Development and Teaching Approaches of Technical and Vocational Education Curricula

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Abstract - We are living in the era of knowledge-based economy. Faced with changes in industrial structure and society, diversification of social values, emergence of multi-strategy learning approaches, shifts in learning approaches, and social appreciation for rapidity and values, students can no longer rely solely on what they have learned from schools. Therefore, how to develop students’ ability in “learning how to learn” and “re-learning” and bring up their life-long learning abilities has become an important issue in vocational education. This paper explores into the curriculum development and teaching approaches for technical and vocational education. It is suggested that, in the era of knowledge-based economy, an ideal curriculum for technical and vocational education should have the following features and supportive measures: (1) flexible curriculum structures, (2) attractive teaching materials, (3) diversified teaching approaches, (4) competency-based assessment mechanisms, and (5) easy access to advanced teacher training programs. There should also be correspondent teaching approaches in place that stress (1) flexibility, (2) adaptability, and (3) competency. This paper proposes that teachers should use problem-based learning as one of their teaching strategies to develop students’ creativity and various abilities to meet the needs of businesses, society and individual career development.

Index Terms - technical and vocational education, curriculum development, teaching approaches, problem-based learning.

INTRODUCTION

In the 21st century, the development of Internet has helped humans go beyond the limitations of national boundaries, time and geography. In the era of knowledge-based economy, where knowledge is transmitted in a rapid pace, those who have the knowledge are the winners [7]. Morris Chang [2] once said, “In a knowledge-based economy, the competition is fierce. Technology, innovation, adventurous spirits and initiative have become key factors to success. And we need to develop talents through education and culture-related aspects.” It is evident that education is the cradle of talented people and human resources; it is also the cornerstone of civilization.

Ovid Tzemg [8] also emphasized that we need to replace the traditional teaching mode of “I teach; you listen” with an approach that develops students’ own abilities to collect, select, filter and assimilate information; that inspires students’ creativity by developing their life-long abilities; and that teaches students how to learn efficiently and actively. The emphasis should be place on learning methods instead of knowledge accumulation. And we need to help students turn their knowledge into innovative ability and knowledge application ability, both of which are much needed in profit creation.

As said, in the fierce competition of a knowledge-based economy, technology, innovation, adventurous spirits and initiative are much valued. In such a world where rapidity and creativity are emphasized, students must know how to use knowledge to create higher added value and hence can no longer rely solely on school education. How to develop their self-learning and re-learning abilities are important issues that need to be taken into considerations when developing curricula and pedagogy for vocational education.

INNOVATION IN CURRICULUM DEVELOPMENT AND PEDAGOGY FOR VOCATIONAL EDUCATION

I. Technical Manpower in the Era of a Knowledge-based Economy

In the era of a knowledge-based economy, it is important to appreciate the features of such an era and the development of knowledge-based technical manpower before how industrial structures need to be transformed can be considered. Scholars have proposed in-depth insights in this regard. Kirby Yang [16] mentioned, the future goal is to develop knowledge-based technical manpower, including:

- Technicians that possess creative, innovative and management abilities.
- Manpower that has initiative, creative and executive abilities, and ability to work independently as well as in a team.
- Resourceful talents that meet the needs of technology development and have adaptive and integrative abilities.

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II. Changes in Society and Social Values

Jin Wu [14] once said a knowledge-based economy places high importance to innovation while innovation comes from cultural attainment. Cultural attainment is achieved in a rich cultural environment, in which education is the most important element. To achieve cultural attainment, multi-value education concepts need to be established through adaptive development and self-exploration. Therefore, in a changing society, concepts of reason, ethics, values and free will need to be stressed in talent development in order to help individuals fully play their potential and develop their own values, knowledge, human relationship, behaviour and attitudes. Furthermore, abilities in self-expression, communication, integration, analysis, apprehension and criticism also need to be developed as well as the ability to create, use and disseminate knowledge.

Changes in social environment have diversified our social values. People are not satisfied with a fair living anymore. They ask for a decent life. Curriculum development must take various needs and approaches into consideration. Teaching content needs to be revised and changed constantly to meet the needs of the time. In a word, industries develop at an amazing speed and only constant innovation can fulfill the anticipation of the society.

III. Changes in and Diversification of Learning Approach

In the report titled “Learning the Treasure Within” by UNESCO, it is stressed that people must adapt themselves to the changes of the society through life-long learning. And there are four basic learning guidelines for life-long learning: learning to know, learning to do, learning to live together, and learning to be [8]. Life-long learning places high importance to learning skills, which are the keys to successful learning. In other words, learning skills are more important than what one learns. [17]

- Learn how to learn: Learners need to know what effective learning is and practice good learning methods.
- Learn how to think: Learners need to learn how to use thinking strategies. Thinking training is helpful in having a good grip on thinking strategies.

