

Study on Research Experience for Undergraduates in Collaborative Innovation Center

—According to the analysis of American's ERC Program and REU Program

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Abstract—"2011 collaborative innovation center" aims to promote innovation ability of talent, discipline and scientific research, but now the collaborative innovation centers focus on scientific research and the development of the subject, ignoring personnel training, particularly despised training of the group of undergraduates. Based on this, this paper analyse similar structure and goals of ERC, and learn from successful experience of the ERC program (Engineering Research Center Program) and REU programs (Undergraduate Research for Undergraduates Program), in order to help undergraduates in China to participate in Collaborative Innovation Centers.

Keywords-Collaborative Innovation Center; participation of undergraduates; ERC and REU Program; Advicet

I. INTRODUCTION

In order to implement the General Secretary Hu Jintao in Tsinghua University Centennial Celebration: the important speech, the Ministry of education, Ministry of Finance in 2011 March 23, jointly issued the "on the implementation of higher education innovation ability promotion plan of opinions" (hereinafter referred to as the "2011 plan"), decided to establish a number of "2011 Collaborative Innovation Center" [1]. "2011 Collaborative Innovation Center" to enhance the innovative ability of the talents, disciplines, scientific research into the core task, so the task is to shoulder the task of personnel training. This year is the fourth year of implementation of the plan in 2011, has established the first National Collaborative Innovation Center 14, the second batch of national collaborative innovation center 24, but the collaborative innovation center widespread heavy scientific research, talent training, especially not to undergraduates [2], the potential innovation group enough [3]. The Engineering Research Center (ERC) on the objectives and structure are collaborative innovation center has a many similarities and in the undergraduate participation in research program (reu) implementation force undergraduates successfully enter the Engineering Research Center for scientific research. Based on this. Based on the analysis of the undergraduate to participate in collaborative the feasibility and significance of the

innovation center, introduced the ERC program and REU program in undergraduate in the successful experience of the scientific research, in order to our collaborative innovation center of Undergraduates in revelation.

II. THE IMPLEMENTATION OF REU PROGRAM ENABLES UNDERGRADUATES TO PARTICIPATE IN RESEARCH OF ERC

A. ERC program has a similar goal and structure with China's collaborative innovation center

ERC is short for Engineering Research Center. ERC is one of programs which are run by the National Science Foundation. ERC program was established in 1985, the initial goals of ERC are to connect universities, enterprise, government, and break down barriers between academia and business, link up American's engineering industry and engineering higher education. Advanced the competitiveness of American Engineering Industry and improve the quality of American engineering higher education.

After entering the 21st century, the United States's government gradually realized that in the era of economic globalization and and global competition, products rely solely on their quality and performance is not enough to win in the competition of globalization, how to make the industry get more innovation support is particularly important. Therefore, since 2008, the United States National Science Foundation was committed to build a new generation of Engineering Research Center, establish a synergy mechanism of connecting laboratories, companies and researchers (including students), and to cultivate global leadership talents for United States [4]. According to the new targets and mission, the new generation of USA Engineering Research Center and our collaborative center has the following similarities. ①Not only focus on scientific discovery, but also pay more attention to the innovation of science and technology, including the transformation innovation, original theoretical innovation, application innovation; ②Building a innovation ecosystem, not only devoted to science innovation but also improving the

education quality, including the task of training; ③ Established a diverse research team, including researchers, teachers, undergraduate students, graduate students, visiting scholars, all committed to the development of the central scientific theme; ④ Stress the joint relationship between innovation and economy, promote employment and entrepreneurship, development innovation economic ^[5]. In order to achieve the new target for Engineering Research Center, the ERC's structure is arranged on and our collaborative innovation center has many similar places with ERC's structure: ① Organizational structure is lead by one university ,but also involving several other universities. The leading university should cooperate with other universities which have complementary advantages on the research theme of each ERC to ensure and maintain the operation of the center; ② Involving government, enterprises, colleges and universities attract more participation, breaking the barriers between the innovation main body, make more efficient flow of innovative elements, promote more effective communication; ③ Both centers are multi-targets, not only to promote the original innovation and innovation of common technology, but also pay more attention to the cultivation of talent of all level, in order to improve the quality of higher education; ④ Both centers are the independent entity groups, each center is led by universities, and other entity organization participate in jointly. It is different from the virtual organization, which is also different from the brief cooperation of projects. The substantiality of centers performance in independent field, independent experimental apparatus, independent research personnel and independent management personnel, independent sources of funding, etc..

