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Construction of Maker Platform with Integration of Course, Competition and Training

Xinbing Chen
Experiment Center
Guangzhou University
Guangzhou, China

Xiaoli Long
Experiment Center
Guangzhou University
Guangzhou, China

Wei Hu
Experiment Center
Guangzhou University
Guangzhou, China

***Abstract*—The rapid construction solution for maker platform for universities is proposed according to the talent needs from manufacturing power. Based on the analysis of the effect of craftsmanship spirit and maker culture on talent training, the resource integration taking the intelligent hardware development as the main clue and the development ideas of the construction of the maker platform depending on the electronic practice center is introduced and the specific measures of continuous training with the integration of course, competition and training is expanded from the aspects such as maker platform, electronic practice, relevant competition and extra-curricular training. The practice indicates that this scheme has solved the problem of path for maker platform construction and promoted the cultivation of maker talents.**

Keywords—electronic practice, manufacturing power, talent training, maker platform; intelligent hardware

I. INTRODUCTION

With the advance of manufacturing power strategy，higher requirements are put forward for quality and innovation of product, which needs an important breakthrough for engineering talent training [1,2]. At present, colleges and universities have staged achievements in the quantity of talent but there is a lager gap between talent quality and actual needs, becoming the bottleneck for manufacturing industry development. Through measures such as deepening engineering education reform, innovating talent training modes, breaking talent training barriers and cultivating tip-top talent, great progress are made in improving the quality of talent training in most universities. Among them, as the practice base for implementing quality education, the electronic practice center (or "training center") undertakes the electronic technology practice teaching tasks of the whole school and plays an important role in scale engineering training, and becomes the experimental field to explore engineering education reform [3-5].

The craftsmanship spirit and maker culture rising in recent years reflect the industry's two major demands for composite engineering talents and provide new idea for engineering education reform [6,7]. Among them, craftsmanship spirit represents the quality pursuit of the manufacturing industry and the connotation of dedication and concentration. Coming from transboundary DIY innovation, maker culture focuses on learning new things in practice and using them creatively, so it reflects the interdisciplinary thinking of new engineering. The Electronic Practice Center of Guangzhou University (hereinafter referred to as the "Center") is responsible for the electronic technics practice and starting from the improvement of students' sustainable development ability, explores a rapid construction solution for maker platform with the combination of relevant resources and integration of advanced education concepts.

Corresponding author: Xiaoli Long, Experiment Center, Guangzhou University, Guangzhou, China.

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II. MAKER PLATFORM CONSTRUCTION

A. Integrating resources

Based on the hardware engineering training, the Center takes intelligent hardware as the theme, integrates common electronic subject factors such as electronic practice, related competitions and extracurricular training courses, and inject the integrated and coordinated development idea to construct the integrative maker platform shown in Fig 1. Based on this, the most succinct and progressive training plan has been developed and the smart car / robot cases are used for the stages teaching, allowing the students to obtain more systematic engineering experience, have the engineering practice ability, independent learning ability, innovation and application ability and the ability to transform ideas into works required to solve more complex engineering problems.

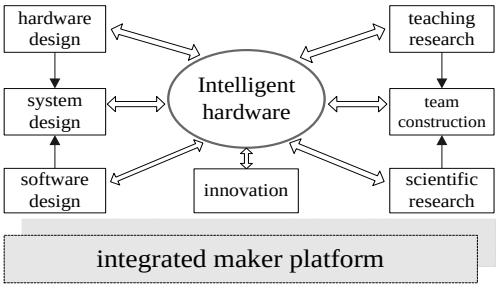

Fig. 1. Platform solution

The functions and construction measures of the practice,

competition and extracurricular training in the platform are introduced below, respectively.

B. Reforming electronic technology practice

As the entry-level course for the students majoring in relevant electronic subject engineering training, electronic technology practice concludes the main contents of electronic production and hardware design and trains the basic practical ability and engineering quality. To systematically improve students' engineering ability, the platform integrates practice into the whole planning to undertake the engineering training functions and with the combines the self advantages of long-term guidance in practice teaching and national college intelligent car competition to transform the racing results into practical teaching project cases, as shown in Fig. 2, solving the associated design problem of practice teaching and extracurricular practice.

