

# Singapore's Vocational and Technical Education in the Era of Knowledge Economy and Its Enlightenment

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**Abstract:** The flexible and efficient vocational and technical education and training system has become an important driving force behind Singapore's "economic miracle", and thus a successful model of vocational and technical education worldwide. Singapore, which has leapt into the ranks of developed countries, still values the cultivation of high-end vocational and technical talents. Its vocational education has significant characteristics of the knowledge economy era, and has made great achievements in cultivating high-quality applied talents. Studying the vocational and technical education and training system led by the government and jointly participated by schools and enterprises has positive significance for the future development of vocational and technical education and training in China, and will effectively promote the transformation of China from a "human resource powerhouse" to a "human resource powerhouse".

**Key words:** Knowledge economy; Singapore; Vocational and Technical Education

Singapore, which had just gained independence in 1965, was plagued by issues such as resource scarcity, racial disputes, and high unemployment, with a per capita gross domestic product of only \$533 and a land area of only 682.7 square kilometers. After just 30 years, Singapore's per capita gross domestic product has doubled nearly 50 times to \$24867 and was classified as a "developed country" by the World Economic Cooperation Organization in 1996. Singapore has entered the era of knowledge economy, and its vocational and technical education strategy has been adjusted accordingly, with the goal of cultivating applied talents with innovative spirit, self-learning ability, and good professional literacy, and meeting the development needs of knowledge intensive enterprises.

## 1 The Characteristics of the Knowledge Economy Era and Its Impact on Vocational and Technical Education

### 1.1 Characteristics of the Knowledge Economy Era

Knowledge economy "is not a new term that has only emerged in recent years. As early as 1983, Professor Paul Romer of the University of California proposed the "New Economic Growth Theory", believing that knowledge is an important factor of production that can increase investment returns. The proposal of the "New Economic Growth Theory" marks the initial formation of the knowledge economy in theory.

In 1996, the World Economic Cooperation Organization officially defined the knowledge economy as "an economy based on knowledge and built on the production, distribution, and use of knowledge" in its report "Knowledge Based Economy". After the United States took the lead in knocking on the door of the knowledge economy, developed countries around the world are rushing to enter the era of the knowledge economy. Some scholars predict that "humanity will fully enter the era of knowledge economy in the second half of the 21st century". The extension of "knowledge" here has been expanded, not only referring to traditional scientific knowledge. The OECD has redefined "knowledge" and believes it includes four types of

knowledge, namely "factual knowledge", "principle knowledge", "skill knowledge", and "human knowledge".

The knowledge economy is a new and vibrant economic form that has emerged in the era of computer information. Its essential feature is that knowledge is the most important factor of production, and technological innovation is the main driving force for economic growth. It will have a profound impact on the production and lifestyle of all humanity. For enterprises, their competitive methods, working methods, and production methods have undergone profound changes. The competition between enterprises mainly lies in the level of knowledge productivity, that is, the efficiency of transforming new knowledge into new technologies, processes, and products. For workers, they will gradually enter a stage dominated by mental labor. The American management guru Du Lake coined the term "knowledge worker". The production process of the 21st century mainly relies on knowledge and mental labor, that is, using knowledge to create wealth.

### 1.2 The Impact of Knowledge Economy on Vocational and Technical Education

The essence of knowledge economy is based on the concept of "science and technology as the primary productive force"

However, science and technology can only be transformed into real productive forces when applied to production practice, and this transformation can only be achieved by relying on the carrier of knowledge and technology-talent.

Scholars have visually classified talent types into "one" type, "one" type, "X" type, and "T" type based on their knowledge structure and basic qualities. "One" represents a broad range of knowledge and a horizontal expansion of personnel's basic abilities and qualities, as well as a horizontal expansion of talent's general abilities to enhance students' employment adaptability. Expanding one's abilities not only provides a foundation for deepening job abilities, but also provides necessary abilities for post employment job migration. '1' represents the depth of knowledge and the vertical deepening of professional abilities, with a special emphasis on professional practical abilities, aimed at strengthening the targeted employment. The "X" type refers to talents who systematically master two types of professional knowledge, with obvious intersections

and combinations between these professional knowledge. And it is believed that with the intensification of competition and the increasing demand for enterprise transformation and innovation, a broad foundation and high skills T-type composite talents will be widely welcomed.

Vocational and technical education has always been aimed at cultivating "I" type professionals, emphasizing the precise and profound professional abilities of a specific position. This means that in order to adapt to the changes in the knowledge economy era, the type of talents cultivated in vocational and technical education needs to shift from "I" type to "T" type. The change in training objectives will lead to a series of changes in training modes and other aspects. That is to say, the impact of the knowledge economy on vocational education mainly revolves around cultivating the labor or human capital required for the development of the knowledge economy, running through the training objectives, training systems, operating mechanisms, and training models.

