

Research on the Ways of Enhancing College Students' Scientific Research Ability: An Experimental Teaching Approach

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Abstract

With the adjustment of talent training objectives in the higher education field, college students' scientific research activities play an increasing important role in the process of cultivating innovative talents. In order to improve the quality of talent training and adapt to China's economic environment and the new higher education development, China's higher education needs to focus on cultivating college students' scientific research ability. On the survey of domestic and foreign related research, this paper conducts a questionnaire study on the cultivation of scientific research ability of college students in China, and suggests the suitable ways to cultivate scientific research ability by analysing the data them. It is concluded that the approach of experimental teaching is the main way to cultivate student scientific research ability, and then summarizes a variety of training methods about experimental teaching, to enhance the scientific research ability of college students and encourage talents with multiple skills.

Key words: *college students; scientific research ability; experimental teaching approach; training methods*

Colleges and universities are the places of cultivating high-quality talents, and the important places of knowledge innovation. They play an unprecedented role in the whole process of knowledge transfer and conversion. Scientific research ability (abbreviation: SRA) is very important for college students, and it is necessary for students to construct innovative thinking. In order to complete the historical mission in the trend of competition and development, cultivating college students' SRA to obtain innovative talents becomes the most important task of teaching in colleges and universities for educators. College students are the main force to promote the development of science and technology. Cultivating college students' SRA needs advanced educational philosophy, clear education policy, scientific education method, and continuous innovation of management system.

1 Investigation on the current situation of scientific research abilities of domestic college students

We selected eight colleges and universities for this research and surveyed 100 students in each institution. The eight colleges and universities include one 985-Project Universities, two 211-Project Universities, three ordinary colleges and universities, one private college, and one adult college. The survey was conducted by using stratified sampling and random sampling techniques. The contents of the questionnaire are divided into five parts with 25 questions. The first part includes the demographic information of the respondents, including gender, grade, and professional. The second part includes the attitude and motivation of the

respondents to cultivate SRA, including the interest in scientific research activities and the reasons for participating in scientific research activities. The third part includes the respondents' training experience of research ability, including the type of activities and the results obtained. The fourth part includes the relevant content of the experimental teaching approach, including whether to understand, participate in, willing to participate in experimental teaching mode. The fifth part includes the degree of university support for college students' SRA training, including information provision, capital investment, faculty involvement, equipments, and so on.

According to the analysis of the data, the attitudes of college students to participate in scientific research activities can be categorized three levels. There were 171 respondents (25.0%) who chose "very interested", 453 respondents (66.1%) reported "generally interested", 61 respondents(8.9%) reported "not interested" . Please refer to Table 1 for details.

Table 1 – College student attitude to participate in scientific research activities

	Quantity	percentage
very interested	171	25.0
generally interested	453	66.1
not interested	61	8.9
total	685	100

Next, according to analysis of the data, 376 respondents (54.9%) reported it is "very necessary" to cultivate SRA, 274 respondents (40.0%) felt it is "not essential ", 35 respondents (5.1%) felt it is "no need". Please refer to Table 2 for details.

Table 2 – College student attitude to conduct SRA

	Quantity	percentage
very necessary	376	54.9
not essential	274	40.0
no need	35	5.1
total	685	100

From the above statistical analysis, we find only 25.0% of college students are interested in research activities. Moreover, the percentage of students who think it is necessary to cultivate SRA is less than 55%. This shows that college students do not know enough about the importance of building SRA. Although the students do not oppose the idea, do not exclude the option of cultivating SRA, but they lack the initiative and the positive attitude. According to the survey data, 8.9% of college students did not have the minimal level of interest in scientific research activities. This reflects the general phenomenon that Chinese college students value theories more than practices. Therefore, at the present stage, it is necessary to address the challenge of how to improve the attractiveness of scientific research activities, in order to extensively cultivate college students' SRA and carry out the cultivation of SRA of college students smoothly. Only by making the students to internally accept and long for scientific research, participate in scientific research activities, it is possible for colleges and universities to truly cultivate SRA of college students.

