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The New Approach to Studying Robotics for Vocational Students through Cloud Learning Tools

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A B S T R A C T

This study proposes a methodological approach that allows educational robotics to be used in order to develop collaboration skills in educational settings. Educational robotics is a promising educational tool that has the potential to become a platform for the development of a range of skills. However, there is a scarce amount of empirical case studies that present detailed information on the way it is implemented within formal primary school education. On the other hand, even though collaboration skills are considered vital for future school graduates, it is rarely discussed as the main focus of educational robotics. Most commonly, collaboration or teamwork skills are viewed as a byproduct of robotics activities. This work views collaboration skills as the main outcome. The methodological approach that this work proposes has been implemented in senior high schools in Pekanbaru (Riau), a province somewhere in Indonesia. The students whose schools are around the Polteknik Caltex Riau campus. They are invited to the campus to study robotics with a cloud facility and low cost (free) through a partnership with Politeknik Negeri Padang in West Sumatera. The ability of the campus to do this event is due to its low cost and high efficiency. This method is applied to common clouds such as Wokwi and Thingspeak. These tools help students study robotics at a low cost and efficiency. This research measures the effectiveness and efficiency of studying robotics based on cloud tools. At the end, the student could show their skill in programming component simulators and present their results. This study needs more or less 4 hours for 30 senior high school. The enthusiasm of students following the study is very satisfying. The final test is done in 30 minutes. These parameters show that they can master robotic programming using our methodology. This methodology may also be beneficial to other lower-grade students such as junior high school or elementary school. However, this student may make mistakes while studying. If the tool is an electronic device, it might cause failures and damage many components. In the future, this methodology will play an important role in developing robotics among younger students and might also be applied to undergraduate students.

Keywords: Blood pressure prediction, ECG image, deep learning, high accuracy

1. Introduction

A current field of research involving education and technology is how to teach younger student to study technology or engineering field such as robotics. This studying might become the main problem for them and make them frustrated. Thus this studying also needs high cost and longer time, and a professional teacher[1]. With recent advances of sciences and technology evolves the manner of learning process. The use of unusual methods and strategies applied by the teacher is still difficult to figure out. These main problem problems left the young students with frustration and inattention[2]. Some innovative and efficient learning strategies have been crated by teachers and researchers. The technology-assisted learning method simplifies the teacher to prepare their material. Then, robotics is a significant tool to empower students and teachers. Several decades ago, robotic term meant a device to be used in the future, including technology and other artifacts that usually seen and imagine in the television. In general, the educational robotics can be categorized into robotics as the main actor/topic and as the coadjuvant topic. The robotics as a main actor means the task of teaching using robotics albeit coadjuvant topic means the teaching for robotics. Thus educational robotics can be defined as the integration of robotics and all related issues into specific curriculum. The difference between robotic education and education with robotics as shown in Table 1.

Table 1. The difference between robotics as the main topic and the coadjuvant topics[1]

Table 1 Robotic Education × Education with Robotics

Robotics as the Main focus	Robotics as the Secondary focus
To learn Robotics	To learn other subjects
Use other subjects as tools	It is a tool to help to learn other subjects

On the other hand, the study of robotics allows student to develop collaboration skill in educational settings. A variety of approaches were available in many places, especially in STEM topics. Those approaches motivate children, teachers, school and industries to rise their technological literacy. In the learning process, the cross correlation between educational robotic and other skills is shown in Fig. 1 below.

