The Issue of Robot Education in China's Basic Education and its Strategies

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Abstract—**Recently, People pay more and more attention to the robot education. Experts at home and abroad in education proposed that education robot could serve as an effective platform for implementing innovation education, quality-oriented education, and technology education. This paper will elaborate the development of robot education in china's basic education, analyze problems along with several strategies from the following three perspectives: robot competitions, robot teaching, and researches on robot education.**

Keywords—Robot Education, Robot competition, Virtual Robot,Basic Education,Strategies

I. INTRODUCTION

With the development of science and technology, the application of robots is not confined to industrial areas or research laboratories, and it has entered into education area. Some educators have claimed that through hands-on experimentation, robots help youth transform abstract science, engineering and technology (SET) concepts into concrete real-world understanding [1]. Recent drop in cost and improvement in simplicity make it possible for students to engage in using this kind of hands-on experimentation with robotics [2]. Therefore, in many developed countries, many primary and secondary schools have implemented a new robotics curriculum or activities in school. The robot education in China's basic education mainly include: Robot Competition and Robot Instruction.

The paper is structured as follows: In section II we illustrate the present situation of robot education in China's basic education from the perspective of Competition, Instruction and Research. Based on the research and investigation , we analyze issues occur during the process of robot education and put forward strategies on how to solve the problems in section III, and conclusions are presented in section IV.

II. THE PRESENT SITUATION OF ROBOT EDUCATION IN CHINA'S BASIC EDUCATION

In order to meet the needs of talent cultivation in future, China Ministry of Education has included the robot competition in the national computer activities for primary and secondary schools since 2003. The New Curriculum Standards for Senior High School promulgated in 2003 have included "Brief Introduction to Artificial Intelligence" and "The making of simple robot" in a list of optional courses [3]. The Curriculum Standards of Physics for Senior High Schools (trial edition) also puts forward requirements of collecting materials to find out the application of robot in production and life. At present, almost 100 primary and secondary schools in China have joined in the experimental schools for robot teaching. Robot as the tool to cultivate students' operational skills and to develop students' thinking skills is being gradually accepted.

A. The summary Of Robot Competition in Primary and Secondary Schools

The main purpose of holding Robot Competition is to popularize and develop the robot education in primary and secondary schools through contest. Compared with international robot competitions, China's robot competition got off to a late start. The China Association of Science and Technology (CAST) held the first China Youth Computer Robot Competition in 2001, which is served as a prelude to the robot competitions in primary and secondary schools. Since then, the robot competitions have developed quickly, with rules and projects of the competitions in accordance with international principles gradually. Currently, there are some more influential robot competitions in primary and secondary schools, such as China Adolescent Robotics Education Online [4],China's Robot Competition and Open RoboCup [5], National K-12 IT Innovation and Practice Robot Competition [6], National K-12 Computer Activities [7], Apart from the domestic competitions, there are several international competitions for primary and secondary school students to attend, such as WRO [8], FLL [9], FIRA [10], RoboCup [11], Asia-Pacific Broadcasting Union (ABU) [12], and Firefighting Robot Contest and Trinity College [13].

B. General Situation of Robot Instruction in Primary and Secondary Schools

By the effective promotion of the robot competition, many developed primary and secondary schools gradually introduced robot into campus, carrying out a series of colorful robot teaching activities. They are mainly in the forms of Scientific and Technological Activities after Class, such as optional courses, comprehensive practical courses, information technology courses and so on. A number of important events about robot education for primary and secondary schools in China recently are listed as follows:

1) In 2000, Jingshan School in Beijing brought robot education into information technology courses as research projects, which is the first robot teaching practice in primary and secondary schools.

2) Since 2001, several schools in the southwest of Shanghai, such as Weiyu Middle School and Luwan High School have been on the way to probe and attempt the activities of robot teaching into the classroom with the form of "school-based curriculum".

3) In 2005, Prof.Miao Fengchun in Beijing Normal University organized a "Robot teaching experimental schools around national primary and secondary schools".

4) In September 2005, robot teaching was first formally introduced into classroom teaching in Harbin, the course of "Robots and Artificial Intelligence" was set in 41 schools such as the affiliated primary school of normal universities, provincial experimental middle school, which took the robot education into primary, junior high and senior high schools in the form of compulsory course.

