

# Models of the Innovative Education of Industry- University-Research Symbiosis

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**Abstract**—To optimize the model of cooperative education of industry-university-research, to better cultivate creative talent and to realize people's all-round development, this paper defines the model of innovative education of industry-university-research symbiosis, analyzes and sorts out its current problems and proposes its corresponding countermeasures. This paper holds that the model can construct systematically the symbiotic relationship of industry, university and research, fully develop and utilize the symbiotic resources and cultivate comprehensively the creative talent. Its core is to optimize the way of thinking for the complementation of logic & intuition, to improve the knowledge structure for the integration of liberal arts & science, to strengthen the practical ability for the unity of cognition & practice, and then to realize the synergetic development of their trinity. As an important way of the development of modern higher education, it represents a new idea, a new direction and a new model of modern innovative education. So to speak, the similar research achievements are still rare so far.

**Keywords**—industry-university-research; symbiosis; trinity; innovative education; model

## I. INTRODUCTION

In today's increasingly globalized world, the education of industry-university-research (IUR) cooperation becomes the fundamental mode and major way of the development of contemporary higher education, which is paid more and more attention from all walks of life. In fact, the education of IUR cooperation is an important educational model to meet the need of adapting to society and personal development and to improve people's comprehensive quality. It embodies a major idea of the reform of contemporary higher education. The fundamental tasks of colleges and universities are "to cultivate the advanced specialized talent with innovative spirit and practical ability" stipulated in Higher Education Law of the People's Republic of China. The cultivation of innovative spirit and practical ability is difficult to realize only by classroom teaching but by considerable social practice and the education of IUR cooperation. The IUR cooperation has an obvious and unique advantage to achieve the objectives of colleges and universities and to cultivate the talent with innovative spirits and practical abilities. Multi-win cooperation and synergetic innovation becomes a major feature of the development of contemporary economy, society, culture and education. Human

being is entering the era of "symbiosis" [1]. However, the previous researches often remain on the surface of IUR cooperation and do not penetrate into its deep-seated problems, let alone explore its symbiotic relationship. In fact, the IUR cooperation gradually develops towards their unity and forms the IUR symbiosis, and correspondingly the education of IUR cooperation evolves into that of IUR symbiosis. It is in this process that the model of innovative education of IUR symbiosis emerges as the times require [2].

## II. DEFINITIONS OF RELEVANT CONCEPTS

The IUR cooperation at first is the cooperation of education among universities, enterprises and research institutions, especially the cooperation and symbiosis of the innovative education. The innovative education of IUR symbiosis and its model have their profound definitions.

### A. Education of IUR Cooperation

Generally speaking, the education of IUR cooperation has both broad and narrow senses in our country. The broad sense refers to the various cooperative educations among universities, enterprises and research institutions, and the education here includes the three tasks or functions of teaching, research, social service etc.; while the narrow sense refers to the cooperative education of talent cultivation among universities, enterprises and research institutions, and the education here refers only to teaching activities. The education of IUR cooperation in the narrow sense is mainly the model to cultivate suitable talent for enterprises, research institutions and society by fully utilizing the different educational resources and educational environment of universities, enterprises and research institutions [3]. The cooperative education is used as the narrow sense in this paper.

In fact, from the perspective of generation, dissemination and application of knowledge, the IUR cooperation reflects in the different effects or functions of cognition & practice of knowledge. Specifically speaking, universities make students cognize and reconstruct the acquired knowledge by teaching; while research institutions explore and obtain the new knowledge and new research achievements by practice & experiment, and enterprises apply the acquired knowledge and research achievements to production & practice.

### *B. Innovative Education of IUR Symbiosis and its Model*

The cooperation among universities, enterprises and research institutions is at low level and their relationship is short and loose in the initial stage of education of IUR cooperation. With the continuous development of education of IUR cooperation, the IUR cooperation gradually develops towards their unity and forms the relationship of IUR symbiosis. The IUR symbiosis refers to the relationship of mutual benefit, multi-win cooperation and synergetic development among industry, university and research [4]. It includes two aspects: one is the symbiosis of organization, i.e. universities, enterprises and research institutions are tightly bound together so as to share benefits, to coexist life & death and to forms the symbiotic unity; and the other is that of function, i.e. their functions are closely linked together in talent cultivation, research achievement transformation, product & service innovation etc. so as to create and obtain comprehensive economic and social benefits.

The innovative education should be constructed on the basis of IUR symbiosis. It is in the process of generation, dissemination and application of knowledge that the model of innovative education of IUR symbiosis comes into being with a new look.

