

Design and Exploration of Scientific Research Education Focusing on Brain Science During Emerging Engineering Education

Cheng Luo¹ Ling Quan^{1,*} Wenyuan Li¹ Sisi Jiang¹ Dezhong Yao¹

¹ School of Life Science and Technology, University of Electronic Science and Technology of China, Chengdu, Sichuan 611731, China

*Corresponding author. Email: quanling@uestc.edu.cn

ABSTRACT

An effective way to cultivate innovative talents in the new era is to integrate high-level scientific research achievements into college classes. To give full play to the scientific and educational synergies of middle and high-level scientific research teams in universities is the key to deepen the construction of Emerging Engineering Education and a strong guarantee to implement the new project education plan of "Scientific Research and Education". Taking the "Pearls of the Crown of Brain Science" plan for the forefront of brain science and brain like intelligence research implemented under the framework of the "UESCT Program" for the construction of emerging engineering education of University of Electronic Science and Technology of China, this paper considers the new model of "scientific research and education" that high-level scientific research teams take systematically part in the first classroom from the perspective of emerging engineering education, with a view to consolidating the educational basis of Emerging Engineering Education in colleges and universities, and improving the quality of top innovative and high-quality personnel.

Keywords: *Scientific research and education, New engineering education, UESTC Program, Brain Science.*

1. INTRODUCTION

Since the fourth industrial revolution, a new round of scientific and technological revolution and industrial change is restructuring the global innovation system and economic structure, which provides development opportunities for the vigorous development of global engineering, and also puts forward higher requirements for the cultivation of engineering talents. In February 2016, with China formally joining the Washington Agreement for International Undergraduate Engineering Degree Mutual Recognition at the International Engineering Union Conference, China has entered the forefront of the reform of the international higher engineering education system, and formally put forward the concept of Emerging

Engineering Education to colleges and universities across the country. Then, after repeated research, discussion and demonstration, the Ministry of Education officially launched the "emerging engineering education" plan for higher engineering education reform in 2017, and successively formed the "Fudan consensus", "Tianjin University action" and "Beijing Guide", committed to exploring the Chinese model of higher engineering education that can adapt to the global scientific and technological revolution and industrial change. So far, the construction of "Emerging Engineering Education" has been carried out in an all-round way in China, including Fudan University, Tianjin University, Zhejiang University, University of Electronic Science and Technology of China (hereinafter "UESTC") and other research universities, in order to meet the needs of high-level and innovative engineering science and technology leaders in China's economic and social development. Efforts have been made to build Emerging Engineering

*Fund: This project is supported by the the CAMS Innovation Fund for Medical Sciences (CIFMS) (No. 2019-I2M-5-039); University of Electronic Science and Technology of China "New Project Education Program for Scientific Research and Education" (2020KY004).

Education specialty and establish Emerging Engineering Education talent training system. Looking at the trend of global higher engineering education reform, it can be found that the main goal of rebuilding engineering education system in the world is to cope with the changes brought by the new industrial revolution. Therefore, it is of great epochal significance and value to build an innovative "scientific research and education" talent training system with the main direction of international scientific and technological revolution and industrial transformation, guided by "facing the world's scientific and technological frontier, facing the main economic battlefield, facing the major national needs and people's life and health".

The work of "scientific research and education" in China has been put forward for a long time. Under the science and education combined with the collaborative parenthood action plan issued by the Ministry of education in August 2012, 10 specific action plans including "college student scientific research practice program, college student summer school program" were required. This marks that the work of "scientific research and education" has entered a period of opportunity for rapid development. Subsequently, the national level successively introduced several policy documents, which clearly required that scientific research results be introduced into classroom teaching content, that scientific research bases be opened to undergraduate students, and that scientific research nurturers initiatives such as undergraduate science and technology innovation programs and scientific research training programs be carried out. These measures are mainly focused outside the first classroom to implement scientific research content rich parenting efforts and enhance undergraduate students' scientific research thinking and scientific research levels through policy orientation, resource tilting, and student interests [1]. However, the existing "scientific research and education" mode with "the second classroom" as the main body has the problems of fragmentation, unsystematic, multiple influencing factors and unstable educational effect. Therefore, it is an important theoretical and practical problem that China must face and solve in its "emerging" engineering education reform that how to combine scientific research and teaching in depth so that they can serve innovative talents cultivation together.

