

## Improving Students' Innovation Capability via "Project-Driven" and "Joint-Guiding" Research Training Strategy

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**Abstract.** In contemporary education, it is very important to improve students' innovation capability, especially in their early age. Since 2015, research training projects for this aim have been launched and carried out by the cooperation with qualified high school and university or scientific research institute. This "Project-driven" and "Joint-guiding" research training strategy for the cultivation the innovative and practical abilities of high school students has made great progress in the past several years. In this paper, we introduced the main idea of this research training strategy and gave some examples for carrying out student-centered innovation training programs. Overall, a student-centered environment is proposed which aims to cultivate the students' innovative and practical abilities as well as individual talent.

### Introduction

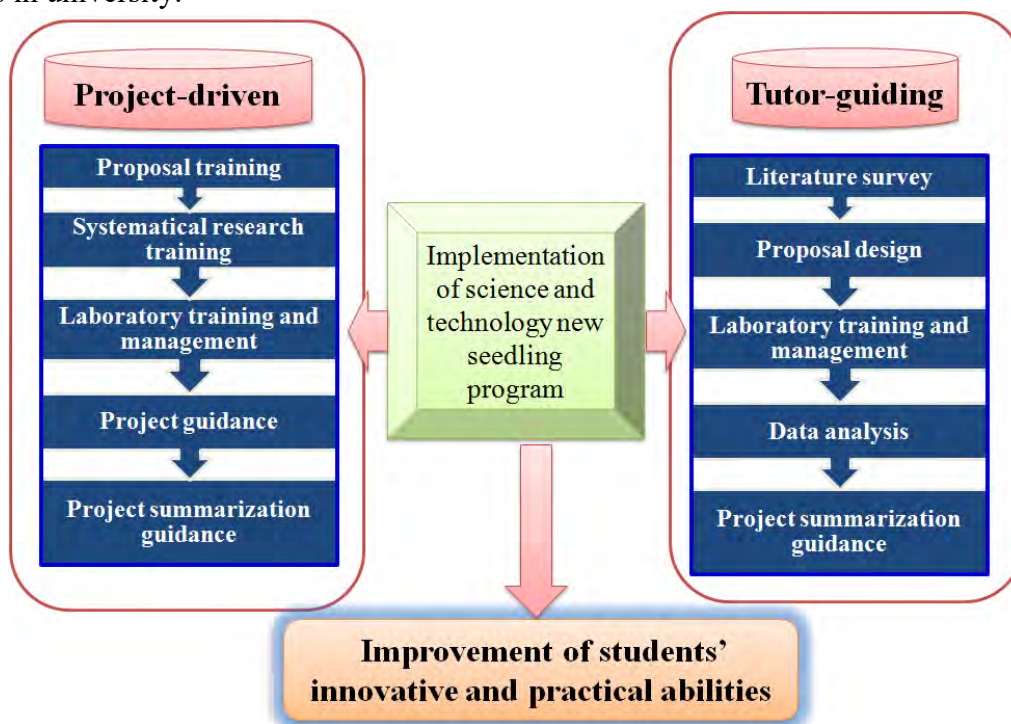
On March 16, 2016, the Fourth Session of the Twelfth National People's Congress voted to adopt the outline of the 13th Five-Year Plan for National Economic and Social Development (the 13th Five-Year Plan). According to the planning outline, the economic and social development in the 13th Five-Year Plan period mainly set up four major indicators, namely, "Economic Development", "Innovation Driven", "People's Livelihood Well-being" and "Resources and Environment", in which, "Innovation Driven" is unveiled for the first time in the five year plan [1-3]. However, "Innovation Driven" should not be confined to individual enterprises, individual units and individual innovation, but should be the innovation of the majority of people, even the innovation of the whole people. The foundation of scientific and technological innovation is the cultivation of talents with innovative ability, especially in the early period of schooling. The implementation of scientific research training for high school students is an effective way to improve their innovative ability. By participating in scientific research training, senior high school students can fully improve their practical and experimental abilities, and their independent, scientific and rigorous thinking abilities, and to improve their ability for lifelong learning or working. Familiar with the scientific research process, cultivate scientific research thinking and enhance the sense of innovation in high school lay a solid theoretical and practical foundation for the their later choice of majors for university studies and later engaging in scientific research, technological improvement and entrepreneurship.

