



Industry 4.0 Manpower and its Teaching Connotation in Technical and Vocational Education: Adjust 107 Curriculum Reform

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ABSTRACT

This research aims to understand industry participants' opinions about vocational education under the development of Industry 4.0 manpower and its teaching connotation. The study adopted the expert interview method and invited 10 industry experts to hold 2 meetings. According to the research results, the original teaching contents in the departments of junior colleges have been changed and departments have been recombined, so that the schools can now offer courses related to big data analysis, cloud computing, Internet of Things, etc. to meet the demands of Industry 4.0. Higher vocational education has set about establishing a practical classroom based on the concept of Industry 4.0, in order that schools and industry can establish a close cooperation relationship and share resources with each other. Industry can help schools update their equipment and eliminate the gap between learning and practice by equipping students at technical and vocational universities with the right competitiveness under system integration and industry connection.

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1. Introduction

Face the aging population, declining birth rate, and the lack of industrial labor. The Industrial 4.0 will be an opportunity for Taiwan (National Institute of Experimental Research, 2015). As the industrial development in Taiwan, clarifying the advantages, disadvantages, and positioning of manufacturing industry in the global industry that putting forward unique value propositions will our government promote the policy of "productivity 4.0" and intelligence. Industry can sustain the fierce competition in the world Competitive advantage. With regard to the electronics industry, precision machinery industry and ICTs industry, it is our country's traditional strength to actively develop and innovate in smart robots and the Internet through industry 4.0 trains to enable industry to reproduce its global competitiveness (National Institute of Experimental Research, 2015).

The 107 course reform in response to Industry 4.0 on the wisdom of the workforce needs. The impact of the 107 curriculum are: First, the 107 programs develop the "core competences in fields subjects" and the "key areas of study" Implementation of the teaching of the course. Secondly, the professional and internship subjects assigned by the course department are clearly divided into professional subjects and internship

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subjects so as to ensure that the internship facilities and supporting measures in each school are consistent. The internship subjects are mainly based on the curriculum of common skill areas in inter-disciplinary. Enhance students' ability to plan interdisciplinary skills areas under clusters so that schools can offer courses more than they can to align their skills with employment. The 107 Course Reform is pragmatic and practical for the core concept of technical education. It shows curriculum design emphasizes practice and theory, and taking into account internship and teaching, so that students can successfully apply what they learned to work. Taiwan has adopted productivity 4.0 as the center of its development in science and technology. It also includes the import of an enterprise resource planning (ERP) system and the digitization of a manufacturing system in addition to the electronization of production and manufacturing. In the future, Industrie 4.0 needs to incorporate Information and Communication Technology (ICT) and intelligent and flexible (customization) production systems so as to achieve productivity digitization and networking of machines (M2M) (Stock & Seliger, 2016; Stosich, 2016; Tait-McCutcheon & Drake, 2016).

Taiwan is facing drastic changes in the global environment, and industrial personnel are confronting the development trend of informatized and intelligentized business service models. The guiding measures taken by the government in Industrie 4.0 are as follows: Industrial Development Bureau, MOEA subsidizes the development of small- and medium-sized enterprises (SMEs); the Ministry of Science and Technology allows schools to conduct fundamental research; and the Ministry of Education plans courses to train new talents (Faller & Feldmüller, 2015; Tan & Atencio, 2016; Wang, Wan, Li, & Zhang, 2016).

In terms of the difficulties possibly met by teachers in the face of Industrie 4.0, vocational schools should precisely design vocational education courses according to future graduates' new work fields and opportunities. During the process of industrial transformation under Industrie 4.0, the main problems met by the teachers include: teachers' industrial experience cognition; rational usage of off-campus resources; adaptation of textbooks suitable for industry courses; ability to design industry-oriented courses; teaching activities about industrial and practical skills; and teaching assessments (Bauer, , Hämmerle, Schlund, & Vocke, 2015; Schuh, Gartzten, Rodenhauser, & Marks, 2015).

When the pre-service teacher in the occupational matter class faced the concern of "pro-industry teaching specialization" of Industry 4.0, it explored how to start professional practice related to teachers and how the professional pre-service teachers in the pro-industry teaching specialization cognitive, value and needs adjustment process. In Industry 4.0, teachers not only need to participate in the common industry-oriented curriculum, but also practice rather personal characteristics of pro-industry teaching specialization. In the process of cognitive adjustment that teaching practice of thoughtful learning is one of the main contributions of this study. Under the impact of Industry 4.0, what are the views of industries on vocational education in cultivating industry 4.0 and its pedagogical connotation? To explore the phenomenon of vocation education facing industry 4.0 How to professionalize teaching in pro-industry? What is the cognitive connotation of teachers' professional development of the pro-industry? What is the teacher's adjustment of the pro-industry teaching specialization? Taiwan is pushing schools to develop Industrie 4.0 talents, and schools can cooperate with the Ministry of Education and the Ministry of Science and Technology to cultivate students with "Industrie 4.0" courses in university courses. The course structure of Industrie 4.0 must be understood to realize sustainable operations in vocational education, with an urgency to upgrade industry and teaching professionalism in technical and vocational departments in response to Industrie 4.0. This research aims to understand industry participants' opinions about vocational education in the development of Industrie 4.0 manpower and teaching connotation. The purposes of this study are to address the 2 following issues.

