The Design of the Higher Education in the Vocational Education System in Taiwan

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Abstract: The education system in Taiwan starts with six years elementary school and follows with three years junior high school. They are mandatory. Due to the need of the low skilled manpower for the labor intense primitive economy of Taiwan in the early 50s, seventy percent of the junior high school graduates were screened, via the examination of their academic performance, and sent into the vocational education system. It was three years training in the vocational high school for skilled operators or five years training in the junior technical college for technicians. Graduates of the vocational education system had no chance at all in the higher education. But they had significant contribution in the Taiwan economy of today. The system lasted forty years without major modification until the late 80s since the evolution of Taiwan's economy. Now there is four years bachelor program for the vocational high school graduates and two years bachelor program for the junior technical college graduates. For the university in the vocational education system, there is a unified name, university of science and technology. The purpose is to differentiate it from the universities designed for the high school graduates. Advanced graduate studies at university of science and technology are available to all students with bachelor degree.

The expansion of the higher education in the vocational education system is speeding up at the present time. There are still confusions in the training objective of the higher education for those students from the vocational education system. Based on the research result, this paper will try to clarify those confusions from the viewpoint of the supply of qualified human resources to the industry of Taiwan today. The differences between the vocational high school and the ordinary high school graduates will be discussed. To show the realization of the training objective, example in the design of the academic program, for the four years bachelor program only, will be demonstrated.

Keywords： higher education, vocational education, and vocational high school

1. Introduction

The education system in Taiwan starts with six years elementary school and follows with three years junior high school. They are mandatory. Due to the need of the low skilled manpower for the labor intense primitive economy of Taiwan in the early 50s, seventy percent of the junior high school graduates were screened, via the examination of their academic performance, and sent into the vocational education system. It was three years training in the vocational high school for skilled operators or five years training in the junior technical college for technicians. Graduates of the vocational education system had no chance at all in the higher education. But they had significant contribution in the Taiwan economy of today. The system lasted forty years without major modification until the late 80s since the evolution of Taiwan' s economy.

The cost of labor and land in Taiwan is no longer proper for the labor-intensive industries since the late 70s. Most of the labor-intensive industries were forced out of Taiwan. High tech industries are the supplements of those labor-intensive industries. Information technology and automation industries are two typical examples of them. Service industry is another example of the newly developed industry in Taiwan. The transition of the industry means the transition of the demand of the job market. The demand of the low skilled manpower is reduced dramatically. High skilled human resources are the new demand of the labor force. The adaptability of the labor force to the variation of the job market is the key factor of a successful transition. Advanced education is the only way to keep the work force flexible. It comes the need of higher education for the vocational high school graduates. The change of policy in the expansion of higher education also eases an extremely high competition between students for higher education opportunities in Taiwan.

Now there are four years bachelor programs for the vocational high school graduates and two years bachelor programs for the junior technical college graduates. For universities in the vocational education system, there is a unified name, university of science and technology. The purpose is to differentiate it from the universities designed for the high school graduates. Advanced graduate studies at university of science and technology are available to all students with bachelor degree.

The expansion of the higher education in the vocational education system is speeding up at the present time. There are still arguments in the training objective of the higher education for students from the vocational education system. Based on the training in the technical operation skills in vocational high school, advanced technical skills are the training objective for the higher education of vocational education system. This is one of the thinking of the training objective. To strength the fundamental capabilities is another one of thinking of the training objective. The fundamental capabilities include logic thinking, self-learning, verbalism, and writing, etc. They are the same with the training objective of universities for high school graduates. To distinguish the higher education of the vocational education system from the ordinary higher education is the theme of these arguments. They are still on

going topics. Confusions are still there and conclusions are not reached yet.

Based on the research result, this paper will try to clarify those confusions from the viewpoint of the supply of qualified human resources to the industry of Taiwan today. The differences between the vocational high school and the ordinary high school graduates will be discussed. To show the realization of the training objective, example in the design of the academic program, for a four-year bachelor program only, will be demonstrated.

2. The differences between vocational high school and high school curriculums

The curriculum designed for the training of mechanical technician in the level of vocational high school and the pre-engineering curriculum designed for the high school students are used to show the differences in the education between two school systems. The vocational high school graduates are weaker in the logic thinking, inference, verbalism, and writing. But they are more capable in the hands-on works. It's a character in common in the vocational high school graduates. The difference in the students' common character of two school systems may result from the curriculum differences shown in table 1. For vocational high school graduates, the credit hours accomplished are one third less in Chinese, half less in English, one third less in Mathematics, two third less in Natural Science than the one accomplished by their high school counterpart. We believe it is mainly the training that leads to the weakness of their fundamental capabilities. As to the other half of the total credit hours, they are designed to build up the expertise of a mechanical technician. One quarter among the total credit hours is set to the hands-on training; the other quarter is for the basic knowledge in mechanical engineering. There are almost no credit hours designed for the high school graduates in such a specialized knowledge. This is the reason why the vocational high school graduates perform better in the hands-on works and in the knowledge of a very specific area, e.g. mechanical engineering.