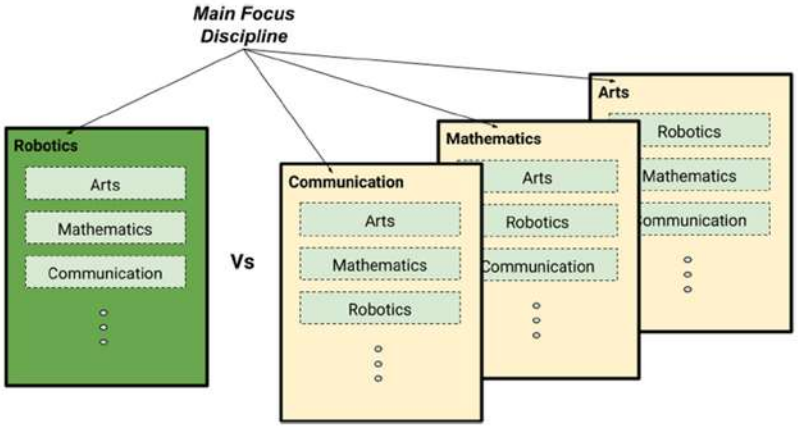


Fig. 1 The correlation between educational robotics and other skills

Educational robotics is a vital educational tool that supports the development of various knowledge. Otherwise, there was still a lack of information on how to study robotics better and how to assess the educational process. On the other hand, educational robotics is also used to generate a collaboration skill among students. This collaboration skill is rarely found in other course fields. The teamwork skills can be assessed as robotics activities. There were many ways for academics and experts to evaluate cooperation element between two or more people. Then the educational environment changes when the learning process moves toward. The teacher is responsible for creating a student-centric environment. This method gives students more power to make decisions than the class instruction method. The difference between student-centric and teacher-centric environment is show in table 2 below.

Tabel 2. Student-centric vs Teacher -centric environment[2]

Student-Centric	Teacher-Centric
Intrinsic Motivation	Extrinsic Motivation
Knowledge Construction	Knowledge Transmission
Loose, trusting students to do	Structured—Social Engineering

Source: Panitz T. (1999). Collaborative versus cooperative learning—a comparison of the two concepts.

Collaboration skills are a generic set of knowledge and skills. It is related to:

1. Planning and group decisions;
2. Communicating about thinking in the group;
3. Contributing resources, ideas, and effort and supporting group members;
4. Monitoring, reflecting and adapting individual and group process to benefit the group.

The collaborative learning environment showed its power when students engaged in solving traffic problems during the COVID-19 pandemic era. The students were using a line-tracker robot to simulate traffic routes and traffic problems[3]Using the theoretical-practical concept, students are engaged in understanding and applying the applicable algorithm to determine the route. Thus, it also improves their development competencies. Educational robotics was heralded as a frontier in the academic realm in building comprehensive student competencies.

2. Background

The most common academic area is STEM. Otherwise, this educational robotics also develops the computational thinking of students[3]. The case study of traffic problem through line-tracker robot is according to Fig. 2.

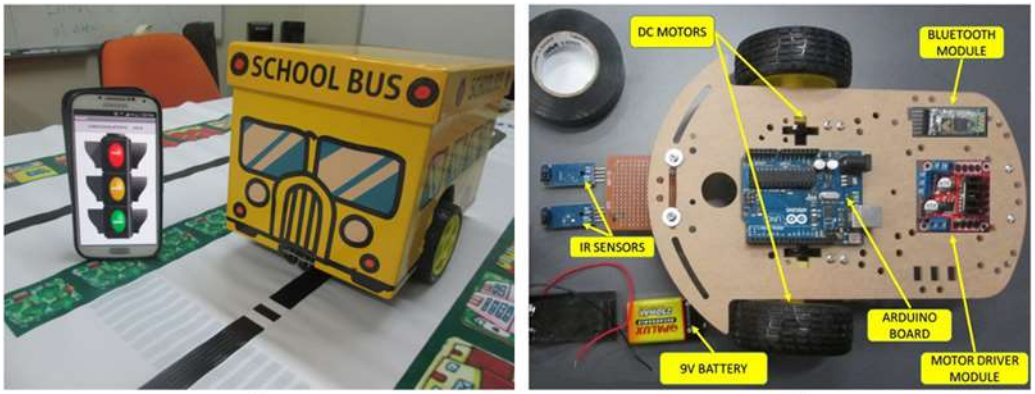


Fig. 2 Line-follower robot; a. Traffic light app; b. Robot design

The traffic lane was simulated with the line-follower robot to describe the transportation lane process around the city. The traffic sign was detected by various sensors installed on the robot. The policy of traffic lanes was adopted and articulated by the computer algorithm. That was a contribution of collaboration skills in student-centric learning.