The integration of science and technology and the complexity of work situations require vocational and technical education to aim at cultivating practitioners with comprehensive professional abilities.

The knowledge and ability structure of "T" type talents is reflected in vocational education and can be expressed as "comprehensive vocational ability". Comprehensive professional competence consists of job professional competence and core competence. In the era of knowledge economy, more emphasis is placed on the cultivation of core competencies among vocational school students. These core skills include basic literacy, information technology skills, communication and cooperation skills, problem-solving skills, independence and sense of responsibility, as well as lifelong learning abilities.

Planck, the founder of quantum theory, said, "Science is an internal unity that is broken down into separate departments, not due to the essence of things, but due to the limitations of people's cognitive abilities. With the progress of science and technology, the trend of differentiation as the main focus has gradually been replaced by the trend of integration as the main focus. The integration of science and technology has greatly improved the technological integration of production processes and new products, and has also put forward higher requirements for the professional abilities of applied talents. The trend of economic globalization has led to increasingly frequent international business and cooperation. In order for vocational and technical talents to complete their work in different languages and social environments, they must strengthen their core skills.

The lifelong learning requires the construction of a three-dimensional vocational and technical talent training system that connects the internal levels of vertical vocational education and horizontal communication with general vocational education.

The era of knowledge economy is an era of rapid technological development and explosive expansion of knowledge and information. With the rapid expansion of the total amount of knowledge and the rapid acceleration of knowledge updates, some experts estimate that the knowledge learned by a college student during their school years will be eliminated within about 5 years. In China, according to a survey conducted by the Talent Exchange Center of Beijing University of Aeronautics and Astronautics on the graduates of the 58th, 59th, and 60th year of our university, 70% of them currently do not work in their original positions. These

situations indicate that the long-awaited "lifelong career" of people in the past has become a thing of the past, and the era of one-time school "charging" and lifelong work "discharging" is gone forever. The shortening of the knowledge aging cycle and the accelerating frequency of career turnover have made vocational and technical education no longer the "terminal" education that promotes employment. A person with just one education can no longer meet the long-term needs of rapidly changing science and technology, and people must continue to learn for a lifetime. Vocational education institutions of all levels and types are places for people to learn for life. The vocational education overpass not only makes it possible for vocational school students to further their education, but also provides a practical foundation for in-service personnel to update their professional technical knowledge and learn new skills.

The update cycle of new technologies, new processes, and new equipment is constantly shortening. In order to maintain the market-oriented and contemporary nature of vocational and technical education, it is necessary to handle the relationships between the government, schools, enterprises, and other aspects well, and establish a good operational mechanism for vocational education that is subject to government macroeconomic regulation, moderate market regulation, and school autonomy.

Mr. Huang Yanpei, the father of vocational and technical education in China, has long proposed that "vocational education cannot be achieved solely by the education industry". This is even more true in the era of knowledge economy. How to change this situation? On the one hand, the government should always place vocational and technical education in an important strategic position, attach great importance to and strengthen management. Macroscopically manage the professional settings, enrollment numbers, training methods, assessment and evaluation of vocational colleges through financial allocation, policy guidance, supervision and management. On the other hand, schools should develop and utilize the resources and wealth of enterprises. Enterprises, especially leading enterprises, have always been leaders in advanced production technology and possess enormous technological wealth. Only through close cooperation and collaborative work among the government, schools, and enterprises can the vocational and technical education system operate efficiently.

In the era of knowledge economy, it is even more necessary for enterprises to participate in the comprehensive implementation of vocational education talent training models.

Vocational education is a vocational oriented education that trains talents directly facing the market, with distinct characteristics of professionalism, practicality, and sociality. The unified point of vocational education and employment orientation should be on the enterprise platform. Schools are more focused on providing basic services, and the current needs and long-term talent planning of enterprises are the foundation of education. Undoubtedly, the participation of enterprises and the medium to long-term planning of their talent needs should be more integrated into school education. The successful experiences of vocational education in Germany, Austria, and other countries have shown that the participation of enterprises can bring the latest industry trends and talent needs to vocational education. The timely transmission of information can greatly reduce the lag and disconnection of talent cultivation.

In today's era, the development and updating of information technology are constantly changing. However, how to obtain

valuable information and transform it into one's own knowledge is a personal demand, and it is also a new requirement for vocational education in the era of knowledge economy. For vocational education, the more valuable information comes not from top research groups or theoretical innovations in a certain field, but rather from the development needs of enterprises. The combination of vocational education and enterprises, as well as the model of combining industry and education, is an inherent requirement for vocational and technical education to run schools with distinctive characteristics. It is a relatively ideal mode of running schools that reflects the direction of vocational education.

