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Exploring Undergraduate Active Innovation Ability Training via Research Project for Transformational Development of Chinese Local University

Ying-kui DU[1], Yuan-hang CHENG[1], Dan TIAN[1] and Yang DU[2,a,*]

[1]School of Information Engineering, Shenyang University, Shenyang 110044, China

[2]School of Chemistry and Chemical Engineering, Southwest University, Chongqing 400715, China

[a]Email: duy360@swu.edu.cn

*Corresponding author

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Abstract. During the transformation and development of Chinese local universities in recent years, the key problem is how to establish positive and effective interaction between knowledge structure and innovative practice while teaching. The scientific research projects only be regarded as a carrier and an element for postgraduate educating, the active role and significance as an undergraduate active innovation ability and the team cooperation awareness carrier was commonly ignored. In our view point, the essential attribute that students participate in research project was the exploratory learning and practice of professional knowledge in the field of science and applied research. It means that research projects can provide more space and more options for undergraduate to discover and motivate their own potential and innovative practice awareness, behavior and abilities and be proficient in certain skills. The classical CDIO conception was referred in carrier design and the efficiency was discussed.

Introduction

In recent years, the employment pressure of university graduate in China was continuing increased. The data released from the Ministry of Education of the People's Republic of China (MOE) was shown that the number of graduates was 7.49 million in 2015 and 0.22 million was increased than the year of 2014 [1]. In addition, impacted by the existed objective factors of economic growth slowing and new economic normality, how to keep the high employment rate has become a seriously difficult problem, the rate of 2014 was 92.1% by MOE announced. Another fundamental problem that there was a large gap between the employers requires and the ability of graduates includes knowledge structure and practical skills, directly intensified more pressure in keeping the employment rate especially for local universities.

A commonly point of promoting the transformation and development of local universities was that the core problem was how to improve the professional knowledge teaching and how to cultivate the ability of innovation practice tightly around the social actual demand orientation [3-5]. To cultivate the innovation and employment ability of graduates, the Chinese local universities tried to change the traditional education mode and reformed in the training, practice, innovation, start-up by school-enterprise cooperation in running schools, establishing the undergraduate training center of innovation and entrepreneurship, increasing the base of training and practice.

In fact, the scientific research projects were the other important and large resource can be utilized to provide more chances for undergraduates to obtain more practical skill and ability [6] as shown in Fig.1. On other hand, the projects of local universities were always close with the actual demand of local industry cluster and structure transformation, especially the applied projects.

Figure 1. Students were designing a multi-channel data collection system.

It's the inspiration of our work. In our view point, the essential attribute that students participate in research project was the exploratory learning and practice of professional knowledge in the field of science and applied research. It means that research projects can provide more space and more options for undergraduate to discover and motivate their own potential and innovative practice awareness, behavior and abilities and be proficient in certain skills.

The paper was organized as follows. In section 2, the distinction between our work and the Student Research Training Program (SRTP) was discussed. In section 3, color similarity probability based belief propagation was proposed to estimate the initial dense disparity map. In section 4, a self-adaptive voting disparity based optimizing method was proposed to adjust the drawbacks.

Distinction between Our Exploring and SRTP

SRTP was originally proposed by the Massachusetts Institute of Technology for undergraduate teaching and was known as Undergraduate Research Opportunity Program (UROP). The object of UROP was to expand undergraduate creative ability by encouraging and supporting the students satisfied with several certain conditions to participate the scientific research projects [7]. An investigation were shown that students received research training of students with three times success rate as interviewing with a task need to innovate to complete. From 1996, The Chinese universities such as Zhejiang University and USTC began the SRTP, to improve the undergraduate practical and creative ability [8].

Emphasis of SRTP

The SRTP was a funding project specially designed for undergraduates to complete a research work independently under the guidance of an advisor. Although with a same object, but it's quite different of the UROP in form and details. Furthermore, only famous Chinese universities established the plan of SRTP and only face to the students with excellent grades, which looks like a pre-training of a master candidate. In the implement of SRTP, more importance was the capability of science research.

Motivation of Our Exploring

Our attempt that utilizing teacher's research project as an innovation training carrier was freely applied for freshman and sophomore. In a way, it was similar to the UROP. The characteristic of the projects of local universities were always close with the actual demand of local industry cluster.

In our exploring, more space and more options were provided for undergraduate to discover and motivate their own potential and innovative practice awareness, behavior and abilities and be proficient in certain skills. So the students will have more capabilities to take a better offer as graduated.

Reflecting on Transformation Development of Chinese Local University

In China, only 40% of university graduates were applied talents and 60% graduates were academic talent, the proportion was relative imbalance. On the other hand, the 2014 China Engineering Education Quality Report released by the Higher Education Evaluation center of MOE clearly states that there was still obvious tendentiousness towards teaching expertise and creative and practical ability training was relatively weak during the applied talent education in Chinese universities [9]. In 2013, the practice and policy of local universities restructuring and development research report, the MOE issued [10], was demanded that restructuring and development of the local colleges and universities for applied technical personnel training as was shown in Fig.2.