With the gradually spreading out of robot teaching in primary and secondary schools, the curriculum and textbooks of robot education have been paid more and more attention to. However, the robot teaching ever has no consistent teaching materials. There are few robot teaching materials suitable for students. With various materials integrated, robot teaching modules can be broadly classified into four categories: (shown in Table I)

TABLE I: KNOWLEDGE MODULE OF ROBOT TEACHING

Module	Name of the Module	Specific Contents
1	Overview of Robot	The concept of Robot, The principle of Robot, The history of robot, the relationship between robot and human beings, Robotics and Society, Etc.
2	Robot Programming	Learn to use Java, Visual C + + / C,MSWLOGO,QBasic,VB,Etc. and Programming Platform. Learn to compile the database program. Being able to design issue-oriented, agent-oriented programming. Being able to make practical robot procedures.
3	Hardware of Robot	Understand the structure of Robot hardware system, and mainly focus on principles and composition of its mechanical structure, drive system, control system, sensory systems, communication systems. Learn to modularly assemble, control and maintenance Robot.
4	Application of Robot	Understand functions, application areas, application methods and performance of Robot. Operation, use and maintenance of robot and other intelligent equipments. Use the knowledge creatively in the robot knowledge and ability competitions.

C. Related Studies on Robot Education in Primary and Secondary Schools

We reviewed and analyzed the research papers on CNKI, a digital library in china , with "Robot education" "Robot Teaching," and "Robot Competition" as the keywords , the time for the research papers was from Jan.1st,1999 to Sep.31st,2007. After screening out unrelated information, there were 28 papers with the key word "Robot education", 21 papers with "Robot Teaching" and 578 papers with "Robot Competition" or "Robot Contest". The three types of these articles were distributed in Figure 1:
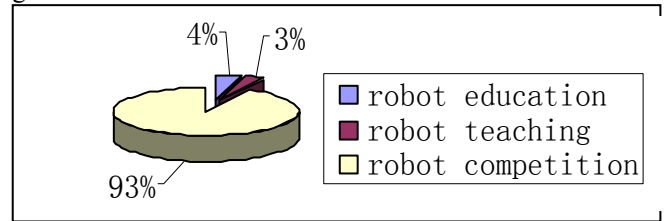

Figure 1.1999—2007 Distribution diagram of three types of articles

From Fig1 above, we conclude that researchers studied robot education from different views, and the researchers' attention was obviously unbalanced for all fields. Currently, the activeness and the degree of staffs dedicated for Robot teaching in primary and secondary schools were obviously not equal. Researchers over-paid close attention to the robot competition, and the direct result of which was a lack of research in the robot educational theories, eventually leading to a lack of effective theoretical guidance of robot teaching, thus making it difficult to go deeply into classroom practice. It can be said that "robot teaching" in China lagged far behind the development of "Robot Competition"

III. PROBLEMS AND STRATEGIES

A. Cognition deviation on the Robot education

When robots education were brought into primary and secondary schools, developed schools invested a large amount of money to build high-grade laboratories, equipped various types of robots. However, most of these initiatives were to prepare for the competitions, and rarely used in routine teaching. Only students who participated in the competition had the chance to utilize them. In fact, in the compulsory education stage, robot education should not be limited to competitions, but should be integrated to the current curriculum reform [14]. Only in this way could the robots education develop and popularize continuously in order to make all students get benefits from it.

For example, in primary and secondary schools, robot teaching can be integrated with "Integrated Practice", "Information Technology Course". In high schools, it can be integrated with "Brief Introduction to Artificial Intelligence", " Algorithm and Program Design", "The making of simple robot"," Electronic Control Technology". Developed schools can carry out the course of Artificial Intelligence and Robot in School-based Curriculum. In fact, robot teaching with its comprehensive knowledge can be carrier not only for education of Information and Technology but also for the integration of ET and courses of primary and secondary schools. Schools in impoverished areas can carry out robot education through virtual robots. The developed schools can both use entity robots and virtual robots in the classroom teaching. Robot basic education can be extended, and the loss of the equipment components can be reduced together with the increase of the

utilization rate of robots in this way. The development of virtual robot competition (eg. the national NOC virtual robot competition [15], the international Robocup junior competition, etc.) makes virtual robots possible to enter the classroom.