- (1) To understand the industry's view of vocational education in cultivating industrial 4.0 human and its teaching content.
- (2) To understand the needs of vocational teachers in industry in response to the specialization of industry 4.0 in industry-related professions.

2. . Methodology

2.1 Research Method and Subjects

With the use of expert interviews and an in-depth interview method, this research aims to understand industry participants' and technical and vocational education experts' opinions about technical and vocational education in the development of Industrie 4.0 manpower and their teaching connotation. In addition to technical and vocational education experts, the subjects in this research also included 10 persons in charge of enterprises or directors of human resources with more than 7 years of industry experience or seniority in the industry, or those in the manufacturing industry with a related background, or in the ICT industry and Internet service industry. Two expert interview meetings were held that aimed to understand the demands of enterprises and technical and vocational education experts in the development of Industrie 4.0 manpower as well as the teachers' opinions about teaching connotation of technical and vocational education. The in-depth interviews were conducted against the 5 persons

The experts discussion record includes live video, audio recording and immediate key recording. First, the contents of the recordings are converted into verbatim discussion records and the original language habits and contents of the participants are retained as far as possible. The logical place, be amended in reply to the participants intention. After completing the verbatim transcripts of the discussion discourse and reading in detail, the key points of the pro-industry teaching expertise and industry experience were searched from the written records. The professional pro-industry teaching was applied and coded, and then converted for the specific concept.

.2.2 Research Tool and Data Analysis

This research used an expert interview outline table to analyze human resource directors' opinions about Industrie 4.0. The contents of the expert interview outline table include enterprises' viewpoints and their adaptive educational measures in education practice, teachers' professional development, students' assessment, teachers-parents communication, industrial transformation, and professional leadership, so that technical and vocational education can conform to Industrie 4.0.

The interview questions included the project's requirements for technical personnel in response to Industry 4.0, the teaching content of cultivating industrial 4.0 human resources in vocational and technical schools, and the priorities and requirements of pro-industry that teachers should cultivate. As a collection of teachers in the industry in response to the process of Industry 4.0, the pro-industry teaching specialization in educational practice, professional development of teachers, student assessment, teacher communication, industrial restructuring and professional leadership and other cognitive content and cognitive course.

Subsequently, according to the materials acquired by expert interviews, a modified analysis was adopted to sort out and analyze all the data and to record their differences and similarities; the related materials in the literature were then compared and discussed; finally, the findings in this research were concluded.

3. Results

The industry participants believe that the import of intelligent manufacturing of productivity 4.0 is one of the important measures to improve production efficiency and manufacturing quality, so as to help the SME manufacturing industry to conquer the above-mentioned difficulties. Industry 4.0 applies Intelligent Robot, Internet of Things (IOT), and Big Data to promote industry development towards the direction of equipment intelligence, factory intelligence, and system abstraction and concretization. The added value and productivity should be improved and accelerated to further create industry's growth momentum. Such actions can help the SME manufacturing industry overcome its current difficulties (Sokolor & Ivanov, 2015; Wang, Wan, Zhang, Li, & Zhang, 2016). The interview as follows:

With the increasing popularity of communications equipment, coupled with the interactive use of wearable devices and the Internet of Things, connects us more closely to the world(A1)

In order to ensure the smooth flow of information, no matter in the world, walking through the mobile phone

network, but also can accurately grasp the important information of business operations, and even remote users increase or decrease the status. (B3),

Future Industry 4.0 technical talents need to meet the market requirements to conform to international development trends. When industry pursues the upgrading of new technology, more important measures must be cultivated for high-quality talents. The development of enterprise's industrial talents should adapt to market changes and requirements. In addition to the emphasis on the overall thinking structure and the improvement of technical integration ability, vocational development ability should also be cultivated. Through cooperation with educational institutions and input in the policies and plans of industry, governments, universities, and research institutes, the Industry 4.0 talent development model has been established to achieve resource sharing of advanced experiences in both product and technology. Education can also conform to industrial trends so as to increase international competitiveness, cultivate talents required by interdisciplinary Industry 4.0, and promote Taiwan's industrial talent cultivation and technical development (Lee, Bagheri, & Kao, 2015). The interview as follows:

