Cross-domain Sharing of Robots in the Community Caring and Practice of University Social Responsibility

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Abstract

This paper focuses on community caring and social practice that assisting robot education development in rural schools to echo the two goals of the United Nations' SDGs (Sustainable Development Goals)–"Goal 4: Quality education" and "Goal 10: Reduce inequality". At the same time, in response to the scientific and technological literacy-oriented needs of the Curriculum Guidelines of 12-Year Basic Education in 2019, it is shown how to assist rural schools in Tainan City of Taiwan to develop computational thinking and cross-domain applications of robots under the COVID-19. Four robot education suites including LEGO Mindstorms EV3, Makeblock mBot, mBot2, and VEX IQ are applied in the rural schools. The dilemma and solutions of robot education in rural schools are also discussed in this article. Universities, non-profit organizations and robot equipment vendors work together to practice social responsibility.

Keywords: Rural Education, Robot education, University Social Responsibility

1. Introduction

The University Social Responsibility (USR) program was promoted by Ministry of Education (MOE) since 2017 to encourage colleges and universities to reflect on the content and goals of higher education in Taiwan[1]. The USR program had entered its second phase during 2020 and 2022. This project–"Rural Information Application Cultivation and Robot Cross-domain Sharing Project in Tainan City" was supported by 2020-2022 USR program to focus on community caring and social practice that assisting robot education development in rural schools to echo the two goals of the United Nations' SDGs (Sustainable Development Goals)[2]–"Goal 4: Quality education" and "Goal 10: Reduce inequality". On the other hand, in response to the scientific and technological literacy-oriented needs of the Curriculum Guidelines of 12-Year Basic Education in 2019, the lacking dilemma of teachers, amount of robot suite, teaching materials and technical supports is arising as well as the demands on developments of computational thinking and cross-domain applications of robots. It is more difficult during COVID-19 epidemic to teach and learn robot and programming in classroom. On-line learning is applied more and more to avoid the epidemic, however, without the robot suite, the learning effectiveness of robot operation and programming decreases.

In this paper, we describe the three lacking dilemmas of robot education in rural schools in Section 2. In Section 3, the solutions and corporation of universities, non-profit organizations and robot equipment vendors are discussed. Four robot education suites including LEGO Mindstorms EV3, Makeblock mBot, mBot2, and VEX IQ are applied in the rural schools. Two canonical examples are shown in Section 4. Conclusions are shown in Section 5.

2. The dilemma of robot education

There are three deficiencies in robot education in rural schools. They are lack of equipment/resources, lack of technology and lack of teachers.

2.1. *Lack of equipment/resources*

Due to the students of rural schools are less than the urban schools, the funding of robot equipment is not sufficient to meet the requirement of teaching and learning activities. The quantity of robot suite cannot meet class size. It is also difficult to choose which robot is suitable with the consideration of lesson preparation, applications and subsequent maintenance. After the lifetime cycle which may be three to five years, where is the source and how to arrange the funding of updating next generation robot are the other two important issues.

2.2. *Lack of technology*

In general, the rural school teachers lack for experiences of robot hardware design, sensors and motors application, control program developing, and coaching a team to joint robot competitions. The continuity problem of staying in the same rural schools enhances this lacking issue in Taiwan. On the other hand, the study or training courses are deficient for rural school teachers.

2.3. *Lack of teachers*

In spite of the continuity problem of staying and deficient study or training courses, insufficient time and enthusiasm from teachers is another factor for the lack of suitable teacher of teaching and applying robot in the class. The principal's and colleagues' support can influence the teacher's willing to learn to teach and apply robot in and/or after class.

3. Solutions

3.1. *Robot education sources*

There are seven robot education sources including official funding, school experience exchange, robot vendors, robot classroom in the after-class education market, network communities, parents and family, and corporate/alumni sponsor.

3.1.1. *Official funding*

There are many official programs or projects every year for schools to apply. The funding of official programs or projects can support the purchase of robot suite and parts, and handling of study courses.

3.1.2. *School experience exchange*

The experience exchanges of different schools are very important. Different levels of school can share their robot teaching and applying experiences from each other. It is useful to share resources such as equipment, teaching material, technology, and project applying. The coaching experience to joint robot competitions is another interested issue.

3.1.3. *Robot vendors*

Robot vendors are the most important equipment support sources. They can not only make advice for the purchase of robots and lessons, but also can provide technical support. Some vendors may make discount or donate to rural schools for their Corporate Social Responsibility (CSR).

3.1.4. *Robot classroom in the after-class education market*

There are abundant teaching and robot competition experiences existing in the robot classroom of after-class education market. They can provide extensive materials for the teaching activities and robot competition.

3.1.5. *Network communities*

Network communities can provide channels for the introductions of robot equipment, technical discussion without the limitation of when and where.