3. High adaptable labor force for a transition economy

Due to the high cost of labor and land, the labor-intensive industries were forced to move out of Taiwan. Hi-tech and service industries are the supplements of those labor-intensive industries. They form the backbone of the economy of Taiwan today. Low-skilled manpower discharged from the labor-intensive industries finds them hard to fit in the hi-tech and service jobs. The incapability to adapt the variation of the environment causes the hardship of the low-skilled labor force. A flexible work force is certainly the key factor to keep a transition economy in growing. Education is the only way to improve the flexibility. For the time being, two third of the work force is supplied through the vocational education system. In order to meet the demand of a more adaptable work force, it is thus very nature and necessary to overhaul the vocational education system.

We believe a person with self-learning capability is more capable to adapt the changes of the environment. Logic thinking, inference, and broad fundamental knowledge are key factors to form the self-learning capability. The training in mathematics and sciences gives the capability in logic thinking and inference. A broad fundamental knowledge comes from the even learning in various knowledge fields. But the traditional training model is more

focused in the manipulation capability for the vocational education. It is not proper to the build up of the self-learning capability and, of cause, the adaptable work force. The education should be more equally weighted in the training of hands-on skills and the training of mind.

4. The training objective of the higher education in the vocational education system

There is argument in the objective of the higher education of the vocational education system. To advance the hands-on skills of the students is the opinion of one side. To strength the fundamental capabilities of the students is the other side of the opinion. We believe the objective of the higher education should be focused more on the enhancement of the strength of the fundamental capabilities. They are mainly the self–learning, logic thinking, inference, verbalism, and writing capabilities. Here are the reasons that support the belief.

From the viewpoint of the supply of an adaptable work force, the students should be educated more comprehensively in various knowledge fields. To build a broad knowledge foundation is the purpose of a more comprehensive education. From the viewpoint of the capability of an engineer, he/she is asked to deal with the daily engineering problems. The engineering systems are usually products of comprehensive technologies. A broad knowledge background is necessary for engineer to perform a good job. From the viewpoint of industry, they are hiring engineers for their engineering problems. They don't distinguish their engineers from the education system they are coming. The performance asked is no difference for all engineers. There is only one position track but two for engineers. All of these are leading to the conclusion that the students shouldn't be educated, in the level of engineer, in a very specific area. The education should be focus more in the enhancement of the strength of the fundamental capabilities.

5. Example in the curriculum design

Based on the above discussion, the vocational higher education should focus more on the enhancement of the strength of the fundamental capabilities of students. It's educational objective is no difference from the objective of ordinary higher education. Due to the fact that National Yunlin University of Science and Technology (NYUST) is one of the first three universities that started the higher education history of the vocational education system in Taiwan. We use the ME curriculum of NYUST as an example to demo the principle of the curriculum design for vocational higher education. To educate the ME graduates of the NYUST reaches the same quality level as the ME graduates of the ordinary higher education system is the goal of our curriculum design. In order to show the quality level of the graduates of the ordinary higher education system, the ME curriculum of National Taiwan University (NTU) is used to show the quality level attempted in the education. NTU is one of the leading universities of the ordinary higher education system in Taiwan. There are differences between those two curriculums even the training objectives are the same. The differences are due to different backgrounds between the vocational high school graduates and the ordinary high school graduates.

Two curriculums, for mandatory courses only, are listed in table 2. It's for the purpose of comparison between educational objectives of two ME departments. As you can see, there are no significant differences between two curriculums. The differences are listed in below.

For the learning of physics, the learning is focus on the electromagnetism at NYUST. It's a class of two semesters. The course is usually an equal-weighted class in mechanics and electromagnetism, one semester for each topic in the ordinary higher education. The difference is due to the fact that vocational high school graduates with mechanical background receive less training in electromagnetism and more training in mechanics. To enhance the weakness of their knowledge in electrical engineering is the attempt of this modification. We also believe the training in mechanics will be more than adequate in their undergraduate study. It's thus tolerable to pay less attention in mechanics when learning physics.

Under the similar reason, i.e. to enhance the weakness, the learning of Chemistry and its lab is also set to two semesters. It will lead to a more complete knowledge background for students at the ME department of NYUST. The vocational high school graduates don't receive enough basic training in chemistry as the ordinary high school graduates.

As to the NTU students, they have one-year training in both engineering graphics and shop floor skills. There are no such courses designed for NYUST students. This is because that engineering graphics and shop floor skills are the central part of their vocational high school education. Under a similar reason, NYUST students don't have the manufacturing engineering class. The course does not designed for the NYUST students since they already have it in the vocational high school.