It is a very important task for every educator to cultivate students' innovative ability and practical ability in school education. With the all-round development of quality education and the deepening of education innovation reform, how to cultivate students' innovative ability and practical ability in education has become more and more important. It is not only the product of the requirement and objective condition of quality education, but also the inevitable result of deepening people's understanding to improve and cultivate students' innovative ability and practical ability continuously. Extensive, in-depth and lasting activities for cultivating students' innovative and practical abilities are conducive to the improvement and comprehensive development of young people's scientific abilities. 21 Century is the century of technological innovation. With the rapid development of science and technology and the increasingly fierce international competition, it has

become a hot issue of educational reform in various countries to focus on improving the innovative and practical abilities of young students. In some developed countries, the content of science and technology has become an important part of the core curriculum of primary and secondary schools, and the cultivation of students' innovative ability and practical ability has also been studied in depth. In order to promote the development of young people's scientific and technological innovation ability, the Chinese Association for Science and Technology holds the National Youth Science and Technology Innovation Competition every year, and has held 33 sessions so far. Ningbo Science and Technology Association and Ningbo Education Bureau, relying on the experts, equipment, facilities and scientific and technological education resources of the whole city and scientific research institutes inside and outside the province, have jointly launched the Ningbo Science and Technology New Seedling Cultivation Plan since 2015, combining with the construction of regular high school subject base and the creation of characteristic innovation projects. As participants in this project, through the guidance of high school students' new science and technology seedling cultivation project, we put forward the concept of student-centered cultivation, using the strategy of combining “project-driven” and “joint guidance” to effectively achieve the goal of cultivating middle school students' innovative ability and practical ability. In this paper, we introduced the main idea of this research training strategy and gave some examples for carrying out student-centered innovation training programs.

### “Project-Driven” and “Joint-Guiding” Research Training Strategy

In the view of the current situation of heavy schoolwork and weak scientific research foundation of middle school students, we applied the strategy of combining “project-driven” with “joint guidance” based on the project of “Ningbo Science and Technology New Seedling Cultivation Plan” (Shown as Fig. 1). The cultivation of the innovative ability and practical ability was carried out by real-run specific project under the guidance of both sides of the middle school tutor and the professors in university.



**Figure 1.** “Project-Driven” and “Joint-Guiding” Research Training Strategy

The execution of the project “Ningbo Science and Technology New Seedling Cultivation Plan” – “Preparation of adsorbent from waste pericarp and its adsorption performance for pollutants in water” was taken as a typical example for discussion. After the project was established, a meeting

was organized for the introduction of the professors and students from the university and the middle school immediately. The meeting was student-centered, and the detailed “joint guidance” model was developed for the students under the “project-driven” model, taking into account the students' learning foundation and specific reality. The main steps were as follows.

(1) Relevant special subject training was carried out by the university side, and the students were trained systematically in the aspects of data consulting, subject understanding, research methods training, experimental comprehensive training and experimental data discussion, while the middle school side added optional courses such as data processing methods to the students involved.

(2) On the basis of literature searching training, the students were assigned to write critical papers on scientific research literature in their spare time;

(3) Students were organized to carry out intensive experiments for more than 20 days in winter and summer vacations. Comprehensive experiments and training were carried out systematically;

(4) We tried to establish the practice mechanism of pairing innovation between college students and middle school students, and so on. We established QQ groups and Wechat groups for the college students and middle school students, who were doing research projects to strengthen the interaction and communication between them. On the one hand, the middle school students who participated in the project studied and did research work in the university to feel the life of the university. The successful experience of innovation and entrepreneurship of the university students can give the middle school students incentives. On the other hand, the university students themselves can also be trained. Their abilities on communication have also been trained and improved. Combined with the joint training of university tutors and middle school mentors, a three-dimensional multi win situation was formed.

(5) Through the efforts of the students and the guidance team of both sides, the project has progressed smoothly, which has made positive contributions to the cultivation of students' innovation and entrepreneurship ability, the improvement of teachers' scientific research level and teaching and research level, and has made gratifying achievements. Students have a preliminary understanding of scientific research, showing a strong interest in scientific research, with research potential. Complete 3 critical reading reports of scientific research literature, and finalized 2 research papers and ready to submit to core journals.

## **Conclusion**

The participation of middle school students in scientific research training has not yet been widely popularized, failing to achieve the original intention of cultivating students' innovative and entrepreneurial ability, and failing to meet the needs of quality education and even the national strategic development. Therefore, reform of scientific research training to improve students' innovation and entrepreneurship needs to be further deepened. Starting from the specific project case by instructing the middle school students participating Ningbo Science and Technology New Seedling Cultivation Plan, we put forward the concept of student-centered cultivation, and adopts the strategy of combining “project-driven” with “joint guidance” to effectively realize the goal of cultivating middle school students' innovative and practical abilities. In recent years, high school students' participation in innovative subjects shows that their enthusiasm is relatively high and their development trend is gratifying. It is of great significance to digest and absorb the advanced experience of scientific research and training for middle school students in order to promote teaching reform, optimize training scheme and cultivate engineering application-oriented innovative talents.

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