

An Exploration into the Development Mode of Innovation Talents and SIT Practice on the Basis of Architectural Design Teaching Perspective of Research-type University

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Abstract—This paper firstly discussed the teaching characteristic of SIT Project of research-type university as a talents development mode to improve innovation ability. Then, it expounded that for the teaching of architectural design, the SIT was not only a supplement to the content and form of regular teaching, but more to the improvement, optimization and balance for current teaching mode. This paper adopted a case of the unfolding of SIT in the School of Architecture of Hunan University, explored the generality and specialty of innovation education mode of research-type university in the professional teaching of Architecture. At last, this paper also discussed the existing problems.

Keywords—*Research-type university; Undergraduate teaching of architectural design; Innovation training; Teaching mode of architectural design*

I. INTRODUCTION

In the current process of China's higher education development, there are constant changes occurring to the methods of developing undergraduate students in order to achieve overall improvement of students' comprehensive quality and attain better development effect so that those developed students could be enabled to better adapt themselves to the current demands of social development. Meanwhile, to deepen the implementation of Suggestions on the Implementation of Deepening Innovation and Entrepreneurship Education Reform in Colleges and Universities from the General Office of the State Council, focus on invigorating the new driving force to deepen the reform, as well as to accelerate all the colleges and universities in all areas to have their reforms newly paid off, innovation training project has been newly added to the practice teaching link for the development of undergraduate students with the approval of the Ministry of Education in recent years. Undergraduate innovation training project bears important significance on promoting the reform of talents development modes [1]. It is proved during the implementing process in practice that undergraduate innovation training project has already been an integral part in the practice teaching link for undergraduate students. Students who have taken part in undergraduate innovation training project have been improved to different extent in terms of practical ability,

scientific research quality development as well as innovation ability enhancement, which has laid a sound foundation for either work or further study after their graduation.

With complete classification of disciplines, research-type university is possessed with advanced facility and resources for scientific research, first class teaching resources and excellent students, as well as extensive international cooperation and communication with the top universities abroad. Those education edges create favorable conditions to cultivate outstanding innovative talents, and develop innovative groups and prominent leaders in such important fields as science and technology, enterprises, culture, social management and etc. Therefore, the core task of research-type university is to innovate knowledge; meanwhile, its main objectives are to develop outstanding innovative talents of high quality [2]. Innovation ability is both the key objective for research-type university to develop undergraduate talents at the current stage, as well as a difficulty in the development practice.

From the teaching perspective, talents development mode includes talents development objectives and specifications, major settings and development, curriculum system, teaching content, methods, assessments as well as quality monitoring, and etc, covering many elements to develop talents such as development objectives, content, methods, and conditions. Therefore, talents development mode is characterized by the general features of a mode, i.e. complexity, paradigm and imitativeness, and etc. Analyzing from the education rules, it also has its own features: first, purpose to promote human and social progress; second, initiative to fully stimulate and mobilize the participation by subjects at all levels; third, in line with the regularity of higher education rule; fourth, diversity of talents development mode determined by diversified demand for talents. The conduct of the undergraduate innovation training project is a new mode for research-type university to develop innovation ability for undergraduate teaching, which remains in a process of practical and theoretical exploration and development [3]. The paradigm in the generality as well as the activity and diversity in the specialty of innovation education mode in Architecture's professional teaching is the focus explored and discussed by this paper.

II. AN OVERVIEW OF THE DEVELOPMENT AND RESEARCH OF INNOVATION AND ENTREPRENEURSHIP FOR UNDERGRADUATES BOTH AT HOME AND ABROAD

