

The Way of Cultivating Innovative Computational Thinking Talents by New Engineering in Applied Universities

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Abstract: Constructing emerging engineering education is a direction of transformation and development for applied universities in the new era. Cultivating innovative entrepreneurship talents is the inevitable requirement of building an innovative country. There are some problems in training students by applying the traditional engineering education, such as poor Computational Thinking and low innovative ability. It is suggested that all-round reforms and innovations should be carried out by means of the construction of "golden course", the training of teachers as well as the integration of development and the collaboration of education in order to cultivate students' Innovative Computational Thinking.

1. Introduction

With the development of science and technology and the proposal of industry 4.0, the emergence of new terms and technologies such as Internet of Things, Cloud Computing, Big Data, Artificial Intelligence, Virtual Reality and Biotechnology have brought about profound changes in education, especially in the field of engineering, where a number of new engineering majors have emerged, which are changed the way of life and thinking for individuals. As the future builders and successors of our country, college students should not only master the ability to analyze and solve complex problems with computer science knowledge, that is, computational thinking, but also innovate the methods and skills to analyze and solve complex problems, namely innovation ability. Therefore, the computer curriculum teaching of Higher Education in the new engineering should not only teach students to use computers, but also consider how to cultivate their computational thinking and innovation ability.

Computational Thinking was first proposed by Professor Jeannette M.Wing, director of computer science department of Carnegie Mellon University in March 2006 in the journal Communications of the ACM. Jeannette M.Wing defines it as a series of thinking activities that cover the breadth of computer science, such as problem solving, systematic design, and human behavior understanding by using the basic concepts of computer science. ^[1] It is an important way to cultivate students' Computational Thinking by introducing computational thinking into the teaching process of the computer curriculum in the new engineering and guiding them to analyze, think, explore and solve problems. Innovation ability is the ability to continuously provide new ideas, new theories, new methods and new inventions with economic, social and ecological values in the field of technology and various practical activities. ^[2, 3] The combination of Higher Education of in the new engineering and innovative entrepreneurship education can effectively promote the development of innovative computing thinking of college students.

2. The Teaching Status of New Engineering Courses

It is generally believed that the new engineering courses offered in Colleges and universities mainly refer to computer courses, including such specialized courses as "Fundamentals of C#.Net

Programming", "HTML Web Page Design", "Delphi Programming", "Asp.net Development Technology", "SQL Server Database", "3Ds Max Design", etc.. The knowledge points of these courses are various and fragmentary, especially in the experimental training projects; the content of teaching materials are lack of innovation, the experimental training projects are not classic, and there is lack of interdisciplinary and interdisciplinary comprehensive application cases to cultivate students' Innovative Computing thinking ability. Secondly, many teachers have not mastered advanced teaching methods and teaching methods, and can not flexibly control quite a few methods to carry out teaching in the classroom, especially young teachers. The majority of them enter to the teaching platform after graduation from the university, and they are lack of the experience of enterprise training and practice. Therefore, the practical teaching ability is generally low. In addition, due to the lack of allocation of school hours, and the uneven foundation of students, it is difficult for teachers to present the model by using comprehensive case analysis to solve practical problems. Teaching is still led by teacher, teaching method, thus, students' Computational Thinking is difficult to be trained and cultivated that lead to their poor innovative ability. In comparison with the development of new engineering proposed by the Ministry of education in the new era, there is still a big gap in training a new generation of innovative talents with solid majors and excellent skills. As the explorers and leaders of education reform and development, teachers in institutions of higher learning need to study and discuss how to set up a new concept of undergraduate education, enrich the new theory of higher education and clarify the new ways of undergraduate education according to the latest requirements of the ministry of education.

