Exploration of Enhancing Graduate Students' Innovation Abilities Based On the Advantages of Instrument Sharing Platform

Xun-Lan YANG¹,²,a and Li-Hong WU¹,b,*

¹School of Materials Science & Technology/ Advanced Analysis & Computation Center, Zhengzhou University, Zhengzhou 450001, PR China
²Water Environmental Monitoring Center of Yellow River Basin, Zhengzhou 450002, PR China

a xunlan@163.com, b wlh@zzu.edu.cn
*Corresponding author

Keywords: Graduate Students, Sharing Platform, Scientific Instrument, Innovative Abilities.

Abstract. The opportunities and abilities of college graduate students to engage in scientific and technological innovation by using scientific instruments are limited, and the professional laboratory staffs are fewer. Aiming at the above problems, the new patterns are proposed. Based on the advantages of the new instrument sharing platform as the carrier, for example, multi disciplines, advanced equipments and open sharing mechanism, training mode of instrument training teaching, test practice and skill assessment for graduate students in related disciplines are explored. The basic theory, methods and skills training are emphasized. And by improving the system, such as strengthening testing practice by the combination of their own topics and the test case analysis mechanism of the responsibility professor, graduate students’ innovative abilities are enhanced.

Introduction

Scientific research needs innovation, and the innovation ability reflects the comprehensive ability of graduate students. But, it has become an important topic in the cultivation of graduate students in colleges and universities that how to train graduate students’ ability to engage in the practical, scientific and technological innovation work, and which is also an important goal of the current graduate training in China [1,2,3]. Laboratory is one of the core resources of high level universities, where the cultivation of graduate students’ innovation ability is accomplished by the scientific research [3]. Scientific instruments are the key elements of modern scientific research, and the advanced instruments and equipments are the important part of university sharing platform or laboratories. Scientific instruments are the necessary hardware guarantee to carry out experimental teaching, which not only plays an important role in scientific research, and but also is an important way to cultivate innovative talents [4,5]. With the rapid development of science, the students are eager to understand the frontier knowledges, and society and employers pay more and more attention of college graduates’ innovative and practical abilities, especially the high-tech operation and utilization of large instruments. The cultivation of graduate students’ innovation ability can not be separated from the learning and practice of scientific instruments [6].

At present, the utilization rate of the large-scale analytical instruments distributed in departments and laboratories is low, and the use of them is still at the sample testing level. At the same time, high-level professional and full-time experimental personnel are fewer and their enthusiasm is lower, which above are the main problems of the university laboratory or instrument platform. But for the majority of graduate students hands-on opportunities are few, they lack the use of large analytical instruments to explore the unknown scientific research field and the discovery of natural law intuitive understanding [3,4,5], which is also a big defect to achieve their own technological innovation and innovation ability. There is a big gap between the large number of idle equipments and the lack of practice opportunities and low innovation skills for graduate students, and there is not an organic combination between equipment resources and human resources. Therefore, it has become the consensus of colleges and universities in actively promoting the construction of
instruments sharing platform, to maximize the mobilization of external resources and platform advantages to cultivate talents with innovative skills [5,7].

**Accurate Positioning to Promote the Construction and Operation of University Sharing Platform**

With the release of "opinions" of the State Council on major national scientific infrastructure and large scientific instruments open to the community, to further promote the sharing of resources, improve the management level and the use efficiency of large-scale instruments, a college-level instrument sharing platform, named Advanced Analysis & Computation Center is set up in Zhengzhou University. The instrument sharing platform better implement large scientific instruments sharing open guidelines, which provides strong support for school key discipline construction, high level scientific research innovation and interdisciplinary research. Since two years, the university has invested 15 million yuan for improving the basic environment, and now the center has completed the relevant construction work in accordance with the requirements of the standardization laboratory. The total large instrument funds are about 50 million yuan through direct investment of the university and indirect investment of related departments. It has been involved in the fields of surface morphology, structural analysis and component analysis. More than 10 sets of related advanced instruments have been running, such as scanning electron microscopy, electron microscopy, X-ray photoelectron spectroscopy (XPS), inductively coupled plasma-mass spectrometry (ICP-MS), confocal microscopy, nuclear magnetic resonance spectroscopy (NMR), magnetic measurement system, X-ray diffractometer, ion mobility imaging system, etc. At present, there are 8 full-time employees in the center, including 7 ones with a doctoral degree, 4 ones with a senior title, 3 ones with graduate tutor qualifications. The construction and operation of the center are carried out simultaneously. With more instruments being installed, professional analysis personnel are gradually increasing.

**Playing Platform Advantages to Explore the Training Mode of Graduate Students’ Innovation Abilities**

A large number of graduate students are an important group in scientific research in university, but it is very difficult for them to make use of the instrument to engage in scientific research, which is extremely detrimental to the cultivation of innovation skills. Therefore, it is an important way to solve the above problems by opening scientific equipments, especially for the public sharing platform. Advanced Analysis & Computation Center of the university is an interdisciplinary public sharing platform, and the service carrier of technological innovation for teachers and students. Therefore, it is of great significance to explore the use of public sharing platform to improve the innovation ability of graduate students. At present, the relevant domestic colleges and universities are constantly exploring various models, which provide a reference for us [8]. For example, the teachers and students after passing the training are allowed to finish the test on their own. But it needs further study according to the current school situation to take advantage of the platform, and to improve the training mode of graduate students' innovation ability. By nearly a year of exploration, skills training mode for graduate innovation suitable for the center operation has been basically formed. The main contents are as follows: theory and on-line training, selection and deployment center, completion of the test, check and issue test qualification certificate.