We hold that the model of innovative education of IUR symbiosis refers to the model of talent cultivation in modern higher education taking the systematic construction of the symbiotic relationship of industry, university and research as its premise, full development and utilization of the symbiotic resources of industry, university and research as its means and the comprehensive cultivation of creative talent as its purpose. As a fundamental mode and major way of innovative talent cultivation, it represents and embodies a new idea, a new direction and a new model of modern innovative education. Its core is to optimize the way of thinking for the complementation of logic & intuition, to improve the knowledge structure for the integration of liberal arts & science, to strengthen the practical ability for the unity of cognition & practice, and then to realize the synergetic development of their trinity.

By this model universities, enterprises and research institutions can achieve mutual benefit, multi-win cooperation and synergetic development, fully utilize their different educational environment and educational resources and their respective advantages of talent cultivation, adjust and optimize students' knowledge structure and way of thinking, improve and strengthen students' behavior pattern and practical ability, and then cultivate and promote comprehensively the students' innovative spirit, competitive ability and comprehensive quality. That's to say, the model of innovative education of IUR symbiosis is becoming the fundamental mode and major way of the reform and development of contemporary higher education, which represents and embodies a new idea, a new direction and a new model of modern innovative education.

### III. CURRENT PROBLEMS

Universities, enterprises and research institutions have conducted the cooperative education since the 1980s and 1990s. Various pilot projects of the model of education of IUR

cooperation have been launched, some achievements have been obtained and an amount of experience has been accumulated. But there are many problems in the education of IUR cooperation, esp. in the model of innovative education of IUR symbiosis, which is far from adapting to the current situation [5]. At present, several main problems in the model of innovative education of IUR symbiosis are as follows.

#### *A. Slowly Updated Ideas of Innovative Education*

People's understanding and ideas update relatively slow in innovative education, esp. in the innovative education of IUR symbiosis. The traditional ideas of elite education have affected widely for a long time in China. The education of IUR cooperation often adopts the model of elite education to cultivate the elite as its noble mission and few reap the benefit in such situation [6]. In recent years the higher education in our country has transformed from the elite into the mass. However, the traditional elite ideas are deep-rooted, severely hinder its progress and development, esp. innovative education, seriously affect the quantity and quality of creative talent cultivation, and restrict the effective implementation of innovative education strategies.

#### *B. Unsystematic Achievements of Innovative Education*

The relevant survey reveals that studies on the education of IUR cooperation, esp. the model of innovative education of IUR symbiosis, are not deep enough with only a few achievements and remain on the description of phenomena and the analysis of individual cases without its own theoretical system [7]. There are few interests for innovative education and even it exists some mistaken understanding that innovative education is just to make inventors of a few top learners. As a result, it inevitably lacks clear goals and requirements for universities to cultivate creative talent and cannot provide scientific and theoretical guidance for the innovative education of universities to develop healthily.

#### *C. Unreasonable Curriculum of Innovative Education*

At present, the structure of curriculum provision is unreasonable in the innovative education, esp. that of IUR symbiosis in China's universities. There are many serious drawbacks of narrow profession, detailed division and the separation of liberal arts & science. Science students are rarely trained in humanities, while liberal arts students are at a respectful distance from science. Decades of practice has proved that the education model of separating liberal arts & science cultivates a lot of students narrow in knowledge, tardy in thinking, poor in adaptability and weak in innovative spirit [8]. They cannot meet the demands of innovative education and creative talent cultivation, and does harm to people's comprehensive development.

#### *D. Inapposite Teaching Methods of Innovative Education*

The teaching methods are simple and inapposite in the innovative education of IUR symbiosis. Especially, the training methods of innovative thinking are unreasonable and lack effective measures. They pay little attention to the cultivation and training of students' intuition, imagination, emotion, will etc. so that logical thinking is kept separate from intuitive

thinking, intellectual factors from nonintellectual factors and then the complementation of thinking and the mutual incentive of psychology cannot be formed. In this way, it is difficult to cultivate creative talent so as to meet the demands of people's all-round development and to conform to the progress of economy and society.

#### *E. Imperfect Rules and Regulations of Innovative Education*

The construction of rules and regulations in the current personnel, labor and financial system is incomplete and imperfect for the innovative education esp. that of the IUR symbiosis. There is no systematic arrangement and a lack of effective teaching management and supervision in strengthening students' practical ability, teaching practice, combining theory with reality etc. Many bad phenomena, such as the poor executive ability, a mere formality of some rules & regulations, and dealing with the assessment, lead to the poor quality of innovative education. Therefore, the model of innovative education of IUR symbiosis cannot be truly conducted and implemented.

