Robot Manufacturing Class for Children Led by University Students

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Abstract

This paper introduces the Tokushima Robot Programming Club. This is a robot manufacturing class for elementary and junior-high school students. This club is planned and managed by university students. First, we show the organization of our club. And, robot kits and software development systems we use are introduced. And then, we describe the activities of this club and show its educational effectiveness for both the children and the university students.

Keywords: Engineering Education, Robot Manufacturing Class, Elementary and Junior-High School Students, University Students

Ⅰ. Introduction

Tokushima Community Learning Network (TCLN), which is an incorporated nonprofit organization, together with the University of Tokushima has been holding a robot manufacturing class, "Tokushima Robot Programming Club", for elementary and junior-high school students in Tokushima, Japan. The purpose of this club is to help children master advanced knowledge, develop their intellect and knowledge of ICT technology in a voluntary way, and grow up to be world-class IT engineers with an innovating spirit.

An important characteristic of this club is that a major part of its planning and management is executed by university students. From this learning system, children (participants of this class) are able to participate in the classes more comfortably. in addition, university students studying ICT, mechanics and electronic technologies also gain skills in project management and presentation by teaching the children. This paper introduces the activities of this club, and shows its effectiveness for both the children and the university students.

Received : December 4, 2009
Revised : April 6, 2010
Accepted : May 10, 2010
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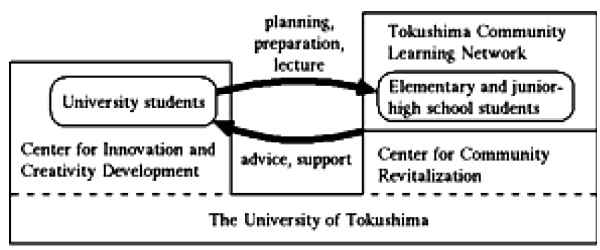
Ⅱ. Overview of Robot Manufacturing Class

[Fig. 1] shows the organization of our class. The class is affiliated with TCLN, an organization that offers various courses to people in Tokushima prefecture using the Internet and ICT technology in cooperation with the Center for Community Revitalization (CCR) of the University of Tokushima. The students of the robot manufacturing class are from the fourth grade of elementary school to the third grade of junior high school.

University students execute the planning and management of this club as a project of the Center for Innovation and Creativity Development (CICD) at the University of Tokushima. This center is the facility where the project that university students voluntarily plan is executed. TCLN and CCR consign management of the club to students while supporting the project financially and logistically.

Club activities began in August, 2006[1]. The



[Fig. 1] Organization of robot club

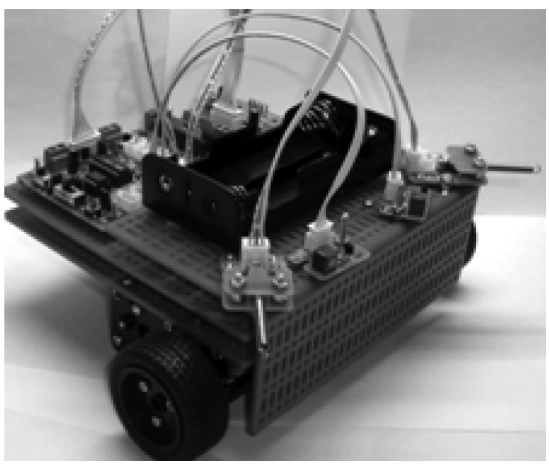
number of participants was fourteen children. After that, we held classes three times in 2006. In 2007, classes were held five times. In these two years, the university professor lectured, and university students did not participate in the club.

In 2008, seven students joined and executed management of the club. Classes were held once a month from August, 2008 to March, 2009. During this time, the budget was supported by the Tokushima Prefecture government. In November, 2008, the club joined a regional ICT festival sponsored by Tokushima Prefecture. Some robots manufactured by children were exhibited and our activities were introduced. Moreover, we held workshops at this festival and lectured to ten children about robot manufacturing. This past December, ten new participants joined, bringing number of participating children to eighteen.

We have held lectures once a month since April, 2009. This year, we have the financial support of the Japan Science and Technology Agency (JST). And another ten participants have joined. Because the number of participants has increased to 28 children, we manage three classes, “Beginner course”, “Basic course” and “Master course”[2],[3]. The details of these classes are shown in later sections.

Ⅲ. Robot Kit

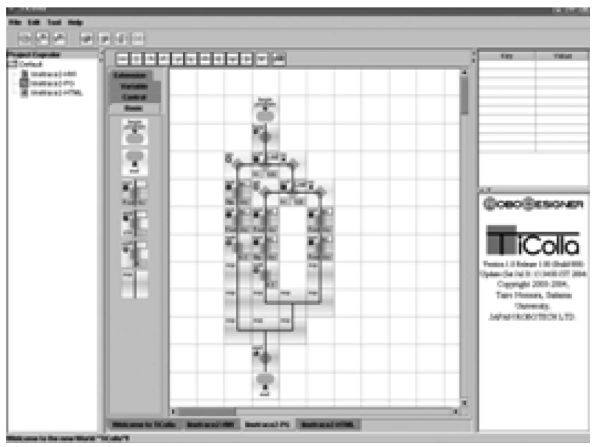
We have used the robot kit “RoboDesigner RDS-X03” (Japan Robotech Ltd.) since the very first lecture in 2006. This kit includes many parts: for example, touch sensors, infrared ray sensors, motors, tires, micro computer and so on. Basically, this robot can be manufactured using only screws and nuts. Children can construct robots in various forms according to subjects and ideas. [Fig. 2] shows the basic style of the robot used by this club.



