

# **Ways and Methods to Improve Students' Innovative Thinking and Ability: Based on the Course of Scientific Writing**

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## **ABSTRACT:**

The cultivation of innovative thinking and the improvement of innovative ability are the core goals of higher education. The ways and methods of cultivating innovative thinking and improving innovative ability of postgraduates through the course of scientific writing are put forward. Through the implementation of scientific and technological writing, oriented to practical application, the focus is on how to collect and sort out the scientific and technological information needed by themselves, formulate and implement experimental plans according to the needs, and express their views and thoughts clearly, concisely and accurately through writing. For the purpose of effectively cultivating students' scientific research thinking, reform the teaching content, teaching methods and assessment methods, adopt the encouragement and reward mechanism, through the participatory and interactive teaching links, train students to actively explore, think independently, stimulate innovative thinking, and improve students' innovative ability.

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## **I. INTRODUCTION**

Scientific and technological innovation is the driving force of human development, innovative thinking and innovative ability are the fundamental of scientific and technological innovation, and college students and graduate students are the reserve force of innovation. How to cultivate and improve the innovative thinking and innovative ability of college students and graduate students is an important mission of higher education. Scientific and technological paper is an important expression form of innovative thinking and innovative ability. Scientific and technological paper plays an important role in promoting the development of science and technology and promoting social progress. As the new force of scientific research, graduate students have become the main writers of all kinds of scientific journals. The writing level of scientific and technological paper can reflect the knowledge category, theoretical basis and comprehensive accomplishment of the author to a certain extent. A good paper is the best carrier of the author's innovative ideas, academic level and scientific research ability [1]. The new talent training mode of colleges and universities requires the creation of innovative talents integrating knowledge, ability and quality to meet the needs of the information age and social and economic development in the 21st century [2]. How to cultivate students' innovative ability, stimulate students to actively think and explore in learning and practice, cultivate interest, form habits, and lay a good foundation for relevant work is a problem that teachers need to constantly think and explore in teaching.

At present, the postgraduate thesis still exists: the content accumulation is not organized, the expression is not professional, the paper lacks the scientific expression, the experience of summarizing the scientific research results, the article lacks the innovation and so on. Innovation is a comprehensive ability, including a lot of content, such as learning ability, imagination ability, analysis ability, problem-solving ability, mainly composed of two levels: first, innovative thinking ability; Second, innovation and practice ability [3-6]. The creative consciousness of thinking activity is manifested as the creative question raising and problem solving. This creative thinking is developed through the acquired efforts, continuous thinking and conscious training. The innovative spirit and consciousness are indispensable abilities and qualities of young people in the new era. The cultivation of graduate students is the cultivation of high-level talents in the country, and more attention should be paid to the cultivation of innovative thinking and learning ability, so as to meet the employment needs of all walks of life in the society, and also lay the foundation for individuals to continue to study and further study. Therefore, how to stimulate students' innovative thinking and enhance their innovative practical ability actively

and effectively in classroom teaching and practice teaching is a very important topic.

This paper studies the ways and methods of cultivating graduate students' innovative thinking and ability through the course of scientific and technological writing.

## II. TEACHING DESIGN OF TECHNICAL WRITING COURSE

The goal of higher education is to cultivate high-quality talents with innovative spirit and ability. Academic inquiry is the essential attribute of graduate education, and the curriculum setting of graduate students must rationally design the curriculum structure and choose the content around the connotation of "academic research" [4]. Based on this, the author pays attention to innovative discussion in the course teaching of scientific and technological paper writing for graduate students, and sets up the course units of independent exploration for graduate students, exploration of innovative characteristics of scientific and technological papers and practical teaching, so as to stimulate students' innovative thinking ability and practical ability, and the cultivation of innovative ability runs through the course.

The teaching design arrangement of this course is shown in Table 1.

**Table 1** Teaching content and elements of science and technology writing course

Course elements	Main content and objectives	Teaching methods	Allocation of time(hour)
Academic norms	The characteristics and writing requirements and norms of the components of scientific and technological papers	Select typical journals and different types of literature and teach their writing characteristics. This paper introduces the specification of bibliographic description and quotation, diagram and so on.	6
The independent inquiry	The selected literature was analyzed	After class, students choose literature independently, communicate in groups, and recommend reports in class	4
Innovation PracticeResearch	Innovative ideas, clever experiments, scientific writing	Invite experts to lecture	2
Reading and Writing	Improve your writing skills through reading	Read up on high-impact papers	2
Submission and publication of scientific and technological papers	The innovative requirements of journals, improving the hit rate of manuscripts, etc	Combined with specific journal introduction	2
Academic moral	Plagiarism and Avoidance	Cases of violation of academic ethics; Avoid methods	2
Writing practice	Writing thesis practice	Select a topic by oneself	After school