In a word, there exist many problems in the model of innovative education of IUR symbiosis. Particularly, the training in way of thinking, knowledge structure, practical ability etc. is far from meeting the expected demands and should be improved urgently by corresponding countermeasures.

### IV. CORRESPONDING COUNTERMEASURES

The following specific countermeasures are taken currently in order to solve the above problems and to truly conduct and implement the model of innovative education of IUR symbiosis.

#### *A. Optimizing the Way of Thinking*

It is a major means to optimize the students' way and methods of thinking so as to achieve the complementation of logical & intuitive thinking, intellectual & nonintellectual factors and left & right brain for the conduct and implementation of the model of innovative education of IUR symbiosis.

Especially, the priority is to optimize the students' methods of thinking, to adjust reasonably way of thinking and to cultivate their strong innovative spirit and good psychological quality, to train effectively their illogical thinking, to stimulate their motivation, interest, emotion, will, character and other nonintellectual factors, and to give play to the important functions of nonintellectual factors such as power, orientation, regulation and intensification for innovative education. Only in this way, can we cultivate and promote the students' innovative ability at their maximum.

#### *B. Improving the Knowledge Structure*

It is also the main means to adjust the curriculum system and knowledge structure so as to achieve the intersection and integration of liberal arts & sciences for the conduct and implementation of the model of innovative education of IUR symbiosis.

Therefore, universities at home should draw lessons from successful experience abroad, focus on the combination of the special & the general of knowledge in higher education, emphasize the intersection and interpenetration of liberal arts & sciences, hold lectures and exhibitions of science & technology and humanities, and increase the depth and breadth of knowledge. On curriculum provision, universities should attach importance to general courses and elective subjects. Students of liberal arts are offered necessary science courses; while students of science also learn humanities knowledge. In fact, since the 1960s, American universities have offered a wide range of courses in natural science and engineering technology for liberal arts students. Meanwhile, science students are under compulsion to select some courses in economics, history, sociology, law and philosophy etc. Students are required to study humanities for 20% of their total class time at physics departments of some universities across the United States [9]. Students are stipulated to obtain 24 credits of humanities and social sciences at Science & Technology Department at Tokyo University of Technology and Waseda University [10].

#### *C. Strengthening the Practical Ability*

It is also the major means to strengthen the practical ability of combining theory & practice so as to achieve the unity of cognition & practice for the conduct and implementation of the model of innovative education of IUR symbiosis. Therefore, it is urgent to establish and improve sound management system of innovative education of IUR symbiosis, to strengthen the practice of teaching, to increase the teaching funds and investment in practical education, to increase publicity, to advocate the education of IUR symbiosis, to promote the communication and coordination among universities, enterprises, research institutions and government and between internal departments of universities.

In short, it should be guided and guaranteed to conduct, implement and improve the model of innovative education of IUR symbiosis by the management system and institutional arrangement so as to improve the quality and scale of creative talent.

#### *D. Realizing the Synergetic Development of IUR Trinity*

The soul and key of the model of innovative education of IUR symbiosis is the organic integration of their trinity which optimizes the way of thinking to achieve the complementation of logic & intuition, adjusts the knowledge structure to achieve the integration of liberal arts & science and strengthens the practical ability to achieve the unity of cognition & practice, so as to realize their synergetic development.

It is a complex systematic engineering to explore and implement the trinity model of innovative education of IUR symbiosis. In fact, the function orientation, symbiotic subject and means of the trinity model are diversified for different types and levels of universities. The roles, main tasks, resource allocation, interacting means and methods etc. are also different in the diverse types and levels of the trinity model for each major and discipline. In that sense, the model of innovative education of IUR symbiosis is not fixed but diversified.

In a word, only the above series of effective countermeasures can be taken seriously, can we truly conduct, implement and improve the trinity model of innovative education of IUR symbiosis formed by the complementation of intuition & logic, the integration of liberal arts & science and the combination of theory & practice, so as to comprehensively enhance the quality and level of innovative education.

#### V. CONCLUSION

The model of innovative education of IUR symbiosis is a major way to cultivate and improve people's innovative spirit, competitive ability and comprehensive quality, and it is a strategic measure to achieve mutual integration, mutual benefit, multi-win and synergetic development among higher education, production practice and scientific research. There are many problems in the model but it is inevitable and imperative. As long as we continue to take a series of effective measures, we will better conduct innovative education and create a vast strength of talent of rich creativity for our country. In a word, the model of innovative education of IUR symbiosis represents and embodies a new idea, a new direction and a new model of modern innovative education. It is of great theoretical and practical significance to explore and implement the model of innovative education of IUR symbiosis for promoting the reform and development of higher education in China and realizing people's all-round and free development.

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