In addition to the attitude of college students to cultivate SRA, the questionnaire also includes the motivation for students to participate in scientific research activities. For "if you participate in research activities, then which of the following may be the cause" question, 206 students (30.1%) chose to participate in scientific research activities is "in order to deepen the understanding of the relevant areas of the professional, as supplement of their own classroom learning ", 98 students(14.3%) chose " for hobbies ", 151 students(22.1%) selected "in order to improve their comprehensive ability", 230 students (33.5%) chose "in order to obtain the honor, for the future apply for graduate students, study abroad, lay the foundation for future work". Please refer to Table 3 for details.

Table 3- The motivation of students to participate in scientific research activities

	Quantity	percentage
in order to deepen the understanding of the relevant areas of the professional, as supplement of myown classroom learning	206	30.1%
for hobbies	98	14.3%
in order to improve mycomprehensive ability	151	22.1%
in order to obtain the honor, for the future apply for graduate programs, study abroad, lay the foundation for future work	230	33.5%
total	685	100

It can be seen that the main purpose of the majority of students to participate in scientific research activities is not to cultivate their SRA, but as a supplement to classroom knowledge or as the cornerstone of postgraduate, study abroad or future work. As one of the basic qualities that students should possess, SRA is complementary with the theoretical knowledge, promoting both of them. Scientific research activities cannot be treated as an appendate to theoretical teaching or extracurricular activities. On the contrary, it is necessary to pay equal attention to the theoretical concept teaching to promote the students to absorb the theoretical knowledge, to explore the problem, to pursue the solutions and to acquire the new knowledge. Therefore, how to make students understand the SRA and the true connotation of scientific research is the urgent task for educators.

2 An analysis of the ways of cultivating experimental teaching

"1123" model is a new experimental teaching model proposed by Sun (2003). The so-called "1123" model refers to one -main line, one-power, tw- methods, and three- support platforms. The one-main line refers to improve the overall quality of students and scientific experimental capacity throughout the entire experimental teaching process. The one-power refers to the continuous reform, and to achieve the experimental teaching system as a whole to improve the teaching quality. Two-methods refer to the teaching structures and open-minded teaching. Finally, the three- platforms refer to the advanced teaching management mechanism platform, the application platform of modern educational technology, and the construction platform of high level experiment.¹

"Trinity" model refers to the discussion, exploration and experimentation as one integrating system. The background of the basic idea is the discussion based teaching. The main line is the experimental scientific inquiry. Scientific research method is the tool. The discussion

based teaching as a teaching process background model always runs through the whole lecture. It can provide experimental prerequisites for experimental-based scientific research activities.

Project-based experimental teaching model: It is a student-oriented teaching method, which was created by Dr. Katz. It is about the teaching activities that a teacher and students jointly implement the comprehensive design project. The experimental teaching model has the following characteristics formed by the experimental teaching: (1) systematic, holistic and interrelated (2) being closely connected with real life or practical engineering (3) having the dual characteristics of inquiry teaching method and problem teaching method.²

Self-help experimental teaching model: The key point of self-help experimental teaching model is the "self-help". This approach literally expresses the meaning that full autonomy of "students", "students" is in the main position, "teachers" is absolute the service provider. In this experimental teaching model, it highlights the individualized teaching idea and the students are treated as the dominant participants.

Open experimental teaching model: The main connotation of the experimental teaching is open. That is, the purpose of experimental teaching, the subject, the teaching methods, and the teaching content are open. This kind of openness is formed on the basis of diversification of teaching mode and teaching style, individuality of talents, and diversification of development goals. And its connotation is: (1) to restore the irreplaceable special role of experimental teaching (2) to reflect the student's dominant position and the leading role of teachers (3) to establish the experimental curriculum system including a modular curriculum and the project level (4) to adapt to the multi-layer and comprehension of capacity-building (5) to determine the main form of the open laboratory (6) to ensure the basis position of network experimental teaching platform.³

The open and multi-layer experimental teaching is an experimental teaching mode that introduces the experimental open teaching method into the basic skill experiment, the objective verification experiment, and the comprehensive inquiry experiment. This requires the students to master the basic experimental technology and carry out the necessary scientific research training. Therefore, they can participate in experimental learning. The experimental teaching model has the characteristics of satisfying the cognitive rules, facilitating the organizing of teaching, promoting the cultivation of the ability, open and multi-layer. It can speed up the change of the traditional teaching methods and is an important means to realize the cultivation of students' SRA.⁴

3 The effect of experimental teaching mode on the cultivation of SRA of college students

3.1 Cultivating students in many aspects of SRA

Cultivate students' problem discovery ability, communication and coordination ability, system planning ability, method application ability, and scientific research marketing ability.