Based on the rapid development of the industrial revolution and the training purpose of higher education, the society needs more talents with computational thinking and innovation ability. Various universities in the building of the new engineering, therefore, should have advance knowledge consciousness, new requirements for coping with teaching development, actively explore new teaching approaches. Teachers should actively learn the new generation of information technology and strive to explore a new way of deep integration of information technology and innovation and entrepreneurship education. In the teaching reform and innovation in the process of entrepreneurship education, active introduction of computational thinking, autonomous, individuality, collaborative, driven and various teaching methods or Flipped Classroom, the classroom teaching modes such as auxiliary teaching, with "golden course" standard accomplish the teaching task, cultivating high-quality talents in the field of computational thinking innovation.

3. The Approaches to Cultivate Creative Computing Thinking Talents

The new engineering department mainly trains high-quality skilled compound talents with prominent practical skills, active innovative thinking and broad international perspective,^[4-7] so that they can meet the needs of future emerging industries and social development. As a training base for new engineering talents, universities should boldly reform and innovate teaching methods and actively explore teaching models based on computational thinking. Teachers should optimize, adjust and restructure course content, and use the charm of computer science to cultivate agile thinking and innovative computing thinking talents with clear, logical and rigorous logic. In order to cultivate such talents, this paper carries out all-round reform and innovation in the ways of building "golden course" (good course), training teachers (good teachers), integrating development (good training process), cooperating Education (good practice platform).

3.1 The Construction of "Golden Course" And Promotion of "Quality Revolution" in New Engineering Courses^[8]

To cultivate innovative computing thinking talents, we need to ensure that students can receive high-level and high-quality "golden course" education. Golden course refers to the sum of all types of courses with high-level, innovative and challenge online, offline, online and offline hybrid, virtual simulation and social practice.^[9] Teachers must eliminate low-level, obsolete, and careless "water lessons" when carrying out "golden course" education.^[10] The construction of "golden course" requires teachers to have deep cultural sedimentation, superb practical skills and rich

teaching experience, and to have a deep understanding of the nature of learning, and recognize that learning is the process of connecting internal experience with external information.^[11] Secondly, students are required to be able to concentrate, study seriously, take the initiative to learn, be willing to use their brains, be able to think, take the initiative to adapt to new teaching methods, cultivate an innovative spirit, and develop the ability to use computational thinking to solve comprehensive problems. Thirdly, teachers need to master advanced modern educational technology capabilities and develop new teaching resources with good teaching platforms and software. Only in this way can we effectively build a "golden course", advance the "quality revolution" in new engineering courses, and teach any student any knowledge.

The construction of "golden course" requires the following five points: To promote the "classroom revolution"^[12] with the help of multiple teaching methods, actively carry out exploration and exploration of new engineering teaching reforms, improve the quality of classroom teaching, and create offline "golden course". Second, to promote the "Internet + Education", with Internet of things, cloud computing and other technologies, build national online boutique open courses, to create online "gold class." Then, to develop new teaching modes such as flipped classrooms and split classrooms based on SPOC, increase the number of projects and funding, build high-quality courses, and create online and offline hybrid "golden course". What's more, to promote "intelligence + education", use artificial intelligence and virtual technology to build a national virtual simulation experiment teaching project, and create a virtual simulation "golden course". Last but not least, the "Internet +" university student innovation and entrepreneurship competition was held, and new engineering education was incorporated into it to create a "golden course" for social practice.

As a university, it should combine and follow the documents of the Ministry of Education to create favorable conditions for teachers to build "golden course", encourage teachers to actively participate in the construction of "golden course" and guarantee the construction of "double ten thousand plan"^[13] for first-class courses by formulating policies and systems, improving organizational structures, implementing training mechanisms, updating evaluation standards, and increasing investment, etc.. All in all, through the construction of "golden course", promote the "quality revolution" of new engineering, and ensure that students can receive high-level and high-quality "golden course" education. Through the construction of "golden course", teachers constantly accumulate knowledge, summarize experience and innovate methods, and then use them to guide students' learning and cultivate students' innovative spirit and computational thinking.