In the case of mechanical and electrical integration engineers, enterprises should, in addition to planning practical assembly and operation of electro-mechanical components, plan to analyze and solve problems of the whole electromechanical system while handling on-the-job training. They should also understand the relevant product life cycle and Supply chain relations. (A2)

At the institutional level, we must consider how to integrate the system of long government wagons into a more efficient and forward-looking mechanism for promotion. As for the implementation aspects, we must plan and implement the incentives to promote teacher-to-business cooperation and encourage industry to engage in industry-university cooperation. (C2) Industry 4.0 adopts a combination of virtuality and reality to drive upgrading and transformation in the manufacturing industry and national economy to create added employment opportunities. Advanced manufacturing technology is applied to become the key power through artificial intelligence and machines' deep learning. Therefore, leaders and policy makers in industry, governments, and schools must have insight into international development trends to cultivate Industry 4.0 talents. The effective methods to improve Industry 4.0 technical talents include the following (Chen & Zhang, 2015; Weiss, Huber, Minichberger, & Ikeda, 2016; Witte & Jansen, 2016).

- Enterprise: Enterprises use intelligent machines to assist with their working environment to retrain front-line in-service staff. Faced with transnational competition in new E-leadership talent, new recruitment policies and human resource plans should employ a business model where advanced intellectual technology is used to develop new products and initiate new services.
- Academic education: Schools should try their best to provide extensive interdisciplinary vocational skills and knowledge education courses by conducting academic and practical cross-boundary communication and innovation. Information and technology education is listed as a required course in each department to close the gap in IT applied technology. Schools and enterprises must cooperate to open up online platforms for free course learning to provide lifelong vocational knowledge education.
- Government: To expand Industry 4.0 employment opportunities, the government must help enterprise staff remain in office or be competent in a new job, so as to coordinate the gap between enterprise talents and academic talent cultivation. It must also continuously deepen qualitative research and soften the effects of diversified advanced technology development on industry labor. The national overall development policy is formulated through central overall planning to give play to cross-functional coordination and to successfully realize the vision of Industrie 4.0.

4. Discussion

The Industry participants' opinions is important about vocational education in the development of Industry 4.0 technical talents and its teaching connotation. To respond to the demands for Industrie 4.0 technical talents, it is suitable to continuously promote talent integration between schools and training units in electromechanics, communications, and information, so as to cultivate the key talents required by the industry. Some specific practices are noted below (Faller & Feldmüller, 2015; Stock & Seliger, 2016; Stosich, 2016; Wang, Pascarella, Laird, & Ribera, 2015; Wijnia, Kunst, Woerkon, & Poell, 2016).

The training of personnel in line with the needs of the workplace in the enterprise has enabled the convergence of technical and vocational education and vocational training systems and laid a solid foundation of human resources in response to the trend of globalization. It has introduced the dual system of Germany into China

(also known as the "Painting"), so that high school students directly after graduation into public institutions, job positions in the workplace to learn the skills and professional knowledge required, supplemented by two-year college or four-year technical education, and by vocational training. In order to reduce the gap between the cost and technical cohesion of trainees and to effectively nurture the human resources required in the workplace, we hope that through double-track and parallel mode, both theoretical education and practical work in schools can be effectively and effectively doubled. Verify, in order to achieve "learn practical" realm (Stock & Seliger, 2016). Productivity 4.0 requirements of the wisdom of "people" is the key to the success of productivity 4.0, the future promotion of smart factories, the first consideration is to train the existing manpower to enable it to future industrial 4.0 environment, improve production efficiency and efficacy. Therefore, in the process of planning the productivity 4.0, priority should be given to cultivating "qualified personnel". By strengthening the existing quality of the labor force, gradual nurturing of all kinds of talents required for the future development of productivity 4.0 will ensure the provision of industrial manpower.

- Dominated by the government, industry group or regional industry group resources can be combined to help manufacturers to investigate the manpower gap and function gap required by the future development of Industry 4.0.
- Based on industry needs, the key industrial function standards of productivity 4.0 shall be constructed and the function standards or function unit courses be opened to carry out function quality certification and improve labor quality.
- The industrial value chain shall be integrated, and a satellite factory or settlement industry model can be used by leading enterprises or enterprises' backbone force for cooperation in cultivating key talents.
- Schools, vocational training units, and research institutions can be combined to discuss together the development and opening up of various professional courses required by Industrie 4.0, such as cloud computing, Internet of Things, big data, mobile application, network marketing, etc., so as to cultivate fundamental professional talents, senior and middle managerial talents, and cross-disciplinary talents.

5. Implications for practice

The strategy of a narrow international talent attraction can be changed and adjusted into a strategy of a more inclusive international talent attraction. Taiwan should adopt more liberal policies for those coming to Taiwan in order to cultivate potential overseas students, encourage them to continue to work in Taiwan after graduation, and to attract more outstanding overseas talents to be voluntarily engaged in Taiwan's industries.

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