3.2 Enhancing team collaboration

Cooperation between members of the research team is essential for the successful completion of the project, so members will be united and cooperated in order to complete the same goal. It is conducive to enhancing team awareness.

3.3 Stimulating students' interest in research

The teaching content and the project of experimental teaching mode present a strong selectivity to meet the different research requirements requested by different students. At the same time, the experimental teaching model supports students to study and explore within the scope of self-experimental topics, so that different types of students can utilize the experimental content according to their own actual situation, thereby enhancing the interest of scientific research activities for students, and achieving personalized training best.

3.4 Strengthening the link between disciplines

Experimental teaching model is a teaching paradigm basing on an experiment without involving the concrete and cumbersome experimental process. However, it only provides the basic experimental framework of a scientific and autonomous thinking. It is conducive so different disciplines apply for it. The links among different disciplines in the experimental aspects are created. Therefore, students are not rigidly adhere to a certain form, and this promotes the comprehensive development of scientific research capacity for college students.

3.5 Extending theoretical knowledge

While participating in the experimental teaching model, students can exercise their ability to operate, touch, understand and master the use of various experimental facilities, which has gone beyond the theoretical knowledge by itself. If there is a sudden problem in the process of experimenting according to the knowledge, the students may choose to ask the instructor or read relevant information after class in order to solve the problem. In this process, students' pursuing theoretical knowledge is no longer limited to the contents of the textbook, but going to a broader field forward by virtue of the spirit of scientific research and their own initiative being cultivated in the experimental teaching mode. At the same time, they also completed the extension of theoretical knowledge.

4 Approaches to cultivating SRA of college students in experimental teaching mode

4.1 Updating the experimental teaching philosophy

In order to better cultivate the SRA of college students, our primary task is to extend the experimental teaching philosophy. Combining thinking and technology, through practice and research activities to shape students' scientific research literacy, cultivating students good thinking, daring to ask questions, being diligent for spirit of scientific research, It is realized that we only pay attention to the experimental teaching mode, extracurricular scientific research activities, and we combine SRA training with theoretical knowledge into the university's school concept in order to cultivate high innovated talent suiting for the current social competition model.

4.2 Building a sound policy system

First of all, in terms of guarantee, our government needs to introduce appropriate policies to ensure that colleges and universities have sufficient funds to carry out the mission of cultivating scientific research capacity of college students. Secondly, the experimental teaching model evaluation system needs to be established. The main body of the evaluation of experimental teaching model should include students and external experts.

There are two kinds of the national incentive policy. The first one is for the teacher's incentive policy, and the second one is for students. For the teacher's incentive policy, it includes a reasonable calculation of the workload of experimental teaching, the implementation of the distribution according to work, more labor, meritorious service incentive model, and the newly developed experimental project is equal to increasing the workload. To fully mobilize the initiative and enthusiasm of students, it can be improved from the following aspects of the system: First, the student reward system means that the schools set up research scholarships. Through the student experiment competition, experimental results exhibition and other activities, outstanding achievements in scientific research activities and contribution, creative and productive students will be given the award. Second, the rigorous experimental assessment system means students will be conducted in a comprehensive and rigorous examination according to a reasonable discipline assessment standard. Students must have a real ability to learn through the experimental assessment of the results and it is related to escalation level and degree of access.

4.3 Making full use of the experimental center and library resources

There are two kinds of the resources of the experimental center. First, the experimental facilities include equipment, places, etc. Second, information includes experimental courses and site arrangements, experimental data, information related to research activities, scientific research, etc. These resources through a certain platform will be shared so that it is fully utilized.