This paper takes the Pearls of the Crown of Brain Science program, a new practice of engineering education reform carried out by UESTC in the field of life science, as the object to

explore a new model of scientific research education applied systematically by high-level scientific research teams in the first classroom when facing the major national strategic needs.

2. DEMAND AND CHARACTERISTICS OF "SCIENTIFIC RESEARCH AND EDUCATION" IN THE CONSTRUCTION OF EMERGING ENGINEERING EDUCATION

2.1 "Scientific Research and Education" Should Aim at the Major Strategic Needs of the Country

Hailed as the most grand research project after the Human Genome Project, the Brain Project has attracted significant resources from all countries around the world to conduct innovative research, and has driven the development and engineering applications of brain-like intelligence technology, which has sparked a global research heat in brain science and brain-like intelligence. In early 2021, China published the "14th Five-Year Plan" and the Outline of the Vision Target for 2035, identifying seven frontier areas of science and technology, such as brain science, as the basic core areas of concern for national security and development. In September 2021, China officially launched the China Brain Program, namely Science and Technology Innovation 2030 — "Brain Science and Brain-like Research", whose main content is to take "Explaining the Neural Basis of Human Cognition" as the main body and core, to promote "Research on Major Brain Diseases" and "Research on Artificial Intelligence through Computing and System Simulation". To promote such a global and fundamental work with major national strategic needs, not only the efforts of contemporary scientific workers, but also the continuous injection of fresh power into the research team, which puts forward new requirements for talent cultivation system. After more than ten years of development, the Key Laboratory of Neuroscience Education Department of UESTC has formed a scientific research system featuring "brain Science + information science", brought together a group of scientific researchers engaged in basic brain science, application of brain diseases and intelligent development of brain, and carried out undergraduate-master-doctoral talents training mainly in Biomedical Engineering for a long time. Looking back on the 20-year talent training

process, although a series of outstanding student representatives such as "Outstanding Graduates of Sichuan Province" and "Outstanding Students of UESTC" have been trained, it is not difficult to find the weaknesses in the training system, such as wide coverage, obsolete contents of some courses, poor lock-in of brain science and brain-like intelligence direction, etc. And there are insufficient new requirements for the training of "brain plan" talents in target countries. To this end, in line with the frontier of international scientific research and major national needs, the research team formed a "brain information acquisition method" around brain science under the framework of the "UESTC Project" built by Emerging Engineering Education, UESCT. A new system for talent training in key fields such as "Informational mechanism of brain function and brain disease" and "New Brain-like intelligence technology" - the "Pearls of the Crown of Brain Science Project for Brain Science and Brain Intelligence" trains qualified new talents for the scientific research and engineering of global brain science and brain-like intelligence.

2.2 "Scientific Research and Education" Needs to Strengthen the Interdisciplinary Integration

At present, a consensus has been reached on the basic scope of the understanding of emerging engineering education discipline, which is simply "stock renewal" and "incremental supplement". Among them, "stock updating" is to upgrade the traditional engineering specialty and reshape the professional structure by integrating new technologies such as informatization and intelligence, while "incremental supplementation" corresponds to the new industrial demand developed based on the new technology updating, which conforms to the new era development and belongs to the scope of engineering and pays attention to the integration with other disciplines. At present, the directions of artificial intelligence, aerospace technology, deep sea and other major scientific and technological needs of the country are all leading-edge scientific and technological fields that belong to the multidisciplinary intersection, only in 31 new engineering specialties released by the Ministry of education in 2018, there are six new specialties associated with spaceflight technology ("aircraft design and engineering; aircraft power engineering; aircraft manufacturing engineering; aircraft environment and life support engineering; aircraft quality and reliability; aircraft navigable Technology Specialty"). It can be seen that the

construction of new engineering specialty with interdisciplinary integration has been attached great importance by various colleges and universities [3]. "Brain science and brain-like intelligence" is a typical product of interdisciplinary integration of engineering-science-medicine and other disciplines. It bursts out tremendous innovation vitality due to the convergence of different disciplines. The cultivation of compound talents with both brain science and brain like intelligence technology has become the top priority of the integration and development of disciplines. Therefore, the scientific research and education system of the "pearls of the crown of brain science program for brain science and brain like intelligence" needs to focus on two aspects: curriculum content design and talent training structure, and strive to strengthen the importance of interdisciplinary integration in the construction of emerging engineering education.