According to the data from the website of National Students' Platform for Innovation and Entrepreneurship Training Program, and as requested by the Notification on the Submission of Approved Projects of National Students' Platform for Innovation and Entrepreneurship Training Program in 2017, 115 colleges and universities affiliated to the Ministry, and local departments responsible for education of 31 provinces submitted the projects of National Students' Platform for Innovation and Entrepreneurship Training Program in 2017. 36000 projects have been approved after examination and verification, among which, 29878 were innovation training projects, 4124 entrepreneurship training projects, and 1998 entrepreneurship practice projects. In the same period, National Students' Platform for Innovation and Entrepreneurship Training Program hosted the academic paper, exhibiting projects and entrepreneurship road show of the 10th National Conference on Undergraduate Innovation and Entrepreneurship and 10th Anniversary Celebration, which included the publishing of academic paper publication, and screening of the report papers and excellent papers. The Conference organizer screened about 200 pieces of academic paper to take part in the Conference on Undergraduate Innovation Communication. Undergraduate Innovation and Entrepreneurship Projects Exhibition, Undergraduate Entrepreneurship Projects Road Show, and promoted entrepreneurship projects mainly include: brief introduction to the team, the degree of project practice, project's market performance, project accomplishments, the task achievements and existing problems in comparison with the expected plan and objectives, the development plans and strategic arrangement in the next step, entrepreneurship process and perception, to name but a few. The Conference organizer would screen about 50 entrepreneurship projects, each assigning 1 student to take part in the Undergraduate Entrepreneurship Projects Road Show. The organizing committee of the National Conference on Undergraduate Innovation and Entrepreneurship organizes the Expert Working Group for the National Students' Platform for Innovation and Entrepreneurship Training Program and the experts from the coordinating group of Provincial Students' Platform for Innovation and Entrepreneurship Training Program, as well as experts from colleges, universities and industries to together form the reviewing group, which carries out a three-tier evaluation and review of the qualification and form examination, online and conference evaluation and review for the recommendation by colleges and universities affiliated to the central ministries and commissions. Also, experts double check and authorize the papers and projects to take part in the Conference from local colleges and universities after determination by administrative departments responsible for education at provincial level. Therefore, it can be seen that SIT Project has already become a quite significant platform for colleges and universities in China to develop innovation and entrepreneurship talents.

Higher education in Japan has been increasingly attaching importance to entrepreneurship education in assisting students

to foster entrepreneurship spirit. It is regarded that entrepreneurship and innovation education is a set of activities in touch with curriculum, research and industries both in and out of the agencies with the aim to foster personal entrepreneurship mentality. Each and every curriculum has various learning objectives, materials, topics, teaching methods and teachers. Strengthening the Development of Global Entrepreneurs Plan by Japanese government aims to develop human resources. The creation and establishment of new enterprises will be promoted with the support of current companies, so as to create an innovative entrepreneurship ecosystem. A 3-year innovation and entrepreneurship project is carried out in higher education as one part of the research project sponsored by government for Japanese entrepreneurs. The long term objective of this research project is to understand the mentality of international entrepreneurs. Looking for innovative concept and the researchers will provide suggestions for employees and decision-makers when research on undergraduate innovation projects concludes [4].

With the national range, many colleges and universities have already taken on the practice and research on the combination of SIT Project and teaching, however, there are few teaching papers, monographs and other materials published. There are only a small number of relevant papers after searching in the Web of Science. Therefore, summary and communication of research and practice in this regard are urgently needed, which will be beneficial to further promoting the development of SIT Project, enhancing the guidance and then promoting the teaching reform and development.

III. FEATURES OF TALENTS DEVELOPMENT MODE OF UNDERGRADUATE INNOVATION TRAINING PROJECT

In order to respond to Hunan University's initiative to promote development by reform in our university, the teaching of architectural designing has formulated an implementing system of mode to develop talents for innovation with curriculum system reform as the key, and the sound teaching environment construction as the back-up to promote the reform of talent development mode in an all-round manner. A link of innovation is set in students' after-school activities, and practical activities have been carried out in a great number. Designing of after-school research activities for college and university students is implemented, and the sophomore students are guided to carry out SIT training project in relation to the architectural designing curriculum integrated with architectural design discipline, and at the same time, enable it to closely interlock and complement with the classroom teaching. Students will have their scientific research quality steadily enhanced in the stage of undergraduate teaching, with the development objectives for students' scientific research innovation in higher education continuously accomplished and developed.