**First is Theory and On-Line Training.** A lot of scientific instruments are damaged not because of the use but the long-term placement, so instrument opening for graduate students can improve their life and utilization, reduce maintenance costs. At present, equipment training for graduates has been carried out by making mainly full use of idle equipment or combining the test tasks. Before training, the center first published a notice on the website, and interested graduate students can log on to the network platform through the campus card account for registration. After reaching a certain number of classes, the centor determines the training time, and notifies the individual through the platform. Training content includes a certain theoretical hours and a longer training...
machine times. After the graduate students have passed the test, the center is registered for selecting graduate assistant subsequently. Since running for a year, the center has trained 15 batches of more than 100 people, and who have been qualified, initially with the independent operation ability of the relevant instruments.

**Second is Selecting Qualified Students and Assisting Test.** Based on the needs, the center will select some outstanding students from the trained and qualified ones as an instrument assistant administrator to assist testing. These students assist the teachers in charge to analysis and test, and which ease the lack of high-level professional laboratory personnel to a certain extent. The students in the center is maintained at about 20-30 person everyday, ensuring the smooth operation of the instrument, and who can also engage in their own topic testing in the idle instrument or in free time. For no selected students, if they also need their own topic testing, they can make an appointment directly through the platform, and independently complete their own test in the specified time after the audit. This not only enriches the test mode, but also gives the opportunity for the students to practice on the instruments. It can deepen the intuitive understanding of the subject, and is conducive to the completion of the scientific and technical subject.

**Third is Check and Issuing Test Qualification Certificate.** Graduate students in the center completed experiment and practice of the specified time, which greatly improved their own skills and practical abilities to adapt to future work. The students can put forward the appraisal application after completing the test requirements. The center will assess and examine their comprehensive test skills according to the relevant methods, and reference user complaints and feedback, advices of the teacher in charge, testing machine, targeted contrast test. Finally by audit opinions of the assessment team, the test certificate is issued to them or not, whose analysis skills are more likely to be recognized, ans is conducive to employment or further study. The instrument sharing platform is a multi-disciplinary research platform, where it is not only conducive to idea collision and knowledge innovation of graduate students, but also the aggregation and innovation ability cultivation of the students from different disciplines. It is said that these students have been favored by employing units in the talent market because of the experience in independenly using large scientific instruments to engage in scientific research.

**Perfecting the System to Ensure Continuous Cultivation of Graduate Innovative Skills**

Combined with the characteristics of students in local engineering universities, Wang Yongqi explored the innovation ability cultivating mode and mechanism of diversification talents [9]. But the platform for graduate students’ innovation ability training is an instrument sharing one in our university, which involves many subjects and has a wide range of graduate students. As a result, a good training mode for graduate students' innovative skills needs a good management mechanism, which can guarantee the smooth operation and continuous implementation of the program.

**First is Establishing a Good Test Platform Atmosphere and Incentive Mechanism.** Laboratory technician is an extremely important part of the laboratory staff, and they not only ensure the level of scientific research in Colleges and universities, but also play an important role in the cultivation of graduate students. The center encourages the teacher in charge of the platform to undertake or participate in the instrument training and the teaching task by setting up the corresponding work evaluation mechanism. The teaching and training courses of teachers in charge can not only be converted into the corresponding test machine time, while the completed work by graduate students can also be reduced as part their work, which stimulate the enthusiasm of experimental work.

**Second is Establishing a Good Mechanism by Combination of Testing and Their Own Topics.** All graduate students voluntarily receive training and actively participate in practical testing to play their potential full. These teachers and students are also supported and encouraged in using spare time to achieve their own project test after the completion of the normal test tasks. Graduate testing fees are given a substantial discount or relief. For the graduates published high-level papers and academic research, incentives and subsidies are established by using test funds to reward them after the approval of the school. At present, 8 qualified graduate students have been rewarded according to the standard.
Third is Establishing a Test Analysis Mechanism Led by Responsibility Professor. The center sets up a committee of experts, and through the cooperation with the expert committee members and related disciplines well-known professors, establish relevant working mechanism, such as making the difficult test project plan, analyzing the result of the test, and carrying out the special lectures and training. These students are encouraged to participate in the whole analysis process, which further enhance the level of graduate analysis and innovation, broaden the horizons. At the same time, the well-known professor is also the relevant instrument assessment team leader, and the graduates are examined by the leader according to the requirements of the graduate examination and quality assessment. The examination result is the important basis for determining the qualified examination and issuing the test skills certificate.

Fourth is Establishing a Systematic Teaching and Training System Based on Practicality and Popularization. Based on scientific testing practice, a popular training and the test practice plan are established to enrich and improve the training of teaching and practice. The lessons and knowledge in actual test course will be fully accumulated to achieve the organic unity of teaching and practice training test, and improve the quality of training and practical testing. At the same time, these above will make a demonstration for the guidance of training and testing. In view of the different instruments, the theory training and the test are carried on for the graduate students from the related discipline. Through the application to whole school, the theory and practice of graduate students' experimental test are systematically formed, such as teaching experiment of electron microscope and mass spectrometry. As a result, we should continuously improve the test management, the quality of training and practical test abilities, and improve the innovation abilities of graduate students through the systematic experimental teaching plan.

Conclusions

University instrument sharing platform and a large number of graduate students are organically combined, and which will play their respective advantages and strengths. Graduate students alleviate the shortage of full-time staff, improve equipments utilization rate, and provide a support for the discipline construction and scientific research innovation. And then, instrument sharing platform provides a good opportunity for graduate students to practice, and ultimately enhance their innovative skills. Finally, universities, centers and graduate students and other win-win situation have been realized.

Acknowledgement

The study is supported by key project of Henan higher education (No.17A630063).

References