B. The implementation of the REU program enable undergraduates to participate in the research in ERC

independent entity groups, each center is led by universities, and other entity organization participate in jointly. It is different from the virtual organization, which is also different from the brief cooperation of projects. The substantialities of centers performance in independent field, independent experimental apparatus, independent research personnel and independent management personnel, independent sources of funding, etc.. REU program is short for Research Experience for Undergraduates. REU is a program for undergraduates to participate in scientific research. Applications of REU program are applicable in any field supported by NSF(National Science Foundation) , including new frontiers, cross field, engineering research center was one of the major fields.

REU is committed to expanding the scientific research experience for undergraduates, whether in discipline or cross discipline. Besides National Science Foundation, there are other subjects support the REU program, including the investment of individuals, groups, and other centers and other national facilities, etc.. REU with integration target of education and research aims to attract a large number of talented undergraduate to join in the fields of science and engineering. this project will

give undergraduates scientific and engineering research experience and educational experience. Make sure that students receive the best education. REU believes that help undergraduate students have scientific research experience is one of the most attractive ways to attract undergraduates to participate in scientific research and prepare for the future career. REU is committed to providing scientific research for undergraduates, and to provide a scientific and educational experience for undergraduates. Students can participate in a variety of interesting research projects, including an ongoing research project and especially tailored for undergraduate research projects, in which undergraduates have interaction with scientific research personnel, teacher guidance ^[6].

The REU project provides an opportunity for the country to tap outstanding research talents, while expanding the subject of participation in scientific research. In REU's recruiting program, REU encourages a minority, women and some of the veterans who served in the US Army. REU projects will generally be carried out in the summer, the semester, generally speaking, the total length of the project is not more than three years ^[7]. NSF (Science Foundation National) supported by the various projects, all engineering research center can be determined according to the specific circumstances, as appropriate. REU's official website will publish all the research projects to recruit undergraduate students, each scientific research projects are relatively independent, which includes the re engineering research center to carry out the project. Undergraduate students can also through various projects of the site, the site of the various engineering research center, according to the different requirements of each center, according to a certain process to apply for participation. If the application is successful, the undergraduates will receive grants and scholarships to support the next research.

III. THE REVELATIONS OF ERC PROGRAM AND REU PROGRAM TO THE UNDERGRADUATE STUDENTS PARTICIPATING IN COLLABORATIVE INNOVATION CENTER

A. The ministry of education, Universities and the collaborative innovation centers should think highly of the undergraduate students' participation in scientific research

In the current era of knowledge economy, talents have become the most precious resources, but our talent training mode is relatively backward, led to the lack of creative talent, especially the lack of top-notch creative personnel. Undergraduate this huge potential group has not been fully stimulate the potential, making this contradiction more serious. The Ministry of education should pay attention to collaborative innovation center this valuable platform, allows undergraduates to participate in collaborative innovation center of scientific research activities conducive to mining top-notch creative talents for the country and meet the goal of building an creative country in China, for China's social and economic long-term healthy development of reserve talent.