As to the conclusion, the curriculum design is based on a very simple principle. A complete curriculum, which will establish a broad knowledge background of the students, is the theme of the curriculum design. The broad knowledge background will lead to the self-learning capability, which is the ultimate goal of our education. A typical ME curriculum suggested, for mandatory courses only, by the Administration of Education for ordinary higher education is used as a draft in the design of NYUST curriculum. The draft has been proven to be an effective education program for the self-learning capability and will be fine-tuned to fit the need of vocational higher education. The ME curriculum of NTU is a distinctive example in the establishment of self-learning capability, proved via the performance of NTU graduates. The fine tune is based on the background of the students in vocational higher education; they have more hands-on training and less academic training in the vocational high school level. In order to enhance their weakness, the ME curriculum of NYUST is more focus on the academic training. We waive the hands-on training where they have the advantage over the high school graduates and focus on the establishment of their broad knowledge background where they are weaker than the high school graduates. But we still try to reserve their advantage in hands-on skills through a one-year-long senior project. It's a

mandatory class and is a comprehensive training in both academic and hands-on works.

6. Conclusion and discussion

Based on the background of students, we custom design the curriculum. To establish a complete knowledge background and the self-learning capability is the training objective. The curriculum of ME department of NTU is chosen as a quality level of our education at NYUST. The custom design of the curriculum is based on two guidelines. Reduce the reiterate training where the students have the competitive advantage. Hands-on skills are the example. But the advantage of hands-on capability should be preserved in the education. Strengthen the weakness of students is the other guideline of the curriculum design. To enhance the learning in areas of electrical engineering, chemistry, mathematics, verbalism, etc. are the examples.

The training idea has been carried out for ten years. The outcome is very promising. One third of the graduates continue their graduate study at the public universities in Taiwan. It's also very common for students employed by hi-tech companies. All of these show the truth that our graduates are competitive in the job market and the educational strategy is on the right track. But we also experience the hardship of the improvement of low academic achievement during the education process. The low achievement comes from the insufficient academic background for the higher education. The hardship is overcome by the extra teaching effort. The topics we are teaching should be expressed as clear as possible. Teaching should be started from the very beginning whenever it is necessary. A step-by-step teaching model is necessary for a good learning. Fortunately, the situation will get improved year by year. The overhaul of the curriculum of vocational high school is an on going process. There will be more academic training for students with the intention of receiving higher education. This will lead to a more efficient vocational higher education and to a higher learning achievement.

7. References

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Table 1. Differences between vocational high school and high school curriculums

Vocational high school		**High school**	
Chinese:	20 credit hrs	Chinese:	32 credit hrs
English:	16 credit hrs	English:	32 credit hrs
Mathematics:	20 credit hrs	Mathematics:	30 credit hrs
Natural science:	12 credit hrs	Natural science:	36 credit hrs
Professional training:	96 credit hrs	Professional training:	0 credit hrs
Total			
graduating credits	194 credit hrs		178 credit hrs

Table 2. Differences between ME curriculums (mandatory courses only) of NYUST and NTU

NYUST	**NTU**
Frshman	
Calculus: 2 semesters	Calculus: 2 semesters
Physics: Electromagnetism, 2 semesters	Physics: Mechanics and Electromagnetism, 1 semester each
Physics Lab: 2 semesters	Phisics Lab: 2 semesters
Chemestry: 2 semesters	
Chemestry Lab: 2 semesters	
Statics: 1 semester	Applied mechanics I: 1 semester
Dynamics: 1 semester	Applied mechanics II: 1 semester
NC Lab: 1 semester	
Introduction to ME: 1 semester	
Introduction to computer science: 1 semester	
	Engineering graphics: 2 semesters
	Shop floor skills: 2 semesters
Sophomore	
Engineering mathematics: 2 semesters	Engineering Mathematics: 2 semesters
Thermodynamics: 2 semeters	Thermodynamics: 2 semeters
Mechanics of materials: 1 semester	Mechanics of materials: 1 semester
Engineering materials: 1 semesters	Mechanical materials: 1 semesters
Mechanism: 1 semester	Mechanism I : 1 semester
Introduction to electrical engineering: 1 semester	
Introduction to electronics: 1 semester	
Circuits (lab): 1 semester	
	Mechanical manufacturing: 1 semester
Junior	
Fluid mechanics: 1 semester	Fluid mechanics I : 1 semester
Mechanical design: 1 semester	Mechanical design I : 1 semester
	Mechanical design II : 1 semester
Automatic control: 1 semester	Automatic control I : 1 semester
Materials (lab): 1 semester	Mechanical engineering lab I: 1 semester
Thermal enggineering lab: 1 semester	Mechanical engineering lab II: 1 semester
Senior project I: 1 semester	
	Heat transfer: 1 semester
Senior	
Senior project II: 1 semester	Mechanical engineering lab III: 1 semester