Besides using a line-tracer robot to simulate a traffic system in educational robotics for junior students, many other robots were used to develop student studying based on a student-centric learning method. Social robots were used in education to increase the skill of human-robot interaction (HRI)[4]. The purpose of this interaction is to optimizing interaction robot and students. This learning process applied previous student knowledge such as psycology, neuroscience and educational research, those were fused to form a good validity and credibility of HRI. The situation of the learning process is shown in Fig.3

Fig. 3 The learning process of HRI[4]

Based on Fig.3 the assessment was done according to some categories, such as student knowledge acquisition, level of enjoyment and level of surprise. The three methoods used to obtain the indicator of performances. The first is one human-tutor lesson, the second is one-robot tutor lesson and the third is two-robot tutor lesson. The use of social robots to serve the students showed that students can optimize communication with robots. It can maximize functional robots according to the robot's purposes.

In order to obtain accurate result, the constraints of the research included;

1. Not cause any attention from the participants.
2. Action to show the behave and dress similarly to the participants.
3. Have the exact same appearance, script, and behavior between conditions to avoid systematic error or adding an unwillingly extra parameter in the experiment.

In order to increase motivation of student to study robotics that can improve their educational target, integrated constructive robotics (ICRE) was introduced[5]. The purpose of this method is to enhance and transmigrate educational robotics into a pedagogical setting. Where students engage in designing, programming, and manipulating robot. This tactile engagement empowers the student to obtain direct outcomes, cultivating sense of agency and ownership in their learning course. The Integrated Constructive Robotics Education model is shown in Fig. 4

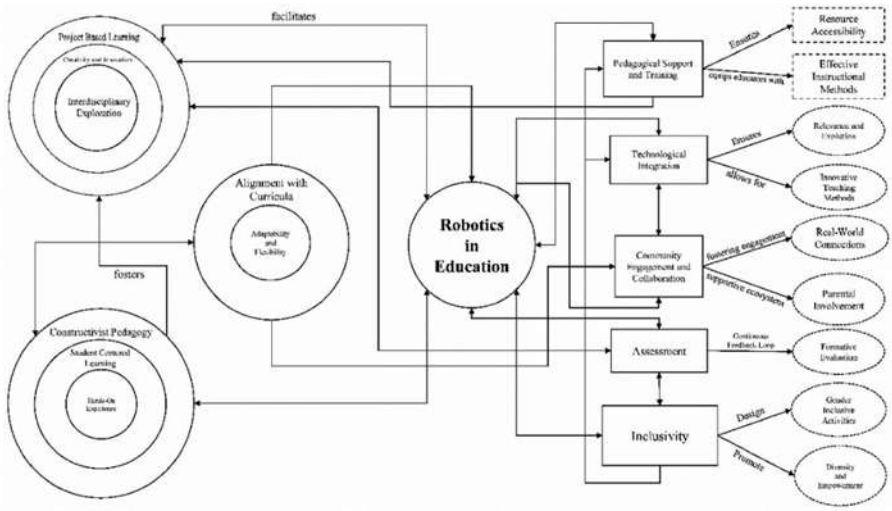


Fig. 4 The Integrated Constructive Robotics Model[5]

This type of learning is commonly known as project-based learning[5]. It formed a cornerstone of ICRE model. It empowers student to embark on robotics project that encourage creativity, innovation, and interdisciplinary exploration. Assessment within the ICRE model focuses on formative evaluation, allowing continuous feedback to fine-tune instructional methods and ensure students' progress aligns with learning objectives. Evaluation metrics measure the impact of robotics education on cognitive, socio-emotional, and technical skills, providing insights into the framework's efficacy. Inclusivity and equity are central tenets of the ICRE model. It emphasizes the design of gender-inclusive activities and instructional approaches to address disparities in STEM fields.