Colleges and universities has been shouldering the mission of cultivating talents, but in this materialistic era, many colleges and universities to teach students the basic mission did not give sufficient to pay of teaching, but pay extra attention of scientific research, and ignore the cultivation of students. In fact, scientific research and teaching are not contradictory to the two opposites. Humboldt in the 19th century Berlin University put forward the idea of unity of teaching and research, but universities should take the student as the main body to give students enough attention and the cultivation of. Collaborative innovation centers which under guidance of 2011 Plan have an important difference from the brief cooperation between universities and enterprise, that is, the main body of the collaborative innovation center the main body of colleges and universities. Based on this, colleges and universities should take the initiative to take active measures to make undergraduates participate in the scientific research in Collaborative Innovation Center, cultivate outstanding undergraduate talents, and improve the quality of Higher Education.

The core objective of the collaborative innovation center is to improve the innovation ability of talents, discipline and scientific research. Collaborative innovation center in carrying out scientific research and innovation oriented around the strategic needs of the country, the comprehensive and systematic study of the advanced science and technology, and included in the relevant disciplines, pay attention to talent cultivation and social service in the process. Each collaborative innovation center should realize that it is an effective platform for the cultivation of talents, and actively play the advantages of the center of collaborative innovation, and cultivate innovative talents. Undergraduate under the guidance of teachers and researchers, through participation in collaborative innovation center of scientific research project, the master of knowledge used in scientific research, also in scientific research, training of thinking and ability, after the latest scientific research output become the carrier of knowledge innovation, to improve the innovation capability.

B. Implement of the relevant policies for undergraduate students to participate in scientific research, reinforce mutually with Collaborative Innovation Center

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Through the REU program, some undergraduate students in United States has entered into the various engineering research centers. In support of the REU program, the undergraduates in the United States can find detailed information about the REU program in the official website of the REU, undergraduate students can accord to their conditions, apply to each sub project,

each center. Undergraduates can also be concerned with their own sense of interest in Engineering Research Center, in various engineering research center official website found by an REU program in support of the undergraduates to participate in the plan, according to the different requirements of applications to participate in the center of scientific research.

The development of China's 2011 plan has entered the fourth year, there are the 14 first batch of National Collaborative Innovation Center, the 24 second batch of national collaborative innovation center, and many the provincial and municipal level of collaborative innovation centers, university collaborative innovation centers. Collaborative Innovation Center's mission is the trinity of ascension in disciplines, scientific research and talent level of innovation, should give full play to the collaborative innovation center of the platform, make full use of the resources, cultivation of innovative talents in the undergraduate. And now our country is lack of commitment to help undergraduates participate in scientific research projects, so that the platform of Collaborative Innovation Center in undergraduate students' participation has not played the greatest potential.

China's relevant departments can refer to the practice of REU projects in the United States, according to the concrete national conditions and present situation of higher education in China, make some policies to help undergraduates to participate in Collaborative Innovation Center. Carry out relevant policies to encourage students to participate in scientific research and the related policy document issued, is committed to the establishment of the to help undergraduates to participate in research projects, and the collaborative innovation center cooperation, to maximize the collaborative innovation center in cultivating undergraduate's potential. The collaborative innovation should be according to the requirements of the relevant policies, combined with the collaborative innovation center of scientific expertise, teachers, project time, to accommodate undergraduate students such as the number of specific conditions, open recruitment to have the willingness to participate in the undergraduates. At the same time, according to the different types of collaborative innovation center research, difficulty, etc., to participate in the selection of undergraduate students, and finally through the undergraduate students can enter Collaborative Innovation Center for scientific research.

C. Each Collaborative Innovation Center Implement Relevant Policies Flexibly, According to the Specific Situation to Recruiting Undergraduate Students.

When recruit undergraduate students to participate in Engineering Research Center, under the guidance of REU program, each center according to their different conditions choose different time, place, number of students who will participate in. What is more, different requirements on the participation of undergraduates are made by different centers, give full play to the flexibility of various engineering research center.