B. The competition is not popular and its educational purpose is not clear

The major problem in robot competition currently is that the competition is still not popular and its educational purpose is not clear enough. Commercial factors have a negative impact on the setting up and evaluating the projects. The contents of some competitions are short of creativity and scientific elenments） in which students' creativity can not show up. Some of the participants' motives are not positive, and some of them even resort to deception, which rely on technical staff to help players win, etc. After systematic analysis, the main reasons can be concluded as: 1) The lack of policy and social support. Especially, under the background of examination-oriented education, "exams and college entrance examination is the lifeline of education." Administrators and parents worry that robot contest will occupy students' learning time.2) The capital investment of robots are so high that the poor schools can't afford the robot education at all.

To reflect the educational significance of the competition and promote robot competition, following things should be done. Firstly, we should build up a competition and social environment which may reflect the ability of students; Propagandize intensively to get the social support(including funding entries, guidance, etc); Organize robot activities such as parent-child education to enhance communication among schools, students and parents, and also develop competition among schools, community and regions widely; Secondly, we should invent robot products which are low-cost, practical and compatibility and lower the entrying doorsill for robot into school; Set up more projects to promote virtual robot competition , which are of much educational significance and can better indicate the students' ability. Finally, as to the evaluation system we should set up a more pragmatic reward system through multi-evaluation.

C. Lack of robot products' standardization

Robot product is the carrier of implementing robot education. There are a lot of brands of education robot with different characteristics at home and abroad. (Table II shows the commonly used robot products in schools.) However, the educational robot products which are suitable for teaching and cost-effective are still quite scarce as a whole. For lacking of standardization, the companies considered more about the commercial factors and less about educational factors, which leads to various education robot brands, self-made systems, incompatible and poor openness. We suggest that the standardization of educational robot development should be considered from the following two aspects: ① Standardize educational robot products. Educational robots of different enterprises should take cognitive level of different age groups of children into consideration, provide the appropriate function, accessories, as well as man-machine interface to different users. This standard should provide reference for enterprises to

researches and development of robot used in education, and for schools to the choose of them . ② Guide education activities of the robot. We should choose robots of different types and specifications for different learners on different levels to participate in the competitions. The standard can provide the reference for robot teaching and extra-curricular activities to achieve the teaching goals.

TABLE II:INFORMATION OF ROBOT PRODUCTS COMMONLY USED IN SCHOOLS

Company	Websites
Lego（Semia）	http://www.semia.com
Shanghai Grandar	http://www.grandar.cn
jonimax	http://www.robotplayer.com
Nanjingziguang	http://www.robot-edu.com
tongyongyinate	http://www.tyenet.com.cn
roboto	http://Robot.hieuppliers.com
FISCHER	http://www.fishertechnik.com.cn
NST	http://www.robotedu.cn

D. The research from the perspective of education is not enough

Aiming at giving full play to the value of education robot, the excellent robot platform should not be separated from analyzing and positioning of the robot education, especially on the robot teaching elements. However, from the current situation of education and research, we found that the lacking of research in education has led to the following consequences: Teaching objectives are unscientific; grading objectives in elementary school, junior high school, senior high school are not clear and reasonable; teaching materials are not normally compiled and their qualities are not high enough; participation and guidance of curriculum and instruction experts are absent; researches on teaching model and evaluation are still very few.

Enhancing robot education research needs the efforts of teachers, and also the educational research institutions and Robot Company to design program and collect cases of robot teaching and researches and development of teaching platform of online virtual robot. Finally, Normal Universities should enhance relevant disciplines construction, train teachers in this field as well, only in this way the professional robot education and research team can be expanded.

IV.   CONCLUSION

China's in-depth development of robot education needs the efforts of educational department, Primary and Secondary schools and the robot companies. To explore the theory and practice of robot education to benefit the students is educators' mission. Robot education must combine with information instruction and fully embody the spirit of curriculum reform to effectively cultivate innovative capability of talents in 21 century.

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