

On Freshman Training of Engineering Students by Projects and DIY Activities

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Abstract- Engineering students begin their first year with fundamental science and pre-technology courses which give little knowledge about engineering. As a consequence, some of the freshmen have no idea about engineering, and are lack of objective and interest in engineering. This paper presents how to help the freshmen have a general idea of engineering and an overall understanding of what they are going to study. One project activity outside curriculum in a LEGO lab and two outside-classroom DIY activity cases are presented. After three years practice, students had more interest and passion in engineering and showed their talents.

Keywords- freshmen training, research-orientated education, engineering DIY activity

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I. INTRODUCTION

Sino European School of Technology at Shanghai University (UTSEUS) was established in 2006, cooperating by Shanghai University (SHU) and University of Technology (UT) network in France. There are three programs in UTSEUS, for Bachelor, Master and Engineer Diploma, as shown in Fig. 1[1].

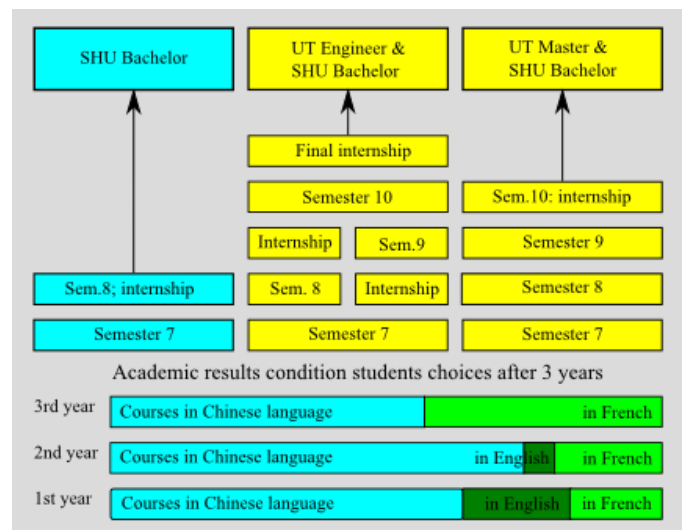


Figure 1. Three degree and diploma programs in UTSEUS

In the program of engineer, students enrolled to Shanghai University first study three years in China, and then they takes other two and half years study in France. After totally five and half years, students get both bachelor degree and engineer diploma if they are qualified to all requirements.

Usually, students begin their first year with fundamental science and pre-technology courses which give little knowledge about engineering. As a consequence of this arrangement, some of the freshmen have no general idea with what engineering is at the beginning of the university study. This leads to the engineering freshmen lack of objective and interest when they are taking fundamental science and pre-technology courses [2].

In term of this, authors of this paper did some work to help freshmen have a general idea of engineering, and make them easier to have an overall understanding of what they are going to study in university, which technology courses they need to master and how those courses are applied to their study.

To achieve this object and get freshmen understood the implicit objectives of further learning, introducing preliminary engineering courses inside or outside classroom is of vital importance. Besides, it contributes to the success of some freshmen and brings them more interest in engineering major.

In this paper one project activity outside curriculum in a LEGO lab and two outside-classroom DIY activity cases are presented. Many students showed their talents on engineering.

II. PROJECT ACTIVITY OUTSIDE CURRICULUM IN THE LEGO LAB

This activity is a kind of project based training with LEGO robot bricks. Freshmen are encouraged to join this activity after class. The LEGO robot lab we have has more than 20 sets of LEGO NXT bricks. Usually every semester 30 students of 10 groups take part in this activity.

The idea of this outside classroom activity is described in detail in Fig. 2.