2.3 "Scientific Research and Education" Needs to Arouse Curiosity and Consolidate the Scientific Spirit

"Exploring the unknown" is not only a fascination of scientific research, but also one of the source of motivation with which scientific researchers strive. The main reasons for undergraduates to participate in "scientific research and education" are "curiosity" and "interest". However, this kind of study with "interest" often leads to a short duration, which greatly reduces the effectiveness of "scientific research and education". The reform of scientific research and education mode under the framework of Emerging Engineering Education needs to focus on cultivating scientific spirit [4], exerting students' potential and realizing innovation and creation on the basis of curiosity. First of all, the most cutting-edge scientific exploration and emerging industrial demand are the driving forces to arouse curiosity. The research team assumes a series of high-level scientific research projects with innovation needs, which can both continuously stimulate the interest of learning and also introduce the exploration of the unknown spirit of innovation. Scientific research projects have scientifically designed research routes, which not only cultivate the realistic spirit of rigorous study, but also make the research scheme and learning objectives clear, avoiding the difficulties of hard results due to randomness in the implementation process, thus losing the positive feedback in the learning process. Secondly, the existing high-level scientific research projects are too difficult for undergraduate students, and it is

required to effectively divide the scientific research content, to catch the essential characteristics of the nurturing people, and to set up hierarchical progressive and both challenging and intriguing "progressive" project groups, which can both ignite the inner driving force of active learning and trigger their deep thinking and foster the spirit of challenging puzzles. Thirdly, it provides the opportunity to really integrate into the team to tackle key scientific research, emphasizing on cultivating students' sincere teamwork spirit and critical spirit of daring to doubt and rational contention, and encouraging students to explore unknown fields freely.

2.4 "Scientific Research and Education" Needs to Strengthen the Reform of Teaching and Training Program

At present, the main position of "scientific research and education" in colleges and universities is to cultivate postgraduates [5]. During the course of postgraduate cultivation, it is often based on scientific research projects, in which the research team is led by the faculty to carry out the scientific research. Teachers are responsible for speaking and teaching, nurturing students to set up a far-reaching scientific research ideal, noble scientific ethics, a true scientific spirit and the right scientific research methods, and improving the literacy of all aspects of students. Scientific research towards undergraduate students is currently focused on the "second classroom", carried out in conjunction with national, school policy orientations and student learning interests. However, at present, there is no complete talent training system between the first and second classroom in colleges and universities, which lags behind the objective requirements of scientific research and education in colleges and universities in the new era. First of all, there are differences in the teaching content, because the first classroom courses are mainly based on professional training programs, and there is a closely demonstrated relationship between courses and a clear teaching program. However, the second classroom teaching content is usually dominated by recent scientific research progress, with obvious timeliness, lack of correlation and fragmentation. Second, there are differences in teaching modes, the first classroom focuses on the cultivation of cultural knowledge of the overall students, the size is large, and the quality of teaching can be examined through measures such as examination assessment, while in the second classroom of scientific research teachers, whether undergraduate into the laboratory

or undergraduate mentor system, mainly relies on the teacher's direct educational model of the students' workshop, which leads to a small size, difficulty in introducing competitive knockout mechanisms. At the same time, the effect of cultivating also relies heavily on the degree of teachers' active input into the education of scientific research, resulting in a large variation in the cultivation between different teachers. Finally, there are differences in the way the education is organized, compared to the first classroom education which is more fixed in time and place, presents the characteristics of curriculum and systematization, the second classroom education form is more flexible and consists of various forms such as academic lectures, professional forums, and scientific innovation games, and the time and place are not fixed [6]. Therefore, the construction of scientific research education system of Emerging Engineering Education construction mode should break through the traditional mode of "scientific research and education" to carry out scientific research training in the second classroom, and need to be implemented in the first class independently and systematically. It is necessary to take the high-level scientific research team as the main body of scientific research and education, face the major national needs, combine the high-level scientific research projects, reconstruct the undergraduate course system and training plan, design and develop the project-based courses, construct the scientific research projects which need to be converted into the core course setting requirements, and convert the latest scientific research achievements into the core course content of the new training plan of scientific research and education.