From the perspective of education rules, apart from the purpose to promote the human and social progress as well as in line with the regularity of higher education rules, SIT innovation talents development mode is also equipped with the activity to fully invigorate and mobilize the participation by subjects at all levels, as well as the diversity of human development mode.

A. Strengthening the students' initiative in scientific research

In China's higher education, the majority study during the previous 2 years of undergraduate development is in the foundation courses of architectural designing, and meanwhile, part of the foundation courses related to the major is also set up in accordance with its different nature. The professional courses of this major still have rather abstract understanding in the major's knowledge and are filled with curiosity and expectation. Since the topic selection of the undergraduate innovation training project is just right in the second half of the sophomore year, students' demand and desire to understand the professional knowledge is able to be fully satisfied. "National Students' Platform for Innovation and Entrepreneurship Training Program" conducted by colleges and universities can attract active and excellent students to be trained in the field of scientific research in advance, and know about the latest knowledge of this discipline, so as to prepare for further study. On the basis of finishing the foundation courses at the current stage, students' interest in scientific research will be raised up all at once by the set-up of undergraduate innovation training project. Students will be grouped by 3~5 people according to their own study interest in each and every area of specialization, and then choose its suitable mentor. The team members and the mentors will get together to communicate their own research thinking on the topic of the specialization area, and then explore to determine on the project name, research content, research results in anticipation, budget demand to unfold the project, and etc. After deciding on all the content related to the project, the mentor will arrange students to refer to the literature related to the project, the process of which is exactly the one to develop students' interest in scientific research. Generally speaking, the research duration for one project is 1.5~2 years according to different research content. 10~20 weeks during the research period will be made the advantage of to refer to relevant literature so as to prepare and lay sound foundation for the implementation of the project. In the 6 years from 2012 to 2017, more than 200 students from the School of Architecture in Hunan University duly concluded 20 national SIT. It can be easily seen that how strong the interest of students is in the research of innovation training for scientific

research, which enables us to successfully attain the goals to develop students' scientific research interest.

B. Improving students' practice and innovation abilities, fostering scientific research thinking

With the extraordinary development of science and technology, mankind's constant exploration into the unknown of the architecture and existing environment, as well as the continuous intersection and integration among designing field and other scientific fields, majors in Architecture and Building Design set even higher standards for the development of students' innovation ability in scientific research. Students of Architectures not only need to develop their thinking in designing, but also in scientific research. However, for undergraduate students who have been traditionally trained after middle-high school education, it is an important task for students to both rapidly adapt themselves to the new teaching mode of higher education, and also to make certain progress in the aspect of practice and innovation after their studying in colleges and universities. Meanwhile, institutions of higher learning also need to constantly create scientific research exchange and practice platforms for students, and encourage them to take part in the undergraduate innovation training project so as to lay a solid foundation for China to transform into an innovation-type country. In the undergraduate innovation training project, students will enter into the stage of implementing the experimental project right after their finishing in referring to and studying in relevant literature for scientific research.[Figure 1] [5]Right now, they become junior students to officially start their study in professional courses. The conduct of undergraduate innovation training project rightly provides good opportunities to practice the theoretical knowledge of the professional curriculum. The professional theoretical knowledge and skills acquired by students can be comprehensively applied to, which plays an unparalleled role against classroom teaching for students to master scientific research methods, improve practical ability and develop innovative thinking.

