The Operation Strategy for the Training Project of Undergraduate Innovation and Entrepreneurship Guided by the Creator Training Course

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Abstract—In order to cultivate the innovative engineers, the Training Project of Undergraduate Innovation and Entrepreneurship, shorted as TPUIE, was presented from 2007. Also, in the Emerging Engineering Education, the TPUIE is one of most important methods to training the creativity, the engineering thinking and others abilities for the future works. Besides University-Enterprise cooperation, the Scientific and technological research projects can effectively promote the students to participate TPUIE. Unfortunately, the freshman can not realize what the difference between the high school education and the university education, so as they usually abandoned the TPUIE when there would be a little difficult or misunderstanding the knowledge in engineering. An Operation Strategy of TPUIE guided by the creator training course was presented to make sure that most freshmen can avoid the falling in their mind caused by the heavy responsibility of TPUIE in the first server months in campus. The strategy could promote the students to transform their interests into practice through the creator training course with some simple but visible tasks. Cases show that introduced by the creator tasks step by step, students' innovative thinking and practical ability could be effectively improved, as well as the success rate of TPUIE were higher.

1. INTRODUCTION

Due to the promotion for the Emerging Engineering Education, the engineering education in China focus on cultivating lots of high level engineers with higher practical capacity, stronger innovative consciousness, and high international competitiveness to solve the complex situations in future engineering, so as to adapt to the rapid development of science, technology, economy and society, promoted by new technology. The Training Project of Undergraduate Innovation and Entrepreneurship, shorted as TPUIE, is well known as the special key to cultivate the engineers who would focus on the international challenge, the carbon dioxide problem, and others emergence in the future.

In order to promote the transformation of training methods and further give play to the role of innovation projects in cultivating the innovative practical ability, various scholars have carried out a lot of research, investigation and practical works[1-3]. The investigation from Lagos state university showed that The special training for the entrepreneurship skills and innovations toward poverty alleviation were very necessary for the future works[4]. The quality and results of the application, implementation and conclusion of innovation projects based on scientific research projects had a great impact on the scientific research ability of the university advisors. Combining teachers' scientific proposal with students' innovative project application would cultivate students' innovative ability. Combined with the scientific proposal, the major competitions and the TPUIE, the students' innovative thinking and practical ability could be improved greatly and quickly. Obviously, depending on the research institution, the teachers' proposals as the basis of the TPUIE had a good effect on the Innovation and Entrepreneurship cultivation. Meantime, adopting the collaboration education to promote creative projects could play a greater role in emerging engineering education[5]. Systematic implementation of school-enterprise cooperation also could promote the development of the university students' innovation and entrepreneurship skill. Combining the project with patents, papers, competitions could achieve transformation to achieve several multi-win situations among students, universities, professors, and enterprises.

However, due to the lever of the scientific research platform and the integrated strategies[6], the advisor from teachers might be slightly lower, the number of university-enterprise cooperation might be less, and the effects for cultivating might not be better[7]. Finding more mechanisms to promote students' positive declaration, approval and smoothly carry out the project, so as to effectively improve the students' ability of innovation was very essential.
Usually, limited thinking, lack of ideas and ability, changeable belief and weak perseverance, were the main problem for the freshmen in campus. As a public city-level university, our school students' admission results are generally at the average level. The above problems are also very obvious among the students in the major of Building Environment and Energy Engineering, shorted as BEEE, in the Wuhan Business University, shorted as WBU. The most obvious contradiction is that lower grade students were willing and motivated but lack practical ability and innovation consciousness. Senior grade students had certain professional knowledge but focused on preparing for postgraduate entrance examination or employment, and had little enthusiasm for innovation and entrepreneurship activities. BEEE is a typical discipline with thick foundation and wide aperture, which involves a wide range of industries. Only at the second semester of sophomore year, the students got to know engineering thermodynamics and fluid mechanics in the basic courses of the major, and from junior year to the first semester of senior year they would complete the professional courses, which are mostly engineering courses, so students had weak ability and motivation to carry out engineering innovation with limited engineering knowledge.

BEEE in WBU belongs to the School of Mechanical and Electrical Engineering while there are a major of vehicle engineering, belonging to the mechanical category, and a major of robot engineering, belonging to the automation category, in the same school. It makes possible that the BEEE students would have a certain foundation in the integration training of thermal engineering, electric engineering, and mechanical engineering. It was essential to find a route promoting the Integration for the knowledge of Mechanical, Electrical and thermodynamic.

Based on the orientation of the school, the situation of the major and the fundamental of the BEEE students, a creator training course is designed to enhance the success rate for the freshmen, those would want to apply TPUIE. They are trying to complete a creative production during the junior year to help students to complete the transition from theoretical learning in basic education to engineering knowledge in higher education. Compared with the common routine to finish a project of TPUIE, including preparation, application, implementation and conclusion, a guiding step is added, which uses the learning and production of basic products of creators to transfer the students’ enthusiasm into the Execution of TPUIE.