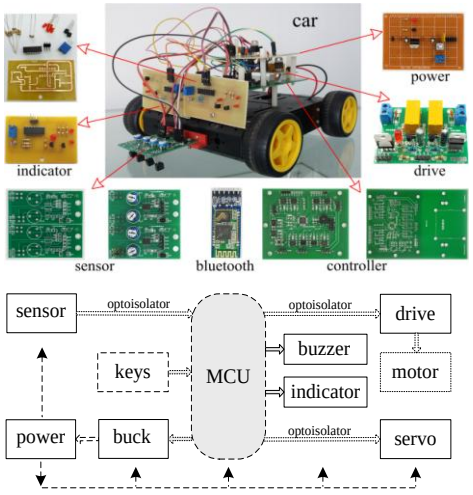

Fig. 2. Project case and modular design

The entire automobile is modularly designed. There are power module, sensing module, display module, drive module and core module according to the functions, reflecting various teaching contents and ability achieve targets and the needs for different professions can be satisfied by the way of "course + module". Practice teaching adopts the through-type teaching design with the integration of curricular and extra-curricular. The practice is conducted by 2 students in one group and circuit planning and design, welding quality and debugging strategies will directly determine the successful future development. In the teaching process, the engineering literacy training such as quality awareness shall be implemented and there shall be strict acceptance check link, ensuring the staged tasks to be solved in each stage. SCM programming occupies an important place in the scientific and technological activities of college students, and is also an important means to achieve creativity. This part is completed through extracurricular training or elective courses, solving the problem of limited time in class and enhancing the independent learning capability of the students. In the hands-on practice process the students establish the concept of engineering system, obtain relatively complete engineering experience and initially have the ability to solve electronic problems in the engineering field.

C. Having interdisciplinary competitions

The personnels of the Center have guided the competitions related to intelligent hardware for long time, such as "National College Student Smart Car Competition", "China Robot Competition", "Guangdong Computer Design Competition", "Guangdong Engineering Students Experimental Skills Competition" and "Guangzhou 3D Printing Creative Design Competition". In the process of organizing the qualification trials in the school, they have constantly explored ways to expand the basic training scale and improved coverage to allow more students obtain engineering experience [8].

To solve the problem of universal education, the platform includes the interdisciplinary competitions into the overall planning to undertake the function of competition inspection and enhances the ability of students transform the creativity into works through the intelligent hardware-related competitions. After the practice, the interested students will enter the Maker base and form an interdisciplinary team to prepare for the corresponding competitions [9,10]. Taking the intelligent hardware development as the theme, they will work together to finish the planning, design, production and joint adjustment of the works and have the ability to solve more complex engineering problems. The students are encouraged to have practice and innovation based on problem-solving. The staged work inspection uses the way of on-the-sport competition and presentation of technical report so the students can find the gaps through the competition inspection results and gradually grow up in practice innovation as well as exchange and sharing, forming the maker culture atmosphere of "practice first, be tolerant of failure, encourage innovation, and dare to explore". Many students continue to explore in practice and win broader development space for scientific research projects or postgraduate study.

Combining with the STEAM training concept, the platform has set up interdisciplinary tutor teams and implemented tutor-responsible system. Each tutor provides research projects and establishes interdisciplinary student teams who help to make development plans, follow up on project progress as well as analyze and solve engineering problems together, achieving the coordinated development. To improve the basic training efficiency the platform adopts the way to transform the racing results into practice teaching vehicles, which not only improves the systematicness of the practice teaching and training, but also solves the entry problem of extracurricular practice.

D. Strengthening extracurricular training

The maker platform defines the extracurricular training as training ground to undertake the function of batch training and solve the common problems in students'

extracurricular practice innovation. Based on the interdisciplinary competitions of intelligent hardware, the platform has created a multi-level maker training course system to help the students master the development tools and on this basis, transform their ideas into works through practice. Finally, the platform inspects the study results by special competitions and selects the potential students to represent the school to participate in high-level competitions, forming the teaching mode for continuous training combining the course, competition and training, as shown in Fig. 3.