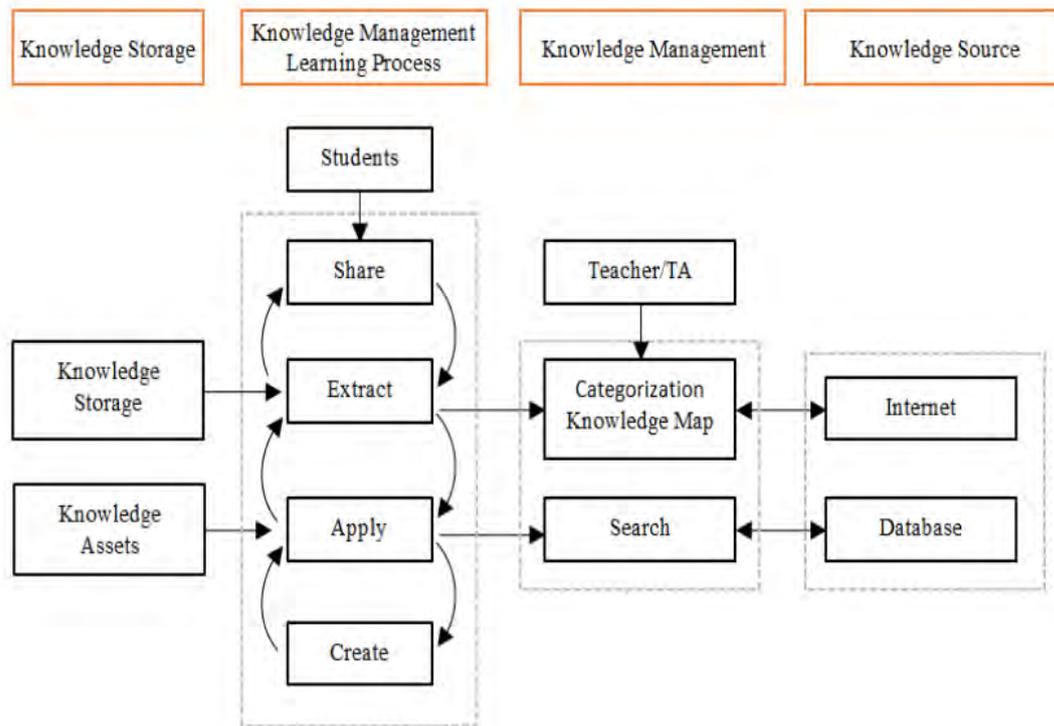


Fig. 1 Architecture Design Knowledge Management Learning System and Learning Activities

Undergraduate innovation training project has budget support in correspondence to different levels, which enables students to better manifest their innovative thinking. For instance, they can create instrument and apparatus on their own, develop, research and manufacture professional software, make report on the latest research progress of the topic, and etc. It is in the implementation stage of the project that toughens the students' innovation ability the most. Under the guidance of the mentor, students will continuously forge ahead towards the top research objectives of the project, seek solutions together with all the team members when faced with problems, constantly test the experimental results, and until reach the optimal research effects at last. Students will draft project proposals, mid-term check chart, phase deliverables reports, conclusion application, defense report PPT, and other materials on their own. They can also apply their research results for national patents, and publish their papers. This enables students to constantly improve their own innovation ability in scientific research. Harvest reaped from undergraduate innovation training project is not limited to the ostensible achievements, but students' overall scientific research quality has been largely enhanced.

C. Developing diversified talents to lay a foundation for further development

Higher education has developed abundant professional talents for the country, whereas the development of high-end talents should also be incorporated into the development objectives. In recent years, the constantly expanded enrollment of students into colleges and universities and the increased pressure on employment make part of the graduates have to

keep further studying, so as to expect better livelihoods after graduation. However, further study cannot be accomplished by immersing oneself merely in mechanical study. Students also need to obtain achievements in scientific research for successful graduation. Through undergraduate innovation training project, students will not only have profound understanding in the work of scientific research, thus improving personal scientific research quality, but also are spiritually cultivated to be promoted for overall development. Therefore, undergraduate innovation training project is a key to developing innovation ability by equipping students with overall and sound comprehensive quality. The participation and accomplishment of undergraduate innovation training project enable students to experience a complete process of a small scale project of scientific research, which is largely different from that of the practice of finishing graduation paper. With a sound practice foundation laid to further study after graduation, students who take part in undergraduate innovation training project are more advantageous than those who don't. Innovation training project not only develops students' attitudes of independent thinking and prudential learning, style of down-to-earth and pragmatic scientific research, but also brings out students who are equipped with scientific research ability and creative thinking by means of carrying out the project, so as to upgrade their confidence and passion towards scientific research. The student presiding A Study on the Generation of Architectural Form on the Basis of Fractal Mathematics, a national SIT project of the School of Architecture of Hunan University continues to further study EMBA in Tsinghua University. Therefore, it can be told from this case that taking part in undergraduate innovation training