2. STRATEGY OF TPUIE TRAINING

The presented innovation training strategy enables freshmen to complete a round of closed-loop five-step innovation project training within two years from the beginning of first semester to the end of the second semester. It would promote students to master certain professional theoretical knowledge, have strong practical ability, cultivate good scientific research and innovation thinking, and further apply the knowledge to the engineering knowledge, and carry out innovation and entrepreneurship activities in the last two years in campus. Also, it would make it possible to carry out the innovation foundation in the future engineering practice and timely apply it to the undergraduate science and technology innovation training projects.

2.1. Strategy routine

At the beginning of enrollment, freshmen are still in the process of changing from the passive learning in high school to the active skill training in the campus. What’s they have is only little understanding for the major of environment, architecture, construction through the enrollment education of BEEE. Also their simple basic understanding for energy and environment is relatively shallow. Although they have very high enthusiasm for participating in the students’ scientific and technical associations, major competitions, and TPUIES, they may not find some deeper problems for the engineering phenomena. Therefore, due to the lack of training for the innovation quality and basic hands-on skill, they would be lost the confidence and the interesting for the next grown step, if there is no external help and continuous attention. That’s to say, the reality practical actions will be less and less.

Therefore, when freshmen joined in the students’ scientific and technical associations, a set of entry-level creative tasks would attract freshmen and increase their interest. They were guided to complete some little creator productions and to carry out the training of subsequent innovation and entrepreneurship projects. Usually, a team was within 5 students to make sure the discussion and term cooperation. A closed-loop plan with time step is shown in Table 1.

<table>
<thead>
<tr>
<th>Step</th>
<th>Semester</th>
<th>Month</th>
<th>Project content</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1st</td>
<td>1st-6th</td>
<td>Introduced with some creator tasks</td>
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<tr>
<td>II</td>
<td>1st</td>
<td>6th-7th</td>
<td>Prepare the TPUIE proposal</td>
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<td>III</td>
<td>2nd</td>
<td>7th-8th</td>
<td>Write the TPUIE proposal</td>
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<td>IV</td>
<td>2nd-4th</td>
<td>8th-22th</td>
<td>Execute the TPUIE</td>
</tr>
<tr>
<td>V</td>
<td>4th</td>
<td>23rd-24th</td>
<td>Conclude the TPUIE</td>
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2.2. Step I: Introduced with some creator tasks

One of the main reasons for why freshmen failed to transform their enthusiasm into sustained action is the lack of systematic and personal guidance. Therefore, after completing the enrollment education of BEEE, the guided project would start to train the creator ability in the school-level students’ scientific and technical, Energy Conservation and Emission Reduction Association. Not only the supervising teachers of the association, but also some outstanding seniors would participate in the training and guiding process, so that the team development model of old-help-new among high and low grade students were gradually formed. The training content mainly focused on learning basic creator skills. The tracking car, the bionic
machinery, and other kits on the Arduino creation platform, were selected as the hardware tools, since those Arduino creation platforms were quick to get started and have many resources. The training time for the creator works would take four months or more, but the results are obvious. There are productions easy to display, which could make students feel great satisfaction. In this way, the students' enthusiasm was transferred to the production, which maintained the confidence and improved the action.

From the beginning of the guiding project, students have defined their learning objectives and training steps, which mainly include the following processes:

- Complete the hardware installation.
- Make the sample program running.
- Achieve another function on the Arduino platform revising the sample program.
- Complete a little scientific and technological production of solar energy tracking based on the Arduino platform.
- Conclude and present the creator tasks.

Students are task-oriented to carry out the systematic training, information inquiry, team discussion, plan revision and other works. Each step in the introduced project would have clear results to present, such as hardware, movement of the production, powerpoint show and so on. It would enhance the confidence, improve the hands-on ability and expand the vision in the mechanical, electrical environmental and other technical aspects. The most important thing is that the seed of students' interest is sprouted through the use of guided projects.

2.3. Step II: Prepare the TPUIE proposal

During the creator learning for a whole semester, the teacher, while affirming the progress of the students, often carried out guiding encouragement, asking whether the kit could be improved, whether it could be applied to other occasions, and whether it could be combined with energy saving and emission reduction, etc. In the process of guiding the development of the project, supervisors encouraged students to discover and explore problems by asking questions, so as to form the innovative research direction of their respective teams and helped students to prepare for the application of the TPUIE in the second semester of the freshman year. In the information age, fragmented learning materials made it easy for students to find a huge amount of open documents and video resources for reference. In addition, the discussion among different groups rapidly expanded their horizons.

2.4. Step III: Write the TPUIE proposal

During the winter vacation, freshmen team could write the proposal for the TPUIE, practiced the process of finding problems, looking up materials, sorting out schemes and forming technical routes, and then, would finish the proposal of the TPUIE after several group discussions. As a result of guiding creator skill training, the students' ability has been exercised to a certain extent. The topic selection and proposal content could reach a certain quality, thus the probability of successful project application is greatly improved.

2.5. Step IV: Execute the TPUIE

When the team got a TPUIE, they would pay attention to how to complete the project. Compared with the guided project, although the difficulty and depth of the project had been greatly improved, the overall trend had been in a progressive state, and the difficulties during this period could be gradually overcome. During the execution of the project, by clarifying steps, breaking down tasks and refining technical routes, the team members' personality development and common progress could be realized.