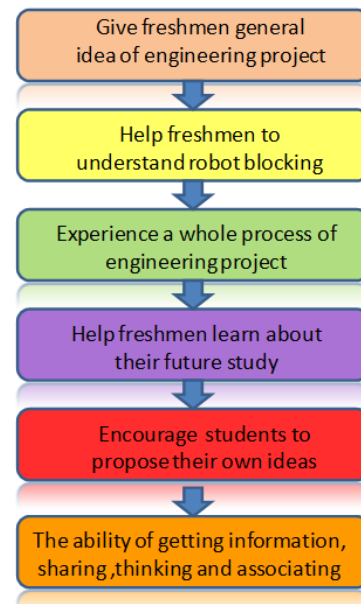


Figure 2. Idea of LEGO Robot Bricks Activity

A. Give the general idea of engineering project

To give freshmen the general idea of engineering, teachers usually show a whole process of engineering projects design to students, explaining every step of design. Taking the process of designing a robot vehicle for example:

- The first step is to understand and investigate the project you are going to do, then propose several ideas and analysis using Mind Storm and Value Analysis methods, etc.
- The second step is to design the structure of the vehicle using the theory of mechanic, material science, sensor technology and so on.
- The third step is to control the robot vehicle. In order to do this, automatic control Principle, C++ language, algorithm, circuit principle and electrics are probably involved in the design.
- The fourth step is to test and adjust, using testing and measuring technology.
- The last step is to present their work, communicate with each other and make some improvements.

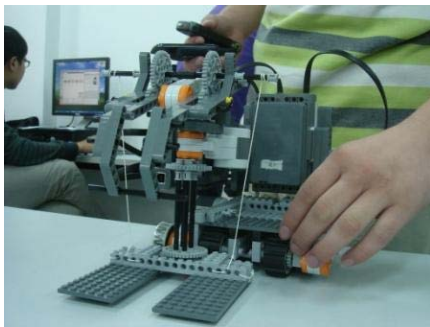
By this activity, freshmen have had a general idea of engineering project and which courses they will learn in their following semesters. The most important is that they know

which kinds of technologies are widely used in engineering. Compared with the students who have no idea with technology courses, they are of more objective and positive to engineering major, and are tend to combine theory and practice together.

B. Help freshmen to understand robot blocking

LEGO robot is a modularize robot produced by LEGO company from Denmark. This kind of robot is composed by several modules, such as microcontroller modules with three input ports and four output ports, motor modules with ports can be connected with microcontroller by cables and sensor modules like sound sensors, vision sensors, compasses and various mechanical parts. Regarding to the mechanical part, there are gears, wheels, shafts and pins in different sizes as well as gimbals (Fig 3.).

Besides, there are several expanded interfaces, which allow LEGO robot to be connected with the sensors from other companies, for example, Hitechnic, Mindsensors.



(a)



(b)

Figure 3. Build Robots with LEGO Robot Modules

The advantage of this kind of robot is modularized, and the students could experience that by using LEGO robots with

fun. If the freshmen have some ideas, they can build the robot and try their new ideas with modularized LEGO robots immediately, without spending a long time to manufacture the mechanical parts. And a useful mechanism structure can be reused, from project A to project B.

The software used for LEGO robots are also modularized, such as ROBOLAB released by American National Instrument. It is a kind of software which is a simple version of Labview. It is easy for students to begin programming, and to enjoy the convenience which modularization brings to them.

C. Experience a whole process of engineering project by designing a robot using LEGO NXT bricks

It is a necessary activity to guide freshmen to experience a whole process of engineering project. A Chinese proverb say: Tell me and I forget. Show me and I remember. Involve me and I understand [3]. In order to do this, in LEGO lab, teachers assign a target that freshmen should achieve by LEGO robots. Freshmen are divided into groups by three or four persons. They'll carry out the completely procedure of an engineering project.

D. Help freshmen learn about what they are going to study in technology courses

In the steps of structure design and control system design, the freshmen need plenty of knowledge about Mechanics, Material Science, and sensor technology and so on. However, the freshmen may know little knowledge of these domains, as they have no experience of engineering projects previously.

With the activity in LEGO lab, students could use mechanical parts, sensors even before they understand and have the skill to take full advantages of them. But the important thing is that the freshmen now have general conception of mechanical parts and different kinds of sensors. As the result of this, students know what they are going to learn in the following years, and when students are taking courses in the future, they may have more interest and better comprehension.

E. Encourage students to propose their own ideas

The activity in LEGO lab has no detailed instruction for students, and the teacher's responsibility is to bridge the knowledge and students. Students have to work out proposals

and solutions by themselves. Without detailed instructions, the minds of students are not constrained at all. They are encouraged to bring out any idea, since the spirit of this activity is no stupid idea [4] [5].