3. NEW ENGINEERING EDUCATION PRACTICE OF THE PEARLS OF THE CROWN OF BRAIN SCIENCE PROGRAM

The UESTC, facing the state proposed comprehensive implementation of the "emerging engineering education" construction plan, responds in real time, and constructs the "emerging engineering education construction scheme" with the core concept of "evoking curiosity and stimulating potential" [7]. As one of the important construction content, the project of high-level scientific research and education for talent cultivating is planned uniformly at the university level, to break through the pattern that traditional scientific research educators carry out scientific

research training in the second classroom, and to systematically and deeply implement high-level scientific research teams into the "first classroom", in order to drive the high-quality development of new engineering education by scientific research and education. After over a decade of construction in the Key Laboratory of neuroinformation, Ministry of education, UESTC, a high level teacher research group including AIMBE follow, dedicated to "brain science and brain like intelligence" key scientific fields, has formed the core research directions of neuroengineering, neuroimaging and brain like intelligence in the field of brain science + information science. Under the guidance of the important national needs, the UESTC takes on the construction idea of the project of the Emerging Engineering Education practice, focuses on the development of undergraduate education in the subject of life science, and puts forward the idea of "basing on life and facing the whole school". At the same time, it deeply integrates the Pearls of the Crown of Brain Science scientific research and education program of Information Science and Brain Science. Brain science is the Pearl on the crown of science and it is expected that a group of excellent talents like pearl can be cultivated through this program.

3.1 Meeting National Needs and Highlighting High-level, Systematic and Multi-disciplinary Integration

The Department of Biomedical Engineering, on which the "pearls of the crown of brain science" program of the UESTC is based, is a highly integrated interdisciplinary. On the one hand, it is emphasized that in the view of engineering and technology to adapt to the development of biomedical fields, serving the national requirements of "facing people's life health"; On the other hand, some new problems in the medical field need to be addressed with research findings from biomedical engineering to form a form of "new medicine". Based on this foundation, the "pearls of the crown of brain science" program, established in the context of emerging engineering education construction, deeply merges several engineering technology medical departments, such as "information science, brain science, psychology, neuropsychiatry", which is both a sublimation of the professional cross convergence of biomedical engineering and a new attempt at innovative reform in higher education. Further, it is planned to continue the idea of "integration-development-innovation" in the course of student selection and to

open all undergraduate students majoring in engineering, science and medicine to the university. Students currently enrolled include 13 colleges in the School of Information and Communication Engineering, Computer Science and Engineering, Medical College, Electronic Science and Engineering, and continue to collide with academic sparks in the intersection.

During the design process, "The Key Laboratory Platform (team) of the Ministry of Neural Information Education has always been the main body, and the scientific research team engaged in interdisciplinary research (neuroengineering and neurodata team) has been pulled into the whole process of undergraduate talent cultivation. In terms of platform guarantee, the state-level scientific research platform and high-level scientific research team of the University have the characteristics of "four stable and one high", which are stable scientific research field, stable research direction, stable academic team, stable fund investment and high-quality scientific research results. In addition, it also includes education guarantee, which has characteristics and advantages in teaching education, knowledge innovation, cultural inheritance and so on. In terms of faculty protection, high-level scientific research team into system implantation can ensure the advance of the culture content. The NeuroEngineering and Neural Data Team consists of 6 professors, 6 associate professors, 4 lecturers and more than 100 graduate students. The entire team undertakes the "Pearls of the Crown of Brain Science" talent training program, and the cascade faculty ensures the practicality and stability of the actual operation level. In the aspect of training program setup, full consideration should be given to the study and research advantages of team members in cross-disciplines, from the physiological basis of brain intelligence anatomy to psychological behavior, to the processing of brain signal analysis and the application of neuropsychiatric diseases and brain intelligence, in order to carry out systematic classroom teaching and scientific research training, and strive to make every link practical and detailed. The growth of students was commensurate with the growth of teachers, and the transformation from excellent scientific research staff to excellent childbearing faculty was gradually achieved. In terms of full process cultivation, multiple experts within related fields are invited to intersperse lecture, leading to new knowledge and new advances in different disciplinary directions. Extracurricular led the students to go deep into the

related industrial companies of brain science and brain like intelligence, the science and technology innovation base and the health care hospital for practical training. Taking more steps together, the multidisciplinary resources were integrated and cultivated, which effectively tamped the connotation of emerging engineering education, new medicine education.