3.2 Cultivating Teachers and Building a First-Class "Double-Qualified" Team

To cultivate innovative computing thinking talents, it is necessary to establish a first-class "double teacher" team. In the process of teaching, teachers should take actual work as an example, and focus on guiding students to think, explore, analyze and solve problems, and cultivate their computational thinking. However, at present, there are some problems in universities, such as inflexible employment mechanisms, single channels of introduction, irrational teacher team echelon, unscientific management assessment and evaluation, and insufficient teachers for innovation and entrepreneurship. Moreover, young teachers lack practical skills, weak awareness of innovation and entrepreneurship education, and innovative entrepreneurship education capabilities and practical experience, which led to the teaching according to the book, the dull classroom, let alone cultivate students' Innovative Computing thinking. Therefore, colleges and universities should pour attention into the cultivation of teachers, strengthen the practical ability of teachers, and build a first-class "double-qualified" team in the construction of new engineering projects and the cultivation of innovative computing thinking talents. Specifically, the following three aspects should be done well.

Firstly, to revise the policy system. Standardize the employment standards from the source, improve the cultivation mechanism and the incentive mechanism, and formulate evaluation standards; it is ensured that the imported teachers have a wealth of theoretical knowledge, high practical skills, and outstanding innovation and entrepreneurial ability; the remaining teachers have

room for development and ensure that they have opportunities participate in the training of innovation and entrepreneurship, or go to the enterprise to participate in the follow-up practice during the holidays, or regularly visit well-known universities at home and abroad to further their studies, continuously expand the knowledge of teachers, and improve and update their knowledge system.

Secondly, to implement the training plan. Colleges and universities should hire experts, professors with rich practical experience, or entrepreneurs and engineers with entrepreneurial experience and ability to conduct lectures or training at the school, guide teachers to actively participate in and guide the work of university students' innovation and entrepreneurship competitions, stimulate the enthusiasm of teachers' professional development, and improve their innovative ability and comprehensive quality. In addition, with the help of experienced senior teachers to guide and help young teachers to carry out teaching method reform attempts, guide young teachers to carry out "curriculum ideological and political education", and improve their own teaching level and scientific research ability in the process of "moral education".

Thirdly, to strengthen school-enterprise cooperation. By adopting the methods of "bringing in" and "sending out", the school teachers and enterprise engineers can exchange training, communicate with each other, learn together, make progress together, and achieve complementary advantages. On the one hand, it will train the teachers' practical experience and the ability to innovate and start the business, and improve the innovative computing thinking for problem solving. On the other hand, it will improve the teaching level of enterprise engineers and lay the foundation for training innovative computing thinking talents.

In short, to create a first-class "dual-faculty" team in various ways, and use the wisdom of outstanding teachers and engineers to jointly train innovative engineering thinking talents in new engineering disciplines.

3.3 Integrating Development, Promoting the Deep Integration of Innovation and Entrepreneurship Education and New Engineering Education^[14]

Cultivating innovative computing thinking talents has strict requirements for the construction of new engineering disciplines. We must not only keep pace with the times, timely revise talent training programs, appropriately increase the number of practical hours, exercise the practical skills of college students using computational thinking to solve practical problems, but also innovation and entrepreneurship Education and talent training are integrated, highlighting the professional attributes of innovation and entrepreneurship. Specifically, we must do the following three aspects.

First, to revise the personnel training program and build a reasonable curriculum system. Based on the demand of new industries for applied, skilled and innovative talents, it is particularly important for colleges and universities to cultivate students' innovative computing thinking to solve problems. It is necessary for universities and enterprises to jointly formulate targeted practical training programs, eliminate outdated courses in a timely manner, appropriately increase common tools, software, technology and innovation and entrepreneurship case analysis courses, and improve the teaching hours of innovative and challenging comprehensive and design practical courses, so as to make the curriculum system more reasonable and meet the needs of enterprises for talents.