In the Engineering Research Center for Extreme Ultraviolet Science and Technology, for example, under

the guidance of REU program, the center began to recruit undergraduate students to do scientific research with graduate students, researchers, instructors in the center since 2003. Today, the United States far from the center for scientific research (ERC EVU) in their official website released the latest undergraduate students to participate in the recruitment details. The far ultraviolet science and Engineering Research Center of 2015 REU projects from June 1, continued to August 7, in three locations on the site can choose: at the University of California, Berkeley, University of Colorado at Boulder was, and Colorado State University. Each site has a different research content, but the research results of each research station are helpful to the overall research and engineering objectives of the research center of the far ultraviolet ray science. Applicants can apply for any one of these three sites in accordance with their own circumstances. The applicant shall provide the following materials: 1 statements in the center of scientific research activities of the purpose of the document 2 from the teacher's recommendation letter 3 copies of official transcripts. Applicants must have the following qualifications: two 1 or three of the 2 students of the United States or permanent residents of ^[7] in 2.8 and above 3.GPA. This shows that the undergraduate place, time, research content, the requirements for undergraduate students are specified by the specific engineering research center.

American Engineering Research Center for undergraduate students to participate in the project, are supported and guided by the REU project, but the various engineering centers did not give up their independence and flexibility. Each undergraduate application to participate in scientific research projects are relatively independent, each engineering research center can be based on their own situation to recruit undergraduate students. The collaborative innovation center in theme, scale, geographical, etc. also have each different, can refer to the practice engineering center in the United States in this regard, even in the national unity undergraduates to participate in the under the guidance of the scientific research program, but also to give the Collaborative Innovation Center independence, to ensure that the collaborative innovation center in the undergraduate training to get the best play, while not interfering with the collaborative innovation center of scientific activity in normal operation.

D. Mobilize the Enthusiasm of the Students to Participate in And Attract Excellent Undergraduates

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Undergraduate students are the main body of scientific research activities, and scientific research activities are often difficult, and even boring and

tedious, may be a similar experiment hundreds of repeated. Based on this, to attract research willingness and enthusiasm of the undergraduates to participate in research activities is particularly important, only with the qualities of students in order to focus on the investment in scientific research activities, with love to overcome the difficulties of large and small. REU programs in the United States in the implementation process to pay attention to arouse students' enthusiasm, to participate in the research activities of the first step is to submit the application and not by the teacher named selection. Thus, the participation in scientific research initiative gives students. In screening of participants from the applicants, REU programs also make emphasis on the assessment of undergraduate students to participate the research enthusiasm of the move, the most typical is undergraduate in application of information to add a data to explain the purpose of their participation in the research. In undergraduate to apply for participation in the research project success, they will get a hefty grants and scholarships to ensure participation in scientific research projects during the spending ^[8], support enthusiasm and ability of students worry about engaged in scientific research, and attract good and scientific research ability of undergraduates to participate in an REU projects.

In China, due to the historical background and cultural differences, such as different undergraduates to participate in the enthusiasm of the educational activities is not high, which lack of cognition and confidence for their subject status is an important reason^[9]. Under such a cultural environment, if you want to enable undergraduates to participate in research projects to achieve good results, must to undergraduate students to fully mobilize the initiative and enthusiasm, let them a clear understanding of their importance, potential and dominant position. We can learn from the experiences of the reu projects in the United States, the first step undergraduate students submit their application, and the application materials can improve shows that undergraduates to participate in research wishes material proportion, such as self statement of purposes of participation in scientific research activities, letters of recommendation and other^[10]. After undergraduate success through screening into the scientific research project, relevant commitment to helping the undergraduates to participate in projects or collaborative innovation center should be allocated a sum of money as undergraduates to participate in Collaborative Innovation Center research grants and scholarships, from policy and material to give interested in reference and scientific research for undergraduates to encourage and support. Through a series of combination of boxing mobilize undergraduates to participate in Collaborative Innovation Center scientific research initiative and enthusiasm, attract enthusiasm and outstanding undergraduate students to participate, to cultivate innovative talents in the undergraduate.

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