3.2 Insisting on the Nature of Seeking Knowledge and Strengthening the Step-by-step Challenge of "Customs Clearance" Development

In the implementation of the "Pearls of the Crown of Brain Science" Emerging Engineering Education talent training program, it is necessary to adhere to the "nature of knowledge, arouse curiosity, stimulate potential, explore knowledge, innovate and create" as the core throughout the training process [8], and to clearly state the objectives of cultivating the discoverers of brain science theory, inventors of brain regulation and brain intelligence technology, and designers and creators of new intelligent engineering systems. To cultivate future reserve research talents and national strategic reserve force for breakthrough and value creation of brain control technology and brain-like intelligence technology.

Firstly, closely follow the national level scientific research projects of brain science and technology innovation and brain-like technology development, design and develop courses, and integrate them into undergraduate training programs. To evoke curiosity, ignite the knowledge seeking nature, and stimulate learning interest by explicitly positioning the high level of learning goals. In this principle, the major supporting courses related to brain science and brain intelligence should be selected, including 5 core theoretical courses such as Introduction to Cognitive Neuroscience, Anatomical Basis of Brain Cognition, Physiological Basis of Brain Cognition, Brain Information Analysis and Brain Intelligence System Development. As well as five core experimental courses of practical hands-on operation training, "Psychological experimental training", "Brain image analysis training", "Brain electrical analysis training", "Brain neural modeling training", "Brain electrical detection/Brain computer interface technology training". All courses were applied to the first classroom in five semesters in the form of open enrollment at the whole school, both to enable students to receive

targeted scientific research training and to implant their existing professional training program in the form of electives credit. The curriculum itself adheres to challenging, research-based teaching reforms, encourages teachers to explore research-based teaching, and guides students to develop "research thinking, challenging learning, innovative practice". Through strengthening the course design and taking project and practice training as the guide, the passive learning mode formed by students in the traditional "instilling" classroom teaching mode has been changed and the initiative of students to think about the actual connotation of the discipline spontaneously has been triggered.

Secondly, using challenging scientific research training projects to lead the interest of students in continuous learning, combined with a step by step challenging course, to achieve the project application-oriented cultivation process. The attractive "practical training project" leads the important "core courses" and closely combines "theoretical basis + skill training" to train students' scientific research ability, accept the influence of scientific research literacy and improve their comprehensive ability. With the goal of "stimulating potentials and developing personality", the training program which can attract students, challenge and display a certain degree is selected from the key scientific research projects related to brain science and brain-like intelligence undertaken by the research team. On the schedule of course progress throughout the four years of the University, the project difficulty also took a hierarchical progressive model: at the first stage, brain intelligence related basic and experimental as core, to stimulate students' learning interest; The middle-order centers on brain intelligent signal processing and system design to hone students' practical skills; The higher-order centers on active exploration research around plates of brain intelligent mechanisms, brain like systems, and so on, ensuring projects are practically operational with a balance of difficulty and interest.

Finally, change the teaching mode, integrate the core courses and training projects, and form a "three-level" problem-solving development that students actively promote. The three phases of the "pearls of the crown of brain science" program, with increasing difficulty and knowledge fusion requirements compared to the previous phase. The teaching goal of the first stage, "brain intelligence foundation", was to understand the basic theories and methods related to brain intelligence, conducted in semester 2-4 by opening 3 courses