## III. INNOVATION THINKING TRAINING AND INNOVATION PRACTICE

### 3.1 Student-centered cultivation of independent inquiry ability

There is a big difference between graduate education and undergraduate education. In recent years, although there has been a great change in the way of undergraduate education, which has given students greater autonomy, it has not fundamentally got rid of the influence of traditional teaching methods, and the knowledge is mainly passed on through the way of teacher's teaching and students' learning. However, the essence of postgraduate education should be to cultivate its academic inquiry. In other words, the content of postgraduate courses should be designed and taught around the core of academic inquiry. Therefore, for the teaching of scientific and technological paper writing of graduate students, the main approach is to divide the teaching content into three parts: preparatory, normative and descriptive. At the same time, follow the principle of matching different teaching contents with different teaching methods[7].

At first, the teaching mode is mainly lecturing, and the main teaching methods are PPT courseware teaching and demonstration teaching. In teaching practice, it is found that although students have high interest in learning content, the practical effect of this "cramming" teaching method is not good. It is mainly reflected in the lack of motivation to mobilize students and the limited enthusiasm for teacher-student interaction. The main contradiction of students' feedback is that the knowledge of the course is very dense, listening to the class with relish, the class operation cannot recall the key points or the actual operation also need to find their own learning materials to master a little [8]. In order to solve this problem, we reformed the division of labor, organizational form and implementation strategy of teachers and students, and realized the transformation of teaching and learning roles.

In order to increase students' sense of participation and cultivate students' practical ability, in order to cultivate graduate students' innovative ability, this course adopts heuristic teaching. After establishing the standardized

teaching of the general concept of scientific and technological papers in the early stage, students can independently explore the writing characteristics of scientific and technological papers in their own research field. Through independent exploration and analysis, the graduate students have a deep understanding of the writing characteristics of each component of scientific and technological papers, and have trained agile and clear scientific research thinking.

In terms of teaching mode, we now more often adopt the teaching method of "learning guidance, feedback and improvement" [5] to guide students' enthusiasm for participation. Take the literature review, one of the main contents of course teaching, as an example. In the first step, we will explain the significance of literature review and main writing methods, emphasizing the writing logic of "start-start-start-start-turn-combination" (research significance of the project - research status and research trend - existing problems in the current research - future research plans and feasible solutions). Then students will write by themselves [9-11].

Each of the 24 students in this course selected one piece of literature to read according to their research direction or field. The number of selected literatures in Chinese and English was similar, with 50 literatures in Chinese, accounting for 50%. Each student made a PPT and gave a class report.

The analysis results reflect the deep thinking of the selected literatures. The students not only analyzed the writing characteristics of high-level articles in this discipline, but also introduced the characteristics of papers published in these journals in combination with the submission requirements of the journals in this discipline (ACS Nano, Green Chemistry, etc.). Some students introduced the articles of the seniors in the same research group, pointed out the shortcomings and gave suggestions for revision. The analysis of the students was very detailed and in-depth, including whether the references in the paper were appropriate, the corresponding author did not correspond to the given E-mail, and the improvement of the title and illustration. Graduate students gain a lot through active participation and interactive learning. The spirit of innovation is formed in the process of cooperative learning, and the cultivation of innovative thinking has a clear path.

### **3.2 Expert Lecture**

Innovation is the soul of scientific and technological papers. It requires that what the article reveals is unprecedented, first or partially first. It requires that something be discovered, invented or created, rather than a retelling, imitation or interpretation of previous work. The value of scientific and technological papers lies in their innovative significance, and papers without innovation or timeliness are completely worthless [7]. If a scientific paper has no new ideas, opinions and conclusions, it is not a scientific paper and has no possibility of publication.

The formation of scientific research innovation consciousness is inseparable from scientific research activities. In order to enable students to better understand and master the connotation of innovation, this course takes the teaching of innovative characteristics of scientific and technological papers as a separate unit, and invites outstanding professors of the university to participate in the teaching. Combined with his own research, the professor introduced the creation process of the thesis in detail through two representative articles.

The professor explained the relationship between scientific research conception, experimental design and scientific paper writing from the following three aspects: 1) innovative ideas -- the proposal and orientation of scientific problems; 2) Ingenious experiments -- solutions and abilities to solve problems; 3) Scientific writing -- the logic and style of thesis writing. In the course of teaching, the professor shared the ingenious experimental design method. Combined with the creation process of the article, the importance of literature reading was explained, and the inspiration of scientific research innovation and academic paper writing came from the accumulation of literature. It is suggested that graduate students should reserve the relevant literature knowledge in their mind in advance for scientific research. At the same time, students should be encouraged to study, develop a serious, meticulous scientific attitude and not eager for immediate success and benefits, do not cheat academic spirit.