Figure 2. MOE Local University Transformational Development Forum.

Interesting Cultivation

The research project was generally composed of several sub-topics, each one will be an option for students to freely choice and was regarded as an innovation training project to implement and carry out. The students can give full play to their professional expertise and the subjective initiative to improve or change the original design and implementation plan.

In our experience, students always put forward his opinion of experiment schemes, then optimize the scheme, improve the hardware design or software programming according to analyzing experimental results or phenomena. During the process, the students not only obtained new knowledge, practice experience and innovation capability but also win the confidence and a sense of achievement, which will greatly enhance the interesting and motivate their own potential and innovative practice awareness, behavior and abilities and be proficient in certain skills.

Ability of Independent Working

The participation in research project was mainly an autonomous action of the students through the whole process. With their own fumble, the students can slowly realize that what method is scientific, which method is suitable for their own, what method can be used, etc., and gradually in the continuous accumulation and inspired for suitable for their own learning and research methods. The abilities of thinking, judgment, decision making and innovation of students can be improved effectively by the practical exercise, which were essential capacity for independent solving a problem.

CDIO Model based Inquiry Learning

CDIO model was the representative of conceived, design, implement and operation. It regard the cycle of product development to product life as a carrier and combine the active practice with course learning for engineering applied talents training. In standard CDIO outline, the system capacity cultivation of engineering graduates can be divided into four levels of engineering fundamentals, personal skills, interpersonal skills and team works [11, 12]. The outline requires students to reach the intended target of the four levels in an integrated manner.

In the carrier, students can independently discover problems, design experiments, practice operation, investigation phenomena, collect and process information, expression and communication, to acquire knowledge and cultivate ability, especially exploration spirit and innovation ability [13-15]. Inquiry learning was conformed to the core cultivation idea of integration that was directly reflected in the Standard 3 and 8 of CDIO model. It provide a platform and condition for students to creative use of knowledge, activation and associated knowledge, to cultivate the ability of autonomous learning and how to find and solve problems with creative thinking.

Inquiry Learning with CDIO Standard 8

The active learning was clearly oriented in the CDIO Standard 8 that requires the implementation was based on the active teaching and learning manner. The details were described is as that active learning let the students to think and solve problems instead of passive information transmission, to engage the students pay more attention to the operation, concept, analysis and judgment.

In our research project bases carrier, the active learning includes cooperation, group discussion, explanation, debate, concepts and questions, and obtains positive feedback with more knowledge and experience. The active participation of students was advocated to explore the learning styles of discovery, exchange, discussion and cooperation. The traditional teaching process that was too relied on teachers and teaching materials was rejected and abandoned such as learning by rote.

The Objective of Inquiry Learning

The most important value of the CDIO engineering model was transform and decompose the essential qualities of knowledge, ability and quality of modern engineer through a complex but systematic implementation process, as was shown in Fig.3.

The outline of CDIO model subdivide the primary theme of engineering knowledge, personal ability, interpersonal ability of team and engineering system ability into the four levels. It make the traditional education expectation was transformed as an observable and operational performance of students and behavior. The CDIO outline forms the results of the target set of expected learning.

Implementation Strategy

The important advantage of CDIO model that subdividing the engineering abilities was covered the every part of the inquiry teaching and learning. It provides a detailed and referable outline for educators to resolve the problem of how to carry out inquiry teaching and learning. For the instance of the critical thinking, that includes analysis of problems, choose logical arguments and solutions, evaluation of supporting evidence, find out the conflicting views, theories and facts, find out the logical fallacy, and validate assumptions and conclusion. In Fig.3, an undergraduate student was testing the output of a smart sensor.

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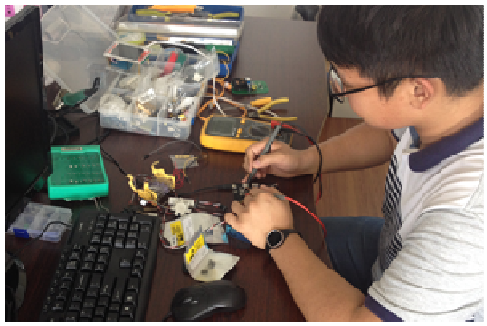

Figure 3. The student was testing the output of an smart sensor of pollution monitor.

Conclusions

In the curriculum plan of Chinese universities, the undergraduates were commonly to learn the basic theory course learning as in a lower grade, engineering practice basic is not involved, especially of the engineering majors. According to the engineering knowledge background of the low grade students, its necessary of cultivating the innovation awareness by discovering and motivating their own potential, innovative practice awareness and behavior. The research projects were very suitable platform and carrier to provide more space and more options for undergraduate engineering training and obtain the essential experience and abilities foundation.

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