and 3 practical courses. These courses are taught in parallel with those required by the profession, so that the students, on the basis of a pre-existing profession, master basic experimental paradigms for doing brain science research, are familiar with the basic skills of brain science experiments, and achieve the purpose of guiding students to understand brain science and foster interest. The second phase, "brain intelligence methods", was conducted in semester 5-6 with 2 courses and 2 hands-on courses, with the teaching goal of training students in brain science research methods. Work on integrating basic theory and engineering practice in organics to give students basically the ability to engage in research in brain sciences. The third phase, "brain and intelligence research" was conducted in semester 7-8, by the students' autonomous choice to enter into a certain preset topic, follow the mentor to complete a specific scientific research task, and then complete the graduation design, to achieve the goal of truly entering the brain and intelligence research phase. In the three stages of in-depth process, by inspiring and practicing multi-dimensional, diversified innovative thinking and divergent thinking, help students complete the key process of anchoring interest, finding problems, raising problems, solving problems, and advancing step by step under the project traction. In the process of implementation, efforts should be made to foster the spirit of rigorous learning and the team spirit of genuine collaboration, and the corresponding scientific research results should be produced, on the one hand, to further stimulate the interest in intellectual research, on the other hand, to help them obtain more opportunities for further study in the world's top universities and scientific research institutions. At the same time, at each stage, clear evaluation indicators are developed, competition elimination mechanisms are introduced, making students both motivated and pressured to establish scientific research awareness of being exploring the peaks of unknown bold climbing, thus motivating the potential, catalyzing the inner drive of active learning and creation during the course of research.

At present, Pearls of the Crown of Brain Science program has set up 4 programs, namely Brain-Machine Interaction Challenge Project, Brain Intelligence Exploration Project, Brain-Music Project and Brain Encoding and Decoding Project for Animals, to lead students' breakthrough development. For example, the "Brain-Music Interaction Project" is designed around the theme of brain-music interaction, which covers both

scientific exploration and engineering application. Classmates involved in this project can act through Methods such as EEG and MRI explore the brain mechanisms of music cognition (recognizing the brain), and music based physiological brain regulatory systems can be designed for physiological / disease states such as mood and fatigue (regulating the brain). The project is intriguing and attracts students into the world of interactive and blending between brain and music to explore the production mechanism and physiological feedback application of music, a human cultural treasure, in the brain. In the first stage, "Mapping Musical Brain Map", guided by the related research on brain mechanism, enables students to understand the basic functions and cognitive basis of the brain, discuss magnetic resonance and electroencephalographic processing technology, and carry out music-related brain science experiments, to develop the basic ability of data processing and experimental operation; The second stage: Develop the brain wave music feedback system with the theme of "Punk World of Brain and Music", provide the basis for students to process data and implement algorithms, form the feedback system framework, enable students to learn to use related tools and software to implement brain wave music algorithms, carry out music-related neurofeedback experiments, set up brain wave music feedback system, and cultivate system thinking; The third stage: With the theme of "the magic of music", the research on music intervention application is carried out, which trains students to understand the basic knowledge of mental illness and brain aging, completes music intervention experiments and data processing, promotes scientific research interest, and cultivates overall scientific research thinking.

3.3 Being Deeply Rooted in the Soil of Educating People, Building a New Environment for Scientific Research and Educating People with Gathered Advantages

"The perpetual development of the effectiveness of "scientific research and education" is inextricably linked to the strong support of schools, the full assurance of colleges and the full emotional input of scientific research teams, in addition to the enthusiasm for students' participation and passion for innovation. At the university level, the UESTC has incorporated the "Constructing a Systematic New Engineering Education Platform for Scientific

Research and Education" as the core content into the "UESTC Program" 2.0 [9], which provides financial support, credit recognition, site guarantee, teacher incentive and other policy and system support for the work of "scientific research and education", and fully ensures the implementation of the program. At the school level, the first is the construction of the Educational echelon, for which the academy has established a scientific research educator job task force that is dominated by the management and scientific research educator project members, and supported by the student working team, while, in particular, each class is equipped with a teaching class director and a student management class director, who are focused and work synergistically with each other, make the joint force guarantee project is stable; The second is the implementation of various systems, through the formulation of the main responsibilities of the head teacher of the "pearls of the crown of brain science plan" for scientific research and education, the assessment measures for the head teacher of the "pearls of the crown of brain science plan" for scientific research and education, and the participation assessment mechanism of the "pearls of the crown of brain science plan" for scientific research and education, and the honor evaluation system of the "pearls of the crown of brain science program" and other management systems to ensure the practical implementation of the project from the institutional level; Then it is the acceptance of stage results, organize regular teacher-student seminars, make "student course feedback card", and update the teaching content and mode in time. Make a record book for teachers engaged in scientific research and education, design periodic feedback on students' achievements, and periodically verify project results. At the linkage level of colleges and universities, teaching seminars are held regularly to discover problems, solve problems and inspire ideas, so that "research-teaching" and "teaching-learning" complement each other. Strictly carry out the course supervision, all the courses included in the first classroom are in accordance with the requirements of the quality supervision of the new teaching reform courses such as the school's "challenging courses". Strictly carry out the three-level supervision of school-college-team, and earnestly help the team to improve the teaching practice ability and enhance the students' learning experience. The multi-dimensional safeguards at all levels above, the evaluation mechanism of scientific assessment, and attractive incentives provide a fertile ground for students to continuously stimulate students to learn endogenously [10].

