Report of a robot competition on the problem of garbage in the sea and verification of learning effects

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Abstract

In the Junior League of the Eighth Underwater Robot Competition held in 2022, a marine cleaning robot competition was held under the theme of "life under the surface," the 14th goal of the SDGs. Specifically, we held a poster session on the problem of garbage in the sea and a robot competition to compete in garbage collection ability, and competed for points. In this paper, we give an overview of the junior league and discuss its learning effects.

Keywords: Robot competition, Education of robotics

1. Introduction

In recent years, the problem of ocean debris has become more serious. Among them, coastal pollution caused by stray litter and the harmful effects of microplastics on marine life are important issues that need to be solved quickly by humankind. The SDGs adopted by the United Nations Summit in September 2015 set 17 goals for a sustainable and better world [1]. The 14th goal, "Life under water," includes the problem of ocean debris. We are working on robot education for middle and high school students through robot competitions, and the 8th

Underwater Robot Junior League is a competition with the theme of underwater robots. Specifically, the robot competition was held on the theme of ocean debris. The junior league is divided into poster presentation and robot competition, and the winner is decided by the total score. The poster presentation investigated the problems that society has at present about the 14th goal of SDG, and proposed a robot to solve them, and in the robot competition, the proposed robot was embodied, and ocean debris was picked up.

In this paper, the outline of the junior league is explained, and the results of this competition are shown, and the learning effect of this competition is verified by analyzing the questionnaire conducted before and after the competition.

2. Outline of Junior League

The junior league was ranked by the total score of the poster presentation and the robot competition[2]. Here, the poster presentation and the outline of the robot competition are explained.

2.1. *Poster Presentation*

Students from different cultures, such as technical college, regular high school and technical high school, participate in the junior league. Poster presentations were held with the aim of encouraging people to find new values by sharing and absorbing different ways of thinking. The poster presentations are shown in Fig.1 The following items were required to be included in the poster and were subject to review:

- Poster title, team name, school name, team member name, teacher name
- Investigations into debris problems in the ocean and rivers,
- Issues to be solved in garbage collection,
- Ideas to solve the issues,
- Proposal for garbage collection robot,
- Conclusions,
- References.

Fig. 1 Poster presentation

2.2. *Robot Competition*

Two teams compete in a competitive format, with robots starting from each team's territory to pick up debris in the debris area. After the competition, players compete for overall points by adding points according to the type and amount of debris collected. The competition field uses a pool 2.2m long, 4.5m wide as shown in Fig. 2. The depth of the pool is about 60cm to 70cm. The competition field is divided into team area for each team and debris areas. The team area is the area where the robot starts, and the debris area is the area where the debris, located in the center of the competition field. And, the short side of the competition field in the team area will be the end line (red line). At the start of the competition, debris floats randomly in the debris area of the competition field, and there are three types of debris: "PET bottles", "jelly containers" and "Styrofoam balls". The type and number of floating debris, and the score when collected are shown in Table 1. Debris floating on the competition field is collected by robots, and if the condition of the debris satisfies the following conditions, points will be added as "collected debris".

- Debris that the robot lifts above the water surface is called "collected debris". If part of the debris touches the surface of the water or is submerged in water, it will not be considered as "collected debris".

- During the competition time, if a part of the robot touches the end line of the team area, the team members standing on the end line side may place the "collected debris" outside the competition field from the robot.

- At the end of the competition, the robot raises it above the water surface, and the debris that is still loaded on the robot

Figure 3 shows the scene during the competition.

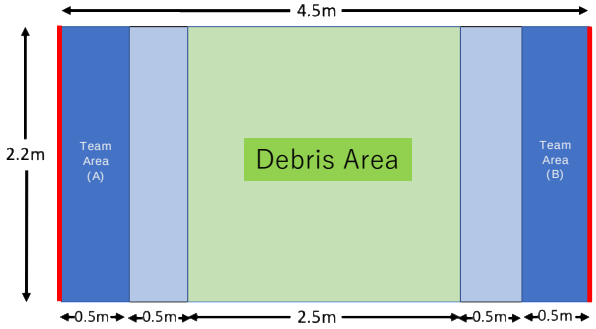

Fig. 2 Competition field

Table1 Debris type and score per piece

Debris type	Quantity	Score per piece
PET bottles	10	10 point
jelly containers	30	5 point
Styrofoam balls	50	3 point

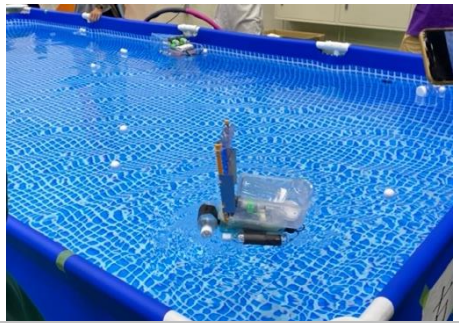

Fig. 3 Scene during the competition

2.3. *Result of Junior League*

The results of the competition of Junior League are shown in Table 2. The 8th competition was attended by 18 teams with a total of more than 120 participants. A lively exchange of ideas was observed in the poster session, and robots with various ideas were active in the robot competition. Most of the winning teams were industrial schools, and the teams with many students with basic knowledge such as microcomputers had an advantage in robot development. However, prior learning was conducted remotely for schools without knowledge, and there were few teams where robots did not work at all. The winning and runner-up robots are shown in Figure 4. Both teams were robots that scooped up debris with their arms and collected it.