Second, the construction of diversified practice is to meet the practical teaching requirements. All kinds of professional practice teaching and training innovative undertaking and need the practice base. Base construction is divided into inside and outside the school; the campus includes virtual simulation experiment teaching base, AI training intelligent base, innovation and the entrepreneurship laboratory (park, space) and entrepreneurship incubation base, etc. Off-campus activities include various internship and practice bases as well as online project factories of cooperative enterprises. These bases have created favorable conditions for the integration of innovation and entrepreneurship with new engineering, and cultivated students' innovative computing thinking.

Third, it is to do a good job in "Internet +" contest of college students' innovative undertaking, to carry out the "golden course" education. This competition is open to colleges and universities all

over the country. It covers a wide area and has great influence. It provides a display of self, blooming youth of the stage of life. It can ignite the entrepreneurial enthusiasm of college students, and cultivate their will quality and physical and mental quality of daring to break into will break into, love to fight will win. It is a kind of "golden course" education of innovation and entrepreneurship with passion and warmth. College teachers should encourage college students to take an active part and guide them to integrate their professional knowledge into the innovation and entrepreneurship competition, so as to bring out personal splendor and glory.

3.4 Cooperate in Educating People and Jointly Building A School-Enterprise Cooperation Platform for Innovation and Entrepreneurship

To cultivate talents with innovative computing thinking, it is necessary for both the university and the enterprise to fulfill their respective roles, cooperate with each other and jointly educate them, jointly build the innovation and entrepreneurship practice platform, and explore the education mode of "full participation and deep integration". Specific to do the following four aspects.

First, we will improve the school-enterprise cooperation system. In order to ensure the normal construction of school-enterprise cooperation platform for innovation and entrepreneurship, it is necessary to improve the school-enterprise cooperation system and clarify the responsibilities, rights and obligations of universities and enterprises in the training of innovation and entrepreneurship talents. Colleges and universities are responsible for the supervision and management of students' learning and teachers' teaching. Enterprises should build feasible school-enterprise cooperation platform for innovation and entrepreneurship and manage daily business according to the requirements of colleges and universities.

Second, the process of training innovative talents. Schools and enterprises should increase the time and space for cooperation, and enhance the breadth and depth of cooperation. Enterprises, in particular, should take the initiative to participate in the whole process of talent training. Schools and enterprises jointly discuss the curriculum reform, optimize the curriculum system, formulate scientific and feasible talent training plans and undertake practical teaching tasks, hold discipline competitions and guide students to participate in project research, deeply integrate the latest knowledge and technology with innovation and entrepreneurship education, and cultivate students' innovation ability and computational thinking.

Third, to integrate education resources of school and enterprise. Colleges and universities should set up their majors in connection with industrial development, devote themselves to serving regional economic and social development, especially to carry out practical teaching, and introduce enterprise resources appropriately. Arrange the practice teaching in the practice base of enterprise as far as possible, and guide students to learn with the help of enterprise engineers. Universities and enterprises should further deepen cooperation, strengthen technical exchanges and interactive learning, realize resource co-construction and sharing and exchange of advantages; the two sides jointly build an education platform of "production, learning, research and application" to jointly cultivate high-quality and innovative talents.

The fourth is to improve the evaluation of personnel training. Between both parties to participate in the evaluation system of personnel training, by increasing the evaluation subject, refining the evaluation indicators, increase the evaluation difficulty, improve the evaluation score of enterprise, outstanding innovation practice ability evaluation, and use a variety of evaluation methods, to ensure the rationality of the evaluation of training personnel, improve the esteemed and credibility of evaluation results. The new engineering department pays special attention to the cultivation of students' comprehensive quality.

To sum up, the new era of cultivating application-oriented university new engineering calculation thinking innovation talented person, should carry out various forms of "golden course" education, build first-class "double division type" team, innovation entrepreneurship education and development of new engineering education depth fusion, build the innovation such as entrepreneurial university-enterprise cooperation platform for bold reform and innovation. At the same time, colleges and universities should actively explore the mode of education that is in line

with school conditions and has professional characteristics, promote high-level application-oriented undergraduate education, and provide more talents with innovative computing thinking for regional economic development.

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