Therefore, in a knowledge-based economy, we need innovative curriculum development and teaching approaches and must develop students’ abilities in the following aspects through curriculum design and assessment:

- developing students’ ability to learn how to re-learn.
- developing students’ ability to use, disseminate, apply and innovate their knowledge.
- developing students’ ability to adapt and respond to changes, and to integrate various information.

In response to the needs of businesses, the concept that education has multi-values needs to be established in addition to learning skills and diverse abilities. Learners need to achieve their goals through adaptive growth and self-exploration.

HOW TO INNOVATE CURRICULUM DEVELOPMENT FOR VOCATIONAL EDUCATION

We are living in a knowledge-based economy and what we have learned is not sufficient to cope with the fast advancement of the society. Vocational education needs to look ahead and find out what students will need in the future and innovate curricula accordingly. There are two major points that need to be borne in mind.

I. Curriculum Development and a Holistic Teaching Approach

There are five aspects that we need to consider when designing and adopting curricula and teaching approaches:

- Flexible curriculum structures: replacing elective courses with programs and playing their full potential role.
- Vivid teaching materials: developing students’ abilities in using, disseminating, applying and innovating knowledge.
- Diversified teaching approaches: adopting appropriate teaching approaches according to program content in order to cultivate abilities that meet demands of businesses in a knowledge-based economy.
- Competency-based assessment mechanisms: designing assessment bases and checkup sheets according to students’ adaptive development and abilities. Administrative staff also need to appreciate this.
- Easy access to advanced teacher training programs: Pedagogy, teaching plan, media application, knowledge application and innovation need to change along with the advent of knowledge-based economy, so teachers need to be provided easy access to teacher training programs and are encouraged to use them.

II. Vocational Curriculum Design in a Knowledge-based Economy

Vocational curricula can be designed based on two tracks: the academic and vocational tracks [3,9]:

- Academic track

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Figure 1 shows the design concept of curricula for academic track. In addition to re-learning and innovative abilities, it emphasizes the development of technological and cultural attainment, acquisition of knowledge, development of holistic person.

1. Starting from the outmost elements, include the use of theme-based learning, problem-based learning and resource-oriented learning and visiting activities, this curriculum design aims at developing students’ abilities to express themselves, establish human relationship, acquire expertise and new knowledge, innovate knowledge, learn foreign languages, have good communication ability and develop leadership.

2. With this curriculum design, students can develop abilities in three major areas: (1) knowledge – improving ability to acquire, exchange, assimilate, apply and innovate knowledge; (2) competence – helping students develop basic daily skills and core abilities needed by businesses; (3) attitude – helping students develop basic values and basic abilities needed by businesses worldwide.

3. Academic curricula aim at helping students achieve technical and cultural attainment in order to become an informed holistic person.

**FIGURE 1**
DESIGN CONCEPT OF TECHNOLOGICAL AND VOCATIONAL CURRICULA IN A KNOWLEDGE-BASED ECONOMY

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**Vocational track**

Figure 2 shows the concept used to design curricula for vocational track. The whole concept is career-oriented. It stresses the development of professional competence (core competence, work competence, individual competence, management competence) that graduates will need when they enter the job market. More importantly, it emphasizes the development of competence that businesses require.

1. This curricular design starts from the introduction of learning theories and stresses the importance of re-learning ability and the application of various teaching methods. It aims at helping vocational track students strengthen their ability in self-expression and human relationship. It also stresses the acquisition of expertise, knowledge, foreign language and abilities in communication, innovation, and problem solving.

2. With this curricular design, students can learn four basic types of competence in their senior year: (1) core competence - basic professional knowledge, (2) work competence - basic values, abilities and skills required by businesses worldwide, (3) individual competence - career development plan, and knowledge of up-to-date information about industrial trends, (4) management competence - basic management concepts about how to deal with people and business in a company. It will be an advantage if students also possess abilities in resources management and information management.

3. This curriculum design aims at improving vocational track students’ technical and career abilities, as well as ability in knowledge acquisition, competence performance and initiative attitude required in the era of a knowledge-based economy, so as to develop vocational talents possessing...
technical competence and meeting the requirements of businesses.

FIGURE 2
DESIGN CONCEPT OF TECHNOLOGICAL AND VOCATIONAL CURRICULA IN A KNOWLEDGE-BASED ECONOMY

HOW TO INNOVATE TEACHING FOR VOCATIONAL EDUCATION

When discussing in an National Science Council research program about the abilities that businesses would need in the future, Dr. Rau et al. [10] said, besides expertise, there are four required abilities: teamwork ability, communication ability, expression ability, and innovation ability. Therefore, how to development these abilities required by businesses and how to innovate our teaching are two important issues that vocational education faces today. There are two major aspects that require our attention:

I. Various teaching methods

Vocational education stresses the importance of developing abilities that businesses need and helping students acquire them through learning. So, vocational teaching should lay emphasis on flexibility and inspiration, adaptivity, and future needs of businesses. There are three guidelines to follow.