[Fig. 2] Robot kit.

Children can use one of two software development tools. One is a visual programming tool called “TiColla”. It can create a program by arranging icons which indicate the function of the program. [Fig. 3]shows an example of a program developed using TiColla. Each icon can be arranged by mouse operation. The program can be downloaded to a robot and the robot is then controlled by the program.

The other is C programming language customized to this robot kit. [Fig. 4] shows a window of program editing. By using C language, we can create a more complex control program than with TiColla. We use two softwares according to the skills of each child.



[Fig. 3] Programming by TiColla.

[Fig. 4] Programming by C language

[Fig. 5] Scenes of classes

Ⅳ. Activities of This Class

The main activity of this club is a class in which children manufacture robots with university students in a room. We manage three different classes, “Beginner course”, “Basic course” and “Master course”. All classes are executed in parallel on the same day. This is because of schedule and room-sharing reservation. We also think that it is effective to exchange children in different courses. [Fig. 5] shows scenes of classes.

The Beginner course is for new participants. In this course, children manufacture a robot in a basic style, learn the programming method with “TiColla” and build up a line tracer and succor robot. This course consists of about six classes and children study one theme per class. The following are the themes of this course:

1. Assembling robot and confirming operation.
2. Making simple robot motion programs.
3. Touch sensors and IR sensors.
4. Line tracer.
5. Succor robot (No.1).
6. Succor robot (No.2).

The Basic course introduces children to not only technical know-how but also the skills to build a robot and program it by themselves. In this course, the functions of the robot kit are expanded by optional parts, and robots with arms and complex motions can be manufactured. This course also consists of about six classes on the following themes:

1. IR Data logging.
2. Improvements of the line tracer.
3. Control of the external motor.
4. Link mechanism.
5. Improvements of robot using external motor and additional parts (No. 1).
6. Improvements of robot using external motor and additional parts (No. 2).

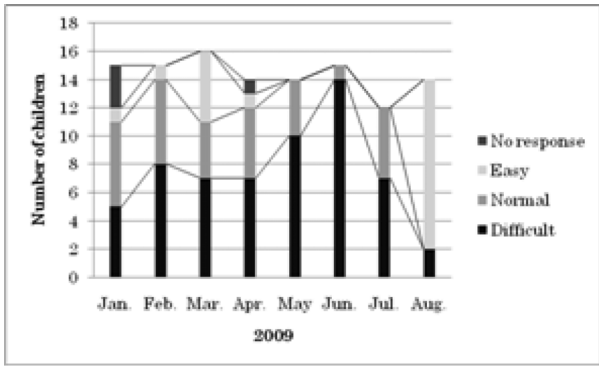
After these two courses, children attend the Master course. In this course, programs are developed by C language, and children study one theme over several classes. In the final class on a theme, contests are held to evaluate robots and programs manufactured by children. This course consists of about ten classes. We have developed the following themes:

1. Line tracer using C program.
2. Remote control robot.

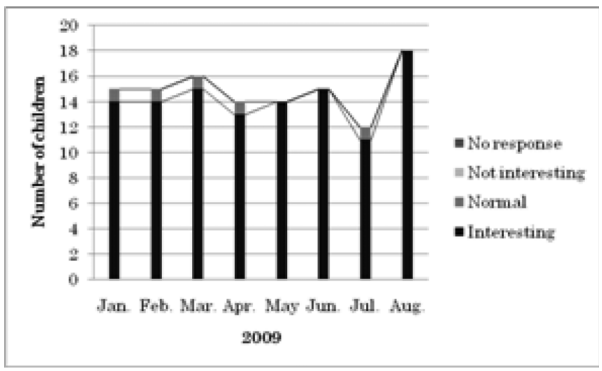
We are also planning other themes.

Ⅴ. Effectiveness for Children

In every class meeting of our club, we provide a survey questionnaire to children. Though there are various questions in it, we report only the results of two questions, “easy or difficult” and “interesting or not interesting” about the class topic ([Fig. 6]). From these results, “difficult” and “interesting” are always the majority opinions. We think that it is important not only to teach knowledge of IT technologies to club members but also to encourage them to make robots by themselves, through trial and error. Hence, children may feel that subjects of the classes are above their ability. But if they can nonetheless master such subjects, they are likely to become especially interested in robot manufacturing.



(a) Easy or difficult



(b) Interesting or not interesting

[Fig. 6] Results of questionnaire

VI. Effectiveness for University Students

As for the program's effectiveness for university students, they have the responsibility of teaching for children. Therefore, students must prepare classes: for example, making trial robots and courts for games, lecture slides and so on. On the other hand, it is necessary to engage children in the lecture time. At the beginning, they were not able to communicate well, but after several classes, they become better able to communicate smoothly. Therefore, the university students could improve their communication skills and presentation abilities from the experience of teaching.

VII. Conclusions

In this paper, we describe our robot manufacturing class for children led by university students. It is not easy to represent its effectiveness for children and students quantitatively. However, we have witnessed improvements in the children's ability in science and technology and university students' communication skills and presentation ability. In the future, we will continue activities of this club and show its effectiveness in various ways.

Reference

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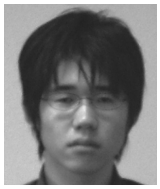

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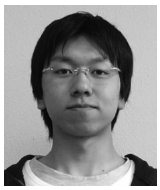

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