The library is the major location for college students' extracurricular independent study. At present, the function of university library in China is still relatively simple, and the scattered knowledge and lagging service can't meet the requirements of college students' disciplines' resource need. Therefore, in order to provide sufficient resources for the cultivation of SRA, the university library should integrate the key knowledge, academic literature, research hotspots, and academic trends related to the subject as soon as possible. Therefore, the macroscopic subject frame in the new direction for college students will be provided, the foundation for the follow-up of scientific research work will be built. The library should deeply track core works, journals and research topics related to subject in a timely manner. The academic sharing space is established, so that students can meet their requirement of research direction through a platform, enrich the relevant knowledge.

4.4 Strengthening the construction of teachers

Learning from the successful experience of cultivating SRA of foreign universities, we fully mobilize the enthusiasm of teachers using experimental teaching approaches. The full-time and part-time teachers and full-time technical staff are composed of relatively stable teaching and management teams, and complete experimental teaching tasks solidly and effectively.

4.5 Development of school - enterprise joint model

Through the joint cooperation between enterprises and colleges and universities, long-term and stable internship bases are established, in order to expand the teaching resources to ensure the effectiveness of practical teaching. On the one hand, enterprises' building internship bases, many colleges and universities sign an internship agreement with enterprises. The main

cooperation includes enterprises providing internships and the environment for the schools, providing in-house education, living arrangements, practice lectures and on-site guidance. The Schools actively cooperate with enterprises to expand their business and conveniently provide personnel training, technical advice and other aspects for enterprises. The schools timely hire business leaders and technical backbone as part-time teachers, and provide the school's practical teaching into vitality. On the other hand, the schools strengthen engineering practice education for enterprises to train the necessary personnel.

5 Conclusions

Through the investigation of the cultivation of SRA of college students in China, it shows that the cultivation of SRA of college students is not optimistic: College students recognize the importance of SRA and show some interest in scientific research activities, but few students participated in scientific research activities, and the form of scientific research activities is relatively simple. A large part of the students participating in scientific research activities is not motivated to improve their own scientific research quality, but rather through the achievements of scientific research activities and honor for the future study, going abroad or laying the foundation of work. It is the student's own problem. In addition to these challenges, the instability of teachers, the unclear idea of the university and the imperfect national system are the main factors that

Although the cultivation of SRA of Chinese college students is challenging, we find that the experimental teaching mode has a positive effect on the cultivation of college students' SRA. It is mainly in the experimental teaching mode, which can cultivate the SRA of college students, strengthen the contact of the disciplines, stimulate the scientific research interest of college students and improve laboratory equipment and resource utilization and extend theoretical knowledge and so on. Due to the special role of the experimental teaching model, we have analyzed and drawn the cultivating mode of the university students' SRA in the developed countries, and put forward the corresponding countermeasures based on the experimental teaching mode at the end of the research on the development of the SRA of college students in China. It is hoped that the SRA of college students should be strengthened by updating the experimental teaching idea, building the perfect policy system, making full use of the experimental center and the library resources, strengthening the discipline connection and developing the joint mode of school and enterprise. Therefore, we can enhance the scientific literacy of college students.

Abbreviations

SRA - scientific research ability

References

1. *L.R.Sun*, Research and Exploration of Experimental Teaching Mode in Colleges and Universities, *J. Laboratory Research and Exploration*, **1** (2003) 4.
2. *L.J.He, Y.B. Zhai*, Project-based Experimental Teaching Mode and Its Feasibility Evaluation Method, *J. Research and Exploration in Laboratory*, **2** (2010) 95.
3. *G.Li.Song, G.Q.Gai, D.M.Su*, Research and Practice of Open Experimental Teaching Mode, *J. Research and Exploration in Laboratory*, **2** (2010) 92-93.

4. *N.Q.Zhang, F.H.Pang, Y.X. Li*, Exploration on the Teaching Mode of Hierarchical Open Experiment, *J. Journal of Nanyang Normal University*, **6** (2009) 105-107