F. Develop the ability of getting information, sharing, thinking and associating

As the development of information technology, the methods for students to get information are more and more [6]. They can obtain information not only from teachers or libraries as before but also from database online, Blogs, E-learning courses, BBS, and so on[7]. The activity in LEGO lab encourages students to get information and find solutions by themselves, and provide opportunities to share their information and solutions with the classmates by presentations.

In addition to working on engineering projects, some students are good at thinking and associating. For example, they know the history of LEGO bricks, the development of LEGO bricks, and why it is so popular in the world to different age people, even have some ideas about the advantages and disadvantages. Excellent students show up though the activities.

III. OUTSIDE OF CLASSROOM DIY ACTIVITY

The purpose of this activity is to manufacture mechanical products by students. This activity requires students spend more time on it. The students are required to propose, design and draw, purchase material and parts from market, manufacture and improve in workshop [8]. Here are two cases.

a). a skateboard bicycle



Figure 4. A skateboard bicycle manufactured by students

This is a bicycle driven by trampling which is different from common bicycle. It was designed and made by two

students who majored in mechanics manufacture. They spent spare time doing this at their second year in university, proposing ideas, designing, manufacturing and testing by themselves with some support from supervisors.

b). a chair keeping health with traction system

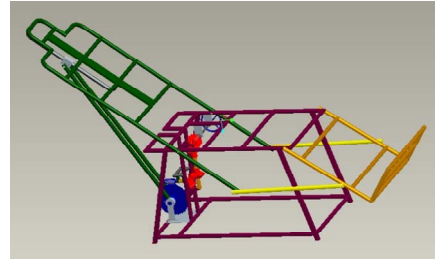


Figure 5. The 3D Assembly drawing of the Chair



Figure 6. Students are Welding the chairs in workshop

Same as the last example, the two students in the picture designed a chair with which people could keep health by dragging neck. Fig. 6 shows two students were welding the chair in the workshop.

CONCLUSION

This paper proposed the activity in LEGO lab based on projects and the outside classroom DIY activities. Those trainings help freshmen understand the whole processes of engineering projects, learn the technology courses they will take with their former experience of LEGO projects and DIY activity. It's vital to freshmen who will get involved in international engineering work in future.

The trainings also increased the passion for engineering of students. A student, Hu Zejun, who joined LEGO project said: *We proposed our own idea to the project. We spent much time, challenged a lot, but at last we know how to find solution by ourselves.* Besides, three students who ever experienced the

projects as a group, have proposed an innovation project based on LEGO and gotten support by National University Students Innovation Experiment Program.

To improve the work on freshmen training in the near future, more surveys are necessary for authors to do.

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REFERENCES

- [1] Michel Grenie, "UTSEUS Introduction", Nov 2007, unpublished
- [2] S. Reisman, "Higher Education: Who Cares What the Customer Wants?" *The Ivory Tower*, November, December 2005, pp62-64
- [3] E. Wang, "Engineering with Lego Bricks and Robolab", 3rd Edition, July 2007, pp1-1
- [4] M. E. Mogee, "Educating Innovation Managers: Strategic Issues for Business and Higher Education", *IEEE Transactions on Engineering Management*, Vol. 40, No. 4, November 1993, pp410-417
- [5] Low, S.M., "Developing Undergraduate Students' Multi-Engineering Skills through Projects on Embedded System", *Information Technology Based Higher Education and Training, 2006. ITHET '06, 7th International Conference*, July 10-13, 2006, pp513-516
- [6] M. Garcia-Saenz, S. S-Smith, B. Longhinos, "Globalization: Effects and Opportunities for Higher Education", *37th ASEE/IEEE Frontiers in Education Conference*, October 10 – 13, 2007, Milwaukee, WI, ppT1A18-23
- [7] J.GMILLER, "Interuniversity Communications Council." *Science*, 1966, (154), pp.483-488
- [8] Nagchaudhuri, A., "Work in progress-development of mobile robotic platforms as freshman engineering design project", *Frontiers in Education, 2004. FIE 2004. 34th Annual*, Vol. 3, ppS2E - 9-13