Through the practice and discussion teaching of innovative thinking training, students have a deep understanding: independent learning is the premise of innovation, innovation is achieved on the basis of absorbing a lot of knowledge, a person with innovation ability must have a rich knowledge reserve and the ability to learn new knowledge. In addition, you need to use your brain and study hard to achieve innovation. Knowledgeable experts and professors with rich experience in innovation practice play an imperceptible role in guiding students' innovation consciousness, and students feel the joy of scientific research. This kind of participation and interaction emphasizes the two-way communication between teachers and students, which is of positive significance to stimulate students' enthusiasm for scientific research.

#### **IV. Ways and methods to cultivate innovative thinking and improve innovative ability**

##### **4.1 Use cases to guide innovative thinking**

Combining scientific, academic and creative nature of scientific and technological papers, this course aims to cultivate students' rigorous scientific habits. It requires students to respect facts and science, and draw practical conclusions from the actual objective data, without falsifying or tampering with data. Instruct graduate students to respect the work of others in the writing process, reasonably cite others' literature, and strictly prohibit plagiarism and plagiarism. In the introduction of signature, combined with the "Copyright Law", aiming at the domestic submission of a lot of signature problems, especially the concept of the communication person is not clear problem, from the perspective of copyright to explain the significance and responsibility of signature. It is of great significance to effectively exert the guiding role of academic moral education, make postgraduates form good academic ethics and behavior habits, and stay away from academic misconduct, to construct their own academic ethics, improve the quality of scientific research and personality, and train high-quality innovative talents.

In accordance with the knowledge objectives, ability objectives and quality objectives of course teaching, as a general course of introductory scientific research for postgraduate students, the teaching content of scientific research methods and scientific literacy course is constantly optimized according to students' professional background and needs in teaching practice. The specific teaching content includes:

- 1) Scientific literacy and research ethics. The teaching focus includes understanding academic misconduct and how to avoid it, especially the prevention of common academic misconduct such as plagiarism, plagiarism, falsification of data and images. Under this framework, the course is divided into 14 thematic lectures with a total of 32 class hours according to different topics. The teaching content of the course has the characteristics of wide coverage, more knowledge points, combination of theory teaching and practice teaching.
- 2) Literature search, management and analysis. On this basis, students are required to independently complete the topic selection and writing of the literature review paper required by the course. The teaching focuses include paper retrieval based on commonly used Chinese and English databases and Web of Science, analyzing the development trend of research according to the paper and finding influential researchers, software-based literature management and reading methods, and how to find your own research topic from the literature.
- 3) Data analysis, discussion and visualization, understand the graphic image requirements and processing methods of journal submission. Teaching highlights include making two - and three-dimensional graphics, how to present pictures in the results section, and writing discussions.
- 4) Academic paper writing, submission and communication, understand the whole process of paper submission and peer review. Teaching focus includes commonly used IMRD (Introduction - Research methods - Results - discussion) structure and the main content of writing each part, how to communicate with editors, patent writing and intellectual property protection.

##### **4.2 Cultivate innovative thinking and expression ability through reading high-level literature**

There is no doubt that the main purpose of literature reading is to obtain the frontier information of the discipline. At the same time, effective literature reading is also one of the effective ways to learn the method of paper conception and improve writing skills. Make full use of the course instructor abundant literature information acquisition and processing power, combined with SCI retrieval system, and is commonly used in the research field of the database of graduate students and high impact papers selected as a case, analysis of literature, help students to understand the discipline front, learning and imitating the structure design and writing skills, comprehension innovation connotation. For example, the latest Review papers in related research fields in SCI database and high-impact papers from American Chemical Society (including the most read, downloaded, recommended by editors, etc.) are selected as specific cases. Guide the student to analyze these high level paper conception, the basic train of thought to analyze and study problems, specific chart reference standard in the writing technique, review articles, etc., so that students in a thorough understanding of frontier disciplines at the same time, improve the ability of acquiring information and learning information, improve the students' lasting interest in new phenomenon, new things, perception, Cultivate good innovative thinking mode and good academic ethics [8].

The establishment of corpus is an effective way to help graduate students to write English scientific and technological papers. At present, only a few schools, such as Shanghai Jiao Tong University, have established a corpus of English science and technology papers to help graduate students write English science and technology papers. In fact, the most difficult thing for graduate students to write English scientific and technological papers is not to put forward academic ideas, but to organize and express the language. Scientific paper writing has very high requirements on the use and organization of language, and many words have their own special ways of

expression. For example, when we want to mean "about", we usually think of the word "about" because we use it a lot in everyday conversation. However, in the writing of the scientific paper, we require the use of "proximity", because "proximity" is more written and standardized than "about".