project can not only develops students' scientific research interest and practice innovative ability, but also arouse their enthusiasm for further study, which will be continually made use of by students for further study after graduation as undergraduate students. Graduates truly equipped with the innovation ability in scientific research are headier with facility when taking on the work related their major, in particular when pursuing further study or scientific research work. The development of students' innovation ability in scientific research at the stage of undergraduate teaching is of great importance. Positive role of practice teaching in upgrading students' scientific ability improvement should be given full consideration, so as to lay a solid foundation for the development of high-caliber personnel.

IV. SIT PROMOTING THE COMBINATION OF TEACHING AND SCIENTIFIC RESEARCH OF ARCHITECTURAL DESIGN

Scientific research plays a promoting role for talents development. When it particularly comes to developing innovation-type talents, teaching and academy are inseparable, but to form a sound pattern of carrying each other. Teaching and academy are by no means contradictory, but to form a benign cycle of promoting each other. High-quality education for teaching should be supported with high-level scientific research to reconstruct the balance between teaching and research [6].

A. Balancing the combination of SIT and teaching, optimizing current teaching structure

The features of the professional education of Architecture in Hunan University are: reliant on the comprehensive education platform shaped by disciplinary group of civil engineering, environment, and social science of Hunan University, characterized by broad caliber, thick foundation and strong capacity, introducing advanced teaching concept, education theory from abroad, combining with regional culture, bringing out local characteristics, and developing talents in architectural profession who are possessed with professional ethics, a sense of social responsibility, solid professional foundation, strong designing creation and adaptability, high comprehensive quality as well as innovative awareness and practical ability [7].

Professional basic training enables students to master scientific designing and practicing method, familiarize with basic principles and operating methods mainly through curriculum experiment, design and other forms to foster students' prudential working style and learning spirit, so as to lay a certain foundation for the professional course study and professional practice. As for the training of professional research ability and professional technology comprehensive ability, they are mainly conducted through SIT Project. Together with research relevant to professional curriculum design, professional internship, comprehensive curriculum design and other forms, students' professional core applicability is developed, which is the most important link in the development of students' professional ability [8].

"Ability Expansion Training" is to develop students' comprehensive ability through social practice, real project

operation and participation, and etc. As an effective method and experimental field to promote teaching reform, SIT Project provides opportunity and reference for regular teaching to explore new thinking and method. As a research-type university ranking among the national first class, many students reflect that university study and life haven't enabled themselves to fully reinvigorate their potentials [9]. They need to increase the academic standards and challenges. Learning experience with coexistence of challenge and support needs to be created for students. SIT Project training is a development method to comprehensively upgrade "professional comprehensive ability training" and "ability expansion training" for a handful of students. SIT Project and the teaching of architectural design realize the combination of "professional basic training" and "professional ability training", as well as "professional comprehensive ability training" and "ability expansion training".

Therefore, reliant on the platform of disciplinary group, undergraduate innovation training constructs a multi-dimensional and opening-up teaching system, emphasizes on the innovative guidance in the link of practical teaching, as well as balances and optimizes current teaching structure while focuses on the development of students' comprehensive quality, and strengthening of the training for basic ability.