2.6. Step V: Conclude the TPUIE

As for the questions and difficulties faced by students in the process of research, the instructor guides them to actively learn new knowledge and skills by pointing the direction and summarizing the points. The point-based knowledge learning process, which aims at solving problems, skips the systematic learning step by step, and also helps students to trace back to the source and further exercise their scientific research ability.

In the process of seriously executing the TPUIE, students can take advantage to participate in some relevant professional science and technology competitions, such as National University Students Mechanical Innovation Design Competition, National University Students Energy Conservation and Emission Reduction Social Practice and Technology Competition, National University Students Programming Competition, and other professional competitions.

Meanwhile, since students need to solve problems and optimize solutions, they would often discuss with their advisors. According to the teachers' sensitivity to science and technology problem, students could summarize and improve key technical points, so as to trying figure out a patent application or write some research manuscript. Those would let the students learning more and getting deeper.

Therefore, with a complete cycle of introduction, preparation, application, implementation, and conclusion, the whole term would figure out various achievements, such as scientific and technical productions, research papers, patents, and self-confidence which is the most important within two years accomplishing TPUIE. Completing a project in the second semester of sophomore year, the students would truly get the training of scientific research quality and the cultivation of innovative thinking.

3. Case Study

There are some cases to show the different in their ways to participate the TPUIE. Some teams of volunteer had achieved certain results in the presented operation strategy. They respectively adopted the engineering project guidance, the creator product guidance. There is a certain
gap among different teams in the guidance, and the final results were not similar.

3.1. Case I: engineering guidance with certain results

The whole process for Team A finishing the TPUIE was one of the typical cases in the campus. The instructor took the students to the field survey. The team found that the cotton spinning plant had a larger space, and the air-condition system in factory was mainly based on the air distribution. The air return system mainly adopted concreted air return trench under the ground, which has large section, serious cotton accumulation and was not easy to clean. Students analyzed and discussed these problems, and achieved a national TPUIE, development of an intelligent cleaning robot for return air system of cotton textile factory. Team A accomplished 1 licensed national invention patent and 1 licensed patent for utility models. Unfortunately, the team was not good at mechanical, electrical and creator capabilities, so as they had tried their best, but could not complete a robot production they wanted.

3.2. Case II: creator product guidance with certain results

Team B was followed the presented strategy above and got a provincial TPUIE. They had learned some basic knowledge for the creator production making, and got a set of basic skills training for creators in the Energy Conservation and Emission Reduction Association. After several times of group discussion, they chose to make one new photovoltaic power generation sunshade as their two years main works. The team is currently working on the application for an invention patent and has changed the outlook of the production hardware for three versions. During the implementation of the project, they participated in some mechanical innovation competitions, such as the National 3D Digital Innovation Design Competition and so on. They had won 2 national third-level awards in those competitions.

3.3. Case III: engineering guidance without any results

Team C got a TPUIE when they realized that the dust on the condenser would decrease the efficiency of the room air-conditioner. That aspect was very essential for the research area in the refrigeration device innovation. The team wanted to make a little robot to wash, to clean and to collect dust on the condenser of the outdoor unit for room air-conditioner automatically. Unfortunately, the will was very better, but they could not finish the project before they walked out the campus since they were lack of the integrated skill of refrigeration, mechanical, and electrical to accomplishing their project.

3.4. Results

From the case studies, the guided training for the freshmen is very essential to overcome the gap between the hands-on ability and the initiative enthusiasm. In recent years, in the implementation of the presented operation strategy with the student association, Energy Conservation and Emission Reduction Association, we had applied for more than 10 TPUIEs including the national, the provincial and the university level. Starting from the guidance step I, nearly all the volunteers could complete the training process of TPUIE within 2 years. At the same time, students also actively participate in various scientific and technical university students’ competitions in the basic principle major, just like mechanical, as well as the BEEE major university students’ competitions. They were well willing to face the challenge in the innovation and entrepreneurship projects. The volunteers had got more than 20 national and provincial competition rewards, over 10 national invention patent license, over 20 patents for utility models and publish some research journal papers and some academic conference papers. The presented strategy not only improves the quality of scientific research, exercises the innovation skills, but also greatly enhances the volunteers to face the greater tasks in the career.

4. Conclusions

A detailed operation strategy of TPUIE Guided by the creator training course was presented to find a way promoting more freshmen dedicate to make the innovative and Entrepreneurial quality of themselves efficiently. An introduction step was employed to establish the confidence to overcome the difficulty in the way to improve the scientific research quality and the innovation ability. A whole loop was introduction, preparation, application, implementation and conclusion in completing a TPUIE. The cases of BEEE in WBU showed that the presented strategy could optimize the cultivation process with outcome based education, especially for overcoming the conflict between the willing and the ability in the first step for TPUIE. The relevant mechanism was also gradually developed, and the innovative thinking, creator ability and scientific research quality are steadily enhanced.

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