3.1.6. *Parents and family*

With the parents' support, teachers can develop in-class and after-class learning activities to explore the applications of robot. Some robot applications arise from living fields or needs, parents may provide the off-campus visit for the class. Parents and family need to accompany students to study after class to enhance the learning effect. During competition seasons, coach or teacher needs the parents' help for the pick-up of students, even the technical supports.

3.1.7. *Corporate/alumni sponsor*

Another unofficial robot education source is the corporate or alumni sponsorship for funding or scholarship. The sponsor may provide funding for robot teaching activities and competition, or provide technical or labor support. With scholarship, the students could be encouraged to study robot applications, and to join further volunteer service.

3.2. *Strategy*

We employ the following four strategies to overcome the three lacks in the rural school robot education. They are learning bases, integration of resources, strive for sponsor of parents and alumni, and professional service learning volunteering.

3.2.1. *Learning bases*

As central learning bases, Far East University and National Yunlin University of Science and Technology provide the robots such as LEGO EV3, Makeblock mBot and mBot2, VEX IQ, teaching materials, and student volunteers to support the project. Some rural schools are chosen to be satellite learning bases to provide the local robot education opportunities. The learning bases already have robot suites with enthusiastic teachers. They can lead the rural schools around them to step into and try to develop robot education. Our USR project supply funding for the maintenance of robot and study courses. The learning bases also provide spaces for the robot study and competition preparation. Two facebook communities (Fig. 1, Fig. 2) are established to link rural and urban schools in Tainan and Yunlin in Taiwan.

Fig. 1: Tainan Robot Education Community

Fig. 2: Yunlin Robot Education Community

During COVID-19 epidemic, on-line learning is applied for classes. For robot learning, it is difficult to test the robot sensors, motors and mechanism without robot. Our USR project borrows robots to students for the robot learning activities.

3.2.2. *Integration of resources*

We invited robot vendors and non-profit organizations to join this USR project. The learning lessons, robot suite, and competition information are integrated to learning bases. We introduce robot vendors to the interested rural schools to plan for the possibility of implementing robot learning and applications. The learning bases and classroom in the after-class education market can work together to preparing robot competitions. Universities and the classrooms in the after-class education market contribute their experience and technic to lead the rural school teachers for coaching teams to join competitions.

3.2.3. *Strive for sponsor of parents and alumni*

The sponsors from parents and alumni like the two rocket boosters of space shuttle. They boost the development of robot education in rural schools. We support lessons and volunteers for satellite learning bases to create highlights of robot education. Then satellite learning bases can strive for official and unofficial project funding with these highlights. Also the highlights can be used to convince parents to encourage the students for joining the after-class learning club.

Universities and rural schools can enhance their relationship between them and local companies. Universities also can strive for the student scholarship and internship to achieve the object of cultivating talents.

3.2.4. *Professional service learning volunteering*

In order to achieve the object of cultivate talents, the student practice internship is valued gradually. However, the internship opportunity may not satisfy students. The

professional service volunteering is integrated into some professional classes to encourage students to provide professional service for rural area or local communities. Via the professional service volunteering, students can provide professional assistance for the rural school robot education.

4. Canonical examples

4.1. *Tainan Municipal Houbi District Houbi Elementary School*

Houbi District is the north countryside of Tainan City, and is famous for rice and rural cultures. Houbi Elementary School is one of satellite learning bases and our most important partner for practicing USR project. It provides Saturday Robot Club activities with average frequency of one course per two weeks for the Xinying District and Houbi District. It is the central robot education of north Tainan City, Taiwan. There are 20 suites of LEGO EV3, 20 suites of mBot, and 20 suites of mBot2 to support club class and competitions. Students of Houbi Elementary School, as well as the outside students from other schools, can borrow robot for home exercise or summer robot competition season. The funding and robot are sponsored by alumni. The youth university Student volunteers form the special achievement class in robotics of National Yunlin University of Science and Technology provide their professional service for the robot lessons. We also provide basic maintenance and repair service for it so that saving the waiting time and cost.

4.2. *Tainan Municipal Cigu District Hougang Elementary School*

Fig. 3: FLL Junior challenge Activity in Hougang Elementary School

Cigu District is an area near the sea in Tainan City, and was famous for salt pans. Hougang Elementary School is also one of satellite learning bases and is the more active school for developing special classes in local caring with robot application. The teacher Kuo guide and coach students to joint 2021-2022, 2022-2023 FLL Junior challenge (Fig. 3) with the Cigu District local materials, and win the prizes. The teacher Kuo develops many special teaching materials and shares without any cost.

5. Conclusions

In this paper, we have discussed the dilemma and solutions of robot education in rural schools. The issue about rural school robot education is worthy of continued care and assistance. The university teachers and students should pay more effort on local care to realize the university social responsibility and to achieve the object of cultivating talents.

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Authors Introduction

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