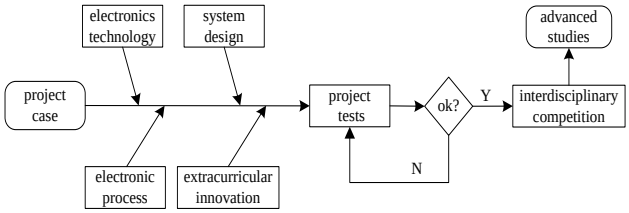

Fig. 3. Continuous training mode

The platform follows the subject of intelligent hardware development and adopts progressive training program, and it is divided into three stages. There are 1-2 engineering training courses in every stage and the course is flexible, as shown in Table 1. The platform uses the project-driven teaching method to guide the students to start from the tracking car for the intelligent hardware design innovation. In the teaching process, there are clear requirements for the phenomena expression, problem location, fault diagnosis, demand analysis, solution formulation and technical report writing, so the professionalism of students shall be continuously improved to achieve the effect of integrating course and competition and promoting studying with competition.

TABLE I. EXTRACURRICULAR TRAINING COURSES

No.	Course	Hours
1	Guide of smart car	16
2	Electronic technology application	16
3	MCU system design	16
4	App development for IOT	16
5	Smart car design	32
6	Robot design	32
7	Creative innovation basis	16

Among them, “Electronic Technology Practice” or its training undertakes the teaching task of hardware teaching design popularization; “Guide of Smart Car” and other courses undertake the teaching task of software design popularization and the course is ended with the competition mode of “colorful waterfall light”; “Smart Car Design” and other courses undertake the teaching task of system design popularization and the course is ended with the competition mode of “top speed smart car”. Courses such as “Robot Design” undertake the teaching task of intelligent hardware design popularization with the interdisciplinary groups and the course is ended with the competition mode of “creative robot”.

III. CONSTRUCTION RESULTS

With three years of exploration, the construction of maker platform has made breakthrough and established the education system of continuous training with the integration of course, competition and training. The training methods are more flexible and the personnel training level has been improved, resulting in achievement of training objectives leap from technical personnel to engineers. The platform has provided various forms of engineering experience opportunities when completed the work of universal education, generally promoting the students' engineering practice ability and innovative application ability. According to the statistics of the undergraduate professional training program in Guangzhou, there are 14 engineering majors in 7 colleges now and the man-machine hours is 49,800 each year.

The platform has achieved the goal of coordinated development. Each teacher is assigned the tasks of practice teaching and extracurricular competition guidance. The engineering problems encountered in the development of intelligent hardware has promoted the research of teachers and students and the research results of them have been transformed into practical teaching contents, which promoted the course construction and teaching research as well as the stable improvement of quality of engineering ability training. In 2016, the platform has established and entered the Smart Car Association. The students have played a huge role in competition organization and advocacy, extracurricular training, teaching suite maintenance, program test, atmosphere creation and external communication and the teachers have improved their work efficiency to have more sufficient energy to engage in teaching and scientific research. In addition to the competitions, the platform has actively organized teachers and students to apply various project grants and develop school-enterprise cooperation, continuously expanding funding sources, continuously expanding the level and scale of engineering training, supporting more students to transform ideas to works and achieving stage results. For now, there are two MOOC online courses have been completed, three textbooks have been published, more than twenty papers have been published, over one hundred awards have been won and more than thirty patents have been authorized. In 2017, the platform has won the first prize of Guangzhou University Teaching Achievements and has been proposed as the key project for the provincial teaching achievements.

IV. CONCLUSION

The construction of the maker platform and its training system has broken through the original pattern of the Electronic Practice Center, promoted the training of composite engineering talents, and provided reference cases for the similar training bases construction and development. The training of engineering quality is the process of long-

term exploration and how to integrate the quick training with system training will be the important task for future reform.

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