## 2 Vocational and Technical Education in Singapore and Its Characteristics in the Era of Knowledge Economy

According to official statistics from the Singapore government, in 2010, almost zero of the Gross Domestic Product came from agriculture, 27.2% came from industry, and the remaining 72.8% came from the information and service industries. From the perspective of industrial structure, Singapore is a typical knowledge-based economy country. The developed vocational and technical education system in Singapore has provided a large number of high-quality applied talents for the dual engines of economic development in the national manufacturing and service industries.

### 2.1 Singapore has built a vocational and technical education overpass led by the government with the participation of schools and enterprises

One of Singapore's basic national policies is to vigorously develop education and gradually develop Singapore into a global education center. The Singapore government is continuously increasing its investment in education, and in the government budget, education expenditure ranks second only to defense expenditure. The vocational and technical education system has also established close connections and cooperation with the industry to maintain the market relevance and flexibility of vocational and technical education. After more than 40 years of reform and development, Singapore has established an orderly, complete, and standardized vocational education system that connects from lower to higher levels, with a "overpass style" of communication from top to bottom.

As shown in Figure 1, the vocational and technical education institutions in Singapore are mainly the College of Arts and Crafts Education and the Polytechnic Institute. The Institute of Technology Education is equivalent to a secondary vocational education institution in China, while the Institute of Science and Technology is equivalent to a higher vocational and technical education institution. The blue arrow in the figure indicates the hierarchical connection of vocational and technical education. When high school students in Singapore graduate, they are required to take the Cambridge General Level Examination (O-LEVEL) in the UK. Those with excellent grades enter junior colleges, and after two years, they take the A-LEVEL exam. Those with excellent grades are admitted to three public universities in Singapore. The other part enters the Institute of Technology for further education. Those who fail can choose to enroll in the certificate program at the Institute of Technology Education. Outstanding students from the School of Technology Education can be transferred to the College of Science and Technology, while students from the College of Science and

Technology can enter universities and study degree or diploma courses in their respective majors in the second or third year based on their academic and course achievements. Social in-service personnel can apply to enter the College of Technology Education or the College of Science and Technology for learning and training to update or improve their knowledge and skills structure, as indicated by the green arrow for vocational and technical training. The government encourages adults to participate in training, reduces tuition fees, and provides subsidies.

### 2.2 Comprehensive implementation of school enterprise cooperation in vocational and technical education

Singapore's vocational and technical education follows the German dual system model. As early as the establishment of the country, the domestic vocational education community had already reached a consensus: to maintain the industrial relevance and flexibility of vocational technology, it is necessary to closely cooperate with the industry and establish close partnerships. Specifically, there are two ways in the implementation process: "inviting in" and "going out".

'Please come in' means bringing personnel, equipment, and other elements from the industry into the campus. Vocational colleges in Singapore not only invite industry professionals to join the management board to provide advice for the development of the school, but also establish an advisory committee composed of practitioners from relevant industry fields. They invest valuable work in new curriculum development, curriculum development, program review, and other matters related to professional training. The college also signs memorandums of understanding with enterprises, cooperates with technical partners to establish professional centers and laboratories, and cooperates in project research and development. These methods and platforms help college teachers update their knowledge and keep pace with the technological development of the industry; Enable students to acquire the latest knowledge and skill training, in line with constantly changing economic needs. Today, this strong culture of collaboration with industry partners continues to be an integral part of the industrial training and education system.

'Please come in' also includes 'moving' the corporate environment into vocational colleges. At present, Singapore's Faculty of Arts and Technology and Polytechnic adopt a "teaching factory" talent cultivation model. The concept of a teaching factory is to introduce a practical corporate environment into the teaching environment, with schools as the main focus, and to establish a combination of the corporate environment and the teaching environment. In a teaching environment with advanced technology, complete equipment, and realistic environment, the organic combination of theoretical teaching and practical teaching is conducive to cultivating students' practical work ability and improving their comprehensive quality.

Going global" refers to vocational college students and teachers coming out of campus to study and work in the real corporate environment. Providing enterprise internship programs for students is an indispensable part of vocational college students' curriculum learning. With the strong support of multinational corporations and small and medium-sized enterprises, vocational college students can gain practical work experience during internships. The internship process of students is supervised and managed to ensure that the internship is meaningful and helpful. In order to

cultivate students' global mindset, more emphasis has been placed in recent years on creating more opportunities for students to intern in foreign companies and institutions. Through these programs, students work outside Singapore, learn about the cultures of other countries, understand diverse business and industrial practices, and also experience different economic and social conditions.