B. Structural supplementation of the set-up of teaching link by SIT

With undergraduate innovation training project as the core, innovative teaching link is set and attainment of innovative ability, emphasized on. Colleges and universities set up the innovation teaching link in parallel with theoretical teaching link, and practical teaching link in the talents development program. With undergraduate innovation training project as the core, all of the undergraduate students are incorporated into undergraduate innovation training project, thus being a compulsory link in their undergraduate study. Ever from the junior year, mentors will fragment their own scientific research topics into the sub topics that can be participated and finished by undergraduates, who will then choose the projects according to their own interest and area of specialization. The projects are divided into one or two years of period. Each project will be freely composed of by 3-5 students to guarantee that all the students can truly take part in. Students will be scored with correspondent credits of innovation teaching link according to their deliverables when the project concludes, and can be duly connected with their graduating paper. By doing so, the development of innovation ability will link through the entire undergraduate stage.

C. Scientific research promotion is the improvement of teaching method

Most of the selected topics in the undergraduate innovation training project come from the scientific research topics of teachers. The scientific research topics can be classified into 2 categories: one is the type of research into scientific foundation theory. These topics emphasize on the system and innovation of scientific knowledge, with certain kind of academic level. They require students to be equipped with solid basic theoretical foundation, and self-conscious innovation

awareness. Many students directly take part in the scientific research work of Provincial and National Natural Science Foundation and other projects undertaken by the instructing teachers. This guarantees a high threshold for undergraduates to take part in the scientific research, and brings students into a higher platform of theoretical research. The other classification of scientific research topics is oriented towards the application of practical engineering [10]. As an engineering focused university, the topics in combination with engineering practice take up a large proportion. From 2012 to 2017, for the School of Architecture of Hunan University, the proportion of national SIT engineering applicable topics is as high as 80%, whereas the type of scientific theoretical research, 20%. Practical engineering topics focus and emphasize on the basic engineering training. Considering the theoretical basis and ability of undergraduates, mentors fragment their own topics into several sub topics, and 2-3 students coordinate to finish one sub topic. A Research into the Usage Evaluation on Maker-space Office and its Optimization Strategy by the School of Architecture, a “research into the maker-space office space” finished by 6 students comes from research topics related to the urban innovation space undertaken by the mentors. In doing so, the difficulty degree of research is lowered down, which becomes in line with the teaching and research requirement for undergraduates; on the other hand, research topics in possession with practicality are advantageous to mobilize students’ interest in learning and thinking, as well as increase learning activity. More importantly, it is beneficial to developing the practice and innovation abilities, which lays a sound foundation for the later work and further study for students.

Promoting teaching by scientific research, actively exploring the method and path to promote the development of high quality talents with high level scientific research, so as to realize the virtuous interaction and circulation of talents development and scientific research, further strengthening the scientific research and self-independent innovation ability for colleges and universities with high quality of talents development, striving for the construction and development of high quality talents, and bringing the special advantages and core function of colleges and universities in the national innovation system into a better play.

V. CONCLUSION

In recent years, colleges and universities have strengthened the development of students’ innovation engineering practice and ability, as well as strived to enlarge the benefits for students through the reform of experimental teaching methods for undergraduate innovation training, as well as the sharing and opening-up of teaching and scientific research laboratories. SIT Project carried out by the Ministry of Education promotes the innovation education, which has achieved prominent effects in the School of Architecture in Hunan University. However, according to the present situation, students are still in lack of practical training in real terms, and the reasons behind are: first, be it teaching project or innovation one, the source remains to be the teachers’ teaching scientific research, which is still distant from the engineering problems in real terms; second, due to limited financial investment, the updating of instrument

and equipment in colleges and universities is slower than that of the enterprises. Both the scale and procedural completeness of the experimental equipment are hard to embody the requirement for engineering education; third, the social evaluation methods currently carried out in colleges and universities are in short of evaluating the talents development quality, which is hard to improve the teaching quality; fourth, in lack of the teachers integrated with the quality as scholar, entrepreneur, and teacher; fifth, influenced by the factors such as enterprises’ safety risks, economic benefits, and etc, innovative projects still remain at the research level, and the internship and practice education modes currently carried out are hard to satisfy the demand in real terms. Therefore, a working method more closely linked with the reality needs to be sought.

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