Students not only possess academic resources with key research platforms and high-level mentor teams, but also turn around to meet masters for academic exchange opportunities, and the research content of the project can directly dock with the high-gold subject contests such as the National Biomedical Engineering Competition, and the "Challenge Cup" National Students' Scientific and Technological Work Competition. Certificate of stage honor is also available after passing the stage assessment, certificate of honor graduation after completing the full challenge and recommended opportunity for a world class scientific research institution.

4. CONCLUSION

"Emerging Engineering Education" has been effectively attempted in many colleges and universities in China, advocating "interdisciplinary, practice-oriented, innovation and entrepreneurship education throughout the whole process of talent cultivation" and gradually establishing a new Chinese model of Engineering education. "Pearls of the Crown of Brain Science" program of UESTC is a pilot of the new engineering education reform of "scientific research and education", serving the major national strategies and people's health needs, facing the future and the development of students, relying on excellent scientific research team to promote systematically, and developing a high-level series of core undergraduate courses based on projects to be applied in the "First Classroom", as well as striving to build a high-level scientific research supporting mechanism for training top-notch innovative talents".

AUTHORS' CONTRIBUTIONS

Cheng Luo and Ling Quan is responsible for research design and wrote the manuscript, Cheng Luo and Dezhong Yao conceived of the scientific and educational ideal, Sisi Jiang and Wenyuan Li contributed to data statistics, revising and editing.

REFERENCES

- [1] Fumao Ru, Zhang Pingsong, Guo Liquan and Ji Guangzhong. Consideration and Practice of Scientific Research Educational Method in Engineering Professional Talent Training [J]. University Education. 2021(6) 180-182.
- [2] Zhou Guangli, Ma Haiquan. Integration of Science and Education: Change and

- Innovation of Higher Education Ideas [J]. *China Higher Education Research*, 2012 (8): 15-23.
- [3] Liu Jianping, Yin Xiangdong. Cross-Border Integration of Emerging Engineering Education: Necessity, Dilemmas and Path to Development [J]. *Heilongjiang Higher Education Research*. 2020 (2): 88-93.
- [4] Liu Daizhou, Tan Mengyuan. To foster the spirit of science: the mission of scientific research and education in Colleges and universities [J]. *Science and Technology in Chinese Universities*. 2020 (1) 82-84.
- [5] Shi Tong, Li Ruili, Yang Bo. Research on Problems and Countermeasures of Scientific Research Educators in Postgraduate Education [J]. *Science and Technology of Chinese Universities*. 2021(9)66-69.
- [6] Zheng Lei, Cao Xianbin, Du Wenbo and Gu Huiyi. Research on Training Model of Top Innovative Talents with Scientific Research and Education as Main Characteristics [J]. *Higher Education Journal*. 2020 (16): 167-171.
- [7] Zeng Yong, Huang Yan, Xiang Guijun, Huang Tingzhu. Starting from freshman project course: Design and practice of Emerging Engineering Education construction "power generation scheme" [J]. *Research on Higher Engineering Education*, 2020 (1): 14-19.
- [8] Huang Tingzhu, Huang Yan, Yang Jianyu. New Engineering Education of "Scientific Research and Education": Recognition, Consideration and Practice [J]. *University Teaching in China*, 2021 (7): 33-39.
- [9] Zeng Yong, Huang Yan, Huang Tingzhu, Qin Qingguo Future oriented emerging engineering education and iterative innovation of "Chengdu University of Electronic Science and technology program" 2.0 [J]. *Research on higher engineering education*, 2021 (3): 16-20.
- [10] Fan Wusan, Xie Xingzheng Dynamic. The dynamic mechanism of constructing scientific research and education system in Colleges and universities in the new era [J]. *China University Science and Technology*. 2018(7)41-13.