The combination of "please come in" and "go out" has comprehensively implemented school-enterprise cooperation, greatly shortening the adaptation process of students from school to their positions, and achieving "zero distance" employment.

### 2.3 Emphasize the cultivation of professional core competencies

Career core competencies refer to the basic abilities that people possess in their careers, in addition to their professional abilities. It is suitable for various professions, able to adapt to constantly changing positions, and is a lifelong sustainable development ability that accompanies people. In Singapore, vocational and technical education not only imparts professional knowledge and skills to students, but also cultivates their core competencies. They believe that in the era of economic globalization, language and communication skills, planning skills, teamwork skills, information collection and processing skills can help practitioners better adapt to the environment and cope with changes; The sense of responsibility for the development of the country, society, enterprises, and communities enables practitioners to approach their job positions with a serious attitude and make contributions.

Taking the School of Arts and Crafts Education as an example, its educational philosophy is "hands-on, brain-driven, and attentive". The purpose of "brain learning" is to cultivate students who think independently and have flexible minds, so that they can cope with changing environments. "Diligent learning" refers to cultivating complete individuals who love their work, are confident, and care for the community and society. Reflected in the curriculum, the Institute of Industrial Education has 15% of life skills courses. The life skills course module ensures that students acquire communication skills, teamwork skills, problem-solving skills, career development skills, planning skills, customer service awareness, and lifelong learning abilities while learning professional skills.

The cultivation of soft skills is also permeated in the teaching of professional courses. The professional courses of vocational and technical education in Singapore mostly adopt the PEPP teaching model, which means that students, under the guidance of teachers, plan how to complete a given task, collect the necessary information, practice, and ultimately execute. Through this teaching method, students have mastered three important abilities in the process of completing tasks: technical ability, methodological knowledge, and social ability.

### 3.4 Professional courses are combined with local economic restructuring and economic development strategies

Roughly in line with the local needs of economic and social development, and according to the local economic and social development.

The cultivation of vocational and technical education talents is mainly achieved through courses. Singapore vocational colleges have always been committed to maintaining close contact with the industries they serve by flexibly and quickly responding to the challenges posed by constantly changing economic conditions. This rapid change not only requires higher levels of professional

skills and theoretical knowledge, but also requires a comprehensive interdisciplinary knowledge and skills. So vocational colleges regularly launch new courses, constantly reviewing and updating existing courses to keep up with (usually ahead of) changes in industry and business. Since its establishment in 1992, Nanyang Institute of Technology has launched many new courses to meet industry needs. In the early 1990s, the types of courses offered were to meet the urgent needs of health, business, mechanical engineering, and information technology. In the late 1990s, as the integration of different technologies became more common, the college launched more blended courses, business informatics courses, and information and communication technology courses. The digital media design course launched in 1996 was offered in advance. At the beginning of 2000, more courses were offered in fields such as biotechnology, biopharmaceutical engineering, and digital entertainment.

## 3 Enlightenment

The core and fundamental driving force of the knowledge economy is knowledge, which is an information resource. The production and use of any knowledge and information depend on various levels of talent. The cultivation of talents relies on education, and from this perspective, it can also be said that "the competition in the 21st century is the competition in education". And vocational and technical education, which undertakes the cultivation of applied talents and the popularization of higher education, has a heavy and long way to go.

The rapid economic development of developed countries such as Germany, Australia, Canada, and others all benefit from the developed vocational and technical education system. Although Singapore is only a tropical island country with limited resources, its economy has undergone tremendous changes in the past 30 years, which is closely related to the government's high emphasis on vocational and technical education.

Singapore's vocational education adopts a "localized" dual system model. Due to inherent limitations such as natural resources and land area, Singapore's industrial structure is incomplete, and enterprises are unable to independently undertake practical courses for vocational and technical education students. Students' vocational and technical theoretical courses and practical courses are mostly completed within the school. The government has increased investment in vocational education and established modern "teaching factories" within vocational colleges, moving "enterprises" into "campuses", balancing theoretical and practical teaching, enabling students to master certain professional basic knowledge while also strengthening practical skills. In the era of knowledge economy, this vocational and technical education system, which is managed by the government as a whole, closely cooperates with enterprises, and emphasizes the cultivation of universal abilities, has higher effectiveness. It can provide more suitable talents for the national economic development, and is also conducive to the personal long-term development and lifelong learning of students.

China is currently in a transitional stage of industrial upgrading and economic transformation, with extremely uneven regional development. Coastal areas and some large cities have begun to take shape in finance, IT, and commercial services, and are entering the era of knowledge economy. Therefore, studying and learning about vocational and technical education in Singapore's knowledge

economy era is of positive significance for the development of vocational and technical education in China.

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