## **V. Embodiment of innovation achievements: submission and publication of papers**

Submission and publication cannot be separated from the contact with editors. It mainly includes two aspects : (1) peer review system. This paper introduces the review system and peer review system of the journal, so that students can have a preliminary understanding of the review process and the role of reviewers in the whole review process, so that they can take a more positive attitude towards the review results. (2) Submission and contact with editors. This article introduces the experience and methods of selecting target magazines and recommending reviewers, explains the preparation needed before submission, and introduces the process and matters needing attention of online submission. This paper introduces the content and writing emphasis of the submission letter, and introduces the methods and skills of revising the manuscript and replying the comments through examples.

According to China's scientific research evaluation commonly used core journals for the specific requirements of paper originality, Nature, Science and other top journals are introduced in the innovative requirements, make the student fully to realize different journals demand for innovative, a paper or a research topic is not necessarily a big, but the study must be thorough, the results must be profound, it should reflect the researcher's original insight. After the focus on how to improve the hit rate of submission, such as objective evaluation of their own paper innovative level, the selection of their own paper level appropriate journal submission; Do a good job before submission of the manuscript format and other checks, develop a rigorous scientific attitude and habits; Manuscript tracking and inquiry after submission. Especially emphasize and guide students to pay attention to the ethical code of paper publication, avoid academic misconduct and the phenomenon of more than one manuscript.

## **VI. Writing ability training homework**

Scientific, innovative, logical and accessible are the salient features of scientific and technological papers. No matter how valuable scientific research is, the work cannot be considered final until it is published in the form of a paper. Therefore, scientific writing is an important part of the process of scientific and technological research, but also an important part of scientific and technological research. Scientific research work generally consists of four steps -- research topic selection, data collection, research experiment and paper writing and publication. That is, starting from research topic selection, satisfactory research results are obtained through data collection and research experiment, and then systematic paper writing work. "Science and Technology Paper Writing" is a public elective course for first-year graduate students. The first-year graduate students have already started to contact the topic, some students have started to participate in the group meeting, and have a certain understanding of their research direction, and some students are recommended to direct doctoral, and will continue to study on the basis of the original graduation thesis. Therefore, the final practical assignment is to ask students to write a paper in a related field, putting the theory learned in class into practice. This requires students to use their spare time to find a large number of materials, through reading and analysis to master the latest research trends in the relevant field, accumulate materials, improve the ability of document information collection, sorting, processing and utilization, and lay a good foundation for future scientific research.

The problems of students in the writing process mainly focus on the following aspects: first, the standard aspect, including the reference serial number, citation source, diagram order and table notes do not meet the standard; Second, the content is just a list of literature, lack of their own summary and opinions, for the chart lack of content analysis. The author analyzes and summarizes the problems existing in students' writing and gives clear suggestions for modification.

Through the practical training of scientific and technological paper writing course, graduate students have an in-depth understanding of how to construct research ideas, how to write scientific and technological papers, how to publish quickly and other relevant knowledge, accumulated writing experience and improved innovation ability. Reference management is also the embodiment of improving writing ability. According to the standard requirements of reference format in scientific and technological papers, the characteristics of several common reference management software are briefly reviewed. This paper focuses on the introduction of NOTEEXPRESS software, and demonstrates the functions of NOTEEXPRESS software in literature collection, management, auxiliary writing and document sharing through examples, so that students can preliminarily master the methods and skills of NOTEEXPRESS software for document management.

Origin Drawing instance. This paper introduces the drawing principles and basic elements of data graph. Through the example to demonstrate the Origin software in graphics rendering and data processing two aspects

of the function, so that students initially master the Origin software to draw data graph and data processing methods and skills.

## VII. CONCLUSION

In order to effectively train graduate students innovative thinking, and improve the innovation ability of graduate students and with science and technology thesis writing course as the breakthrough point, analyzes the graduate student exploring path of technical writing, make a lot of beneficial exploration and practice, has gradually formed a perfect training system of education mode, constantly promote an improvement of the graduate education quality in colleges and universities. In the course teaching of scientific and technological paper writing, the students' scientific research ability, innovation ability, logical reasoning ability, inquiry ability, observation ability and thinking ability have been improved to a certain extent by optimizing the course setting and changing the teaching method, and the academic moral cultivation has been improved. The students are gradually equipped with good scientific research attitude, rigorous scientific style and innovative thinking consciousness, which provides new ideas and methods for cultivating high-quality talents with innovative spirit and innovative ability.

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