- Inspire students’ creativity through flexible teaching. Creation is the fruit of creative thinking and critical thinking. Creative thinking and critical thinking are complementary to each other. Teachers can help inspire students’ creativity through flexible teaching methods and by giving students room and time to think for themselves.

- Adaptive teaching and adaptive development. Every student has interest in different things and they have different aptitude and abilities. Teaching should be about inspiring students’ different potentials and encouraging them to develop according to their own aptitude and to learn with their classmates.

- Competence-based teaching to develop abilities that meet business needs. In the era of knowledge-based economy, the half-life of knowledge has been shortening annually, leading to a fierce competition among businesses. Businesses must have innovation ability and recruit team members of different talents in order to succeed in the business world. Team members need to conduct efficient brain-storming and play their full potential for their business. Therefore, teachers must consider and help students to develop abilities that businesses will need in the future.

II. Teaching strategies that meet the future needs of businesses

Based on the above three guidelines, this research found problem-based learning, which has been implemented and has gotten good efficacy in Finland and Singapore, a very efficient learning method. Problem-based learning means that teachers use practical problems as core themes in class and encourage students to conduct group discussion in order to develop student’s ability in active learning, critical thinking and
Biggs [1] believes problem-based learning can help students to conduct innovative thinking. The reason lies in that, when a problem is presented, students conduct self-learning first and then group discussion. At last, they will discuss with the teacher and share their ideas with students in other groups. [6] There are two aspects that need to be placed under consideration: concepts used to design and compile teaching materials, and design concepts of teaching activities. [11]

- **Concepts used to design and compile teaching materials**

Problem-based learning has two major features: active learning and problem-finding in the process of brainstorming. For problem-based learning to be conducted successfully, the conversation and situations designed in teaching materials and teaching plans need to be able to arouse students’ learning motivation and interest in learning. In other words, the design of teaching materials needs to be able to improve students’ active learning. The steps for designing such teaching materials are described as follows.

1. **Select a good theme or unit name that is suitable for problem-based learning**: Suitable themes or unit names are problems that are pertinent to daily experience and frequently seen in daily life. They must be attractive, urgent, dangerous and task-oriented.

2. **Select act names based on the theme (unit names)**: It is better that there are 3-5 acts of situations in each theme (unit) according to the range and demands of each theme. Besides, the width and depth (difficulty) are increased act by act.

Take a 3-act theme as an example: The first act emphasizes core knowledge – speak out, write down and draw a conceptual diagram. The second act attaches importance to comprehension and application of the theme - that is, proposing problem-solving methods and steps and then solving the problems directly. The third act increases and advances students’ knowledge - that is, proposing a development project and make a practical plan. The design of such a 3-act theme is described in Figure 3.

- **Design concept of teaching activities**

1. **Select weak-structure problems**: Select problems that are closely related to and frequently encountered in daily life or work. They must be attractive, urgent, dangerous and task-oriented. It is better to use weak-structure problems, which refer to problems that can inspire diffusive thinking and generate more than 10 items in the brainstorming activity.

2. **Conduct diffusive thinking and set up learning goals**: Students of different aptitudes are dispatched to groups and use brainstorming and diffusive thinking to think out weak-structure problems. They need to write down the information they think of on the blackboard and then conduct induction and set up learning goals.

3. **Collect materials, conduct extensive self-learning and induction**: Students collect materials and conduct extensive self-learning. Then they make induction and bring up results at discussions.

4. **Conduct group discussion and induction, and share results**: After setting up learning goals and induce conclusions, students need to discuss and share what they’ve found in group discussions.
CONCLUSION

The half-life of knowledge is getting shorter, and the innovation speed is extremely fast. How to develop students’ ability in “learning how to learn” and “re-learning” and how to bring up their life-long learning abilities have become important issues that deserve our attention. This paper has discussed how vocational education can cope with the advent of knowledge-based economy from two aspects: curriculum development and teaching. First, it proposes two sets of concepts for academic track and vocational track respectively. The curriculum concepts for academic track aim at helping students pursue higher education and holistic education that focuses on the acquisition of knowledge and development of character. The curriculum concepts for vocational track are career-oriented. They aim at developing expertise that meets the needs of industry so that graduates can get jobs more easily. The two sets of curricula cannot succeed without multi-strategy teaching approaches and supportive measures. This paper also proposes two concepts of curriculum design based on problem-based learning: concepts used to design and compile teaching materials, and design concepts of teaching activities. They aim at inspiring students to develop various abilities. In the era of knowledge-based economy, we need curricula and multi-strategy teaching approaches that are meticulously designed and meet the demands of businesses, society, and career development. Only by so doing can we really evoke students’ innovation ability and develop talents that businesses need.

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