Table 2 Award team list

Award	Team Name	Affilication
Winner	Noukou G's	Tabuse Agricultual Technical Highschool
Runner-up	Know Sea's	Tabuse Agricultual Technical High school
Third place	Kokkaginoushi no tsudoishi Minamata-shibu	Minamata High school
Robot competition 1st place	Noukou G's	Tabuse Agricultual Technical High school
Robot competition 2nd place	Know Sea's	Tabuse Agricultual Technical Highschool
Poster presentation 1st place	Umi no Gomi wo Nakushitai	Jyoto High School
Poster presentation 2nd place	M・E・C Suirobo Doujinkai	Osaka Metropolitan University College of Technology
Governor of Yamaguchi Prefecture Award	Tokuyama Kosen Mechatro System Club	Natinal Inst. of Tech., Tokuyama College
Mayer of Iwakuni Award	Gankou “Damashii”	Iwakuni Technical High school
Special Award	Dept. of Electronic Mechanics	Mifune High school
Fiting-spirit Award	Team 0	Individual participation

(a)

(b)

Fig. 4 The Winning and Runner-up robots (a) Noukou G's (b) Know Sea's

3. Verification of Learning Effects

We conducted a questionnaire about changes in understanding before and after the competition, and verified the educational effect. Answers to five questions about robots, circuits, and SDGs were aggregated and summarized in a graph. The contents of the responses are as follows.

A1: No understanding
A2: If they are teached they can understand
A3: they can understand on their own
A4: they can understand and teach to others

Figure 5 shows some of the responses to the question about understanding microcomputer programming. Response A1 decreased significantly, and responses A2 and A3 increased. Figure 6 shows some of the responses to the question about understanding of circuit making. A1 decreased significantly, and A3 increased significantly. Figure 7 shows some of the responses to the question about understanding of robot mechanism making. Overall, there is no big change, but answer A1 is the least among questions about understanding of microcomputer programming, circuit making and robot mechanism making. Figure 8 and Figure 9 show some of the responses to the question about understanding of SDGs and ocean debris. Among all the questions, the response A1 is the least. About circuit production and microcomputer programming, the response A1 decreased significantly before and after the convention, which is considered to have had a great educational effect. It is considered that the pre-learning we conducted online for each team two months before the competition led to their understanding of circuit construction and microcomputer programming.

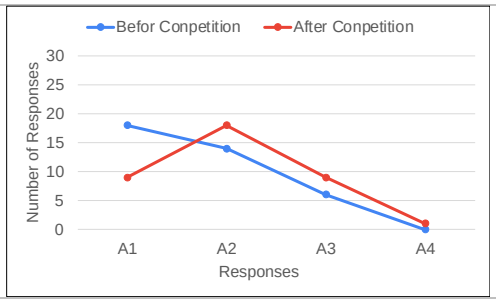

Fig. 5 Changes in understanding of microcomputer programming before and after competitions

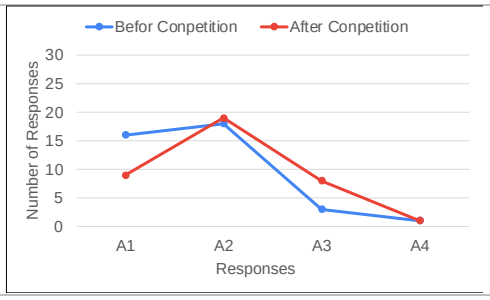

Fig. 6 Changes in understanding of circuit making before and after competitions

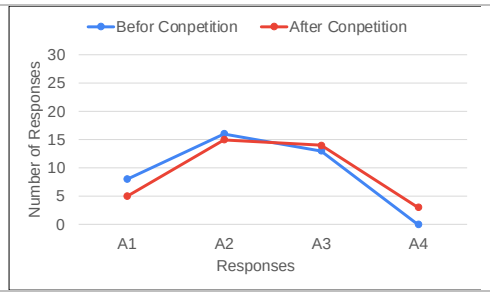

Fig. 7 Changes in understanding of robot mechanism making before and after competitions

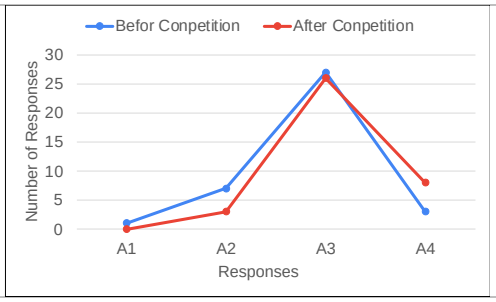

Fig. 8 Changes in understanding of SDGs before and after competitions

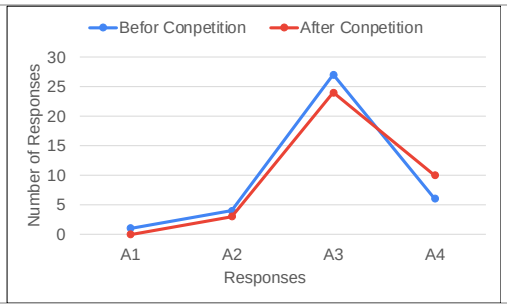

Fig. 9 Changes in understanding of ocean debris problem before and after competitions

4. Conclusions

The 8th Underwater Robot Competition Junior League held a robot competition on the theme of ocean debris problems. The competition was participated 18 teams and realized the active exchange of ideas among teams through poster presentations and the proposal of debris collection mechanism through robot competition.
From the point of view of robot education, the educational effect was confirmed mainly on microcomputer programming and circuit making.

Acknowledgment

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Authors Introduction

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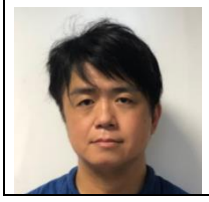

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