modern vocational Education, 24, 154-156.
[11] Jiang Ziyi. (2022) Analysis on the Cooperation path of Vocational Education between China and Zambia under the digital background. Journal of Ningbo Vocational and Technical College, 26, 1, 6-10.
[12] Ma Jing. (2022) Research on Ideological and Moral Cultivation and Basic Legal Curriculum with Integrating Media as the Media. Modern vocational Education, 24, 13-15.
[13] Dai Cuiping, Zhu Zhuqing, Zhang Yuhong, Tsering Qusang.—— is based on the connected nursing major of Tibetan and higher vocational colleges. Science and Education Guide (journal), 2020(35):47-48. DOI:10. 16400/j. cnki.kjdkz.2020.12.023.
[14] Chen Wenzhen. Research on the Development of Integrated Teaching Resources in Secondary vocational Tax Practice Course. Modern vocational Education, 2021 (48): 36-37.
[15] Xie Yunfei, Zhu Liang. (2022) Under the background of 1 + X certificate, the innovation and practice of the talent training mechanism of "double subjects, three progressive, four integration" under the background of civil engineering class. Modern vocational Education, 26, 52-54.

Appendix

Table 1: Application status of Energy Storage in power system

Energy Storage	Mechanical			Electrochemical					Electromagnetic		
	Pumped Storage	Flywheel Energy Storage	Compressed Air	Lithium Cell	Lead-Acid Cell	Vanadium Flow Battery	Flow Battery	Sodium-Sulfur Cell	Hydrogen Energy Storage	Superconducting Energy Storage	Supercapacitor
Fast Frequency Hopping	A	A	A	A	A	B	A	A		B	A
Inhibition Of Low-Frequency Oscillations		B								B	
AGC	B		A	A		B		A			
Balance The Output Of New Energy Sources		B		A	A	A	A	A	A	B	A
Micro Net Black Start	B		B		B		A				
Peak Filling Valley	A	A	A	A	A	A	A	A			
Market Readjustment	B			A							
Hot Standby	B	B	A	A	A		B	B		A	
Cold Standby	A			A		A		A			
AVC		A		A	A	A		A			
SSO										A	B
Power Quality Control		A	B	A	A	A	A	A		A	A

Note: A represents the existing engineering practical application, B represents the theoretical research stage.