The educational robotics learning is influenced by many factors such as price and availability in common market. One of the viable option on educational robot is MBot[6]. It is shown in Fig.5

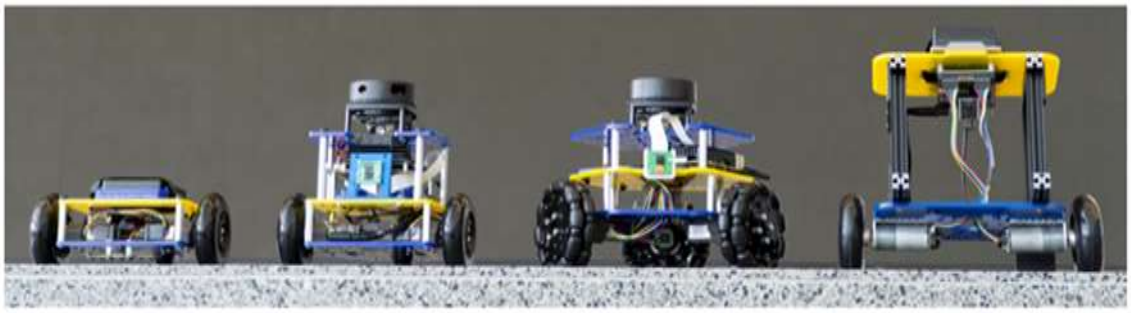
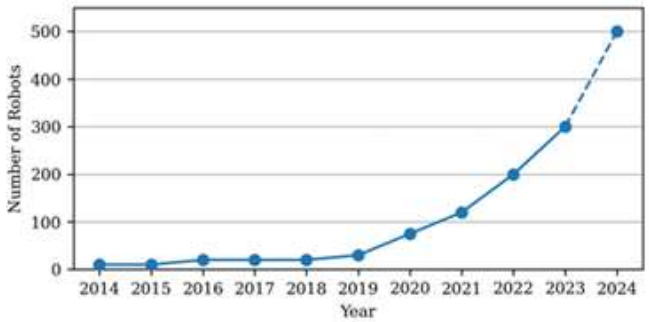


Fig. 5 The Mbot used for educational robotics learning[6]

The Mbot is a low-cost educational robot that can be applied by students to study robotics. It has been used to train more than 1000 students in autonomous navigation. This tool is designed for students to meet the need of teaching robotics as a skill field and academic discipline. Where the need for future is a skilled alumni in robotics across industries and academia. The need of Mbot is shown in table 2.

Tabel 2. The increase of using Mbot per year



Tabel 2 shows the increase rate of using Mbot to be learned by students every year. The rise represents the motivation and improvement of students knowledge and skills attend the robotics courses.

This need sparks the development of courses in robotics field with various educational departments. The level of age of students also varied from childhood to youth. The level of difficulties in educational robotics is show in Fig.6.

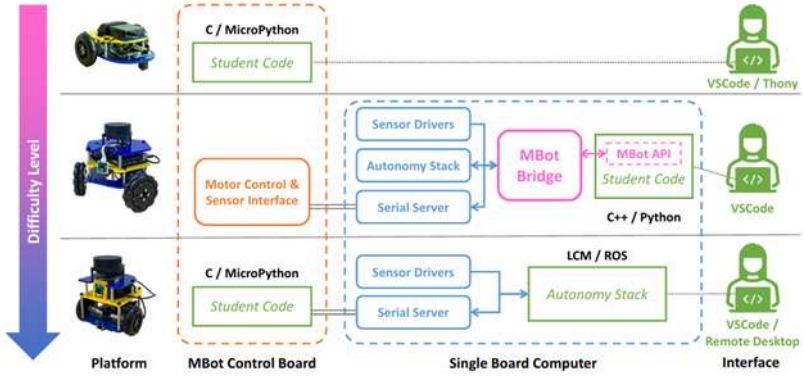


Fig.6 The level of difficulty in educational robotics[6]

Incorporating real robot platforms into such courses and curricula is effective for conveying the unique challenges of programming embodied agents in real-world environments and sparking student interest. Higher motivation is created. However, teaching with real robots remains challenging due to the hardware cost and the development effort involved in adapting existing hardware for a new course.

3. The Proposed Method

The proposed method uses is studying robotics using cloud. The purpose of this educational robotics learning is to spread educational robotics more space. Whereas, Indonesia is so large and restricted access to remote region. The using of educational robotics through cloud help increasing participants quadruple. The dashboard of cloud of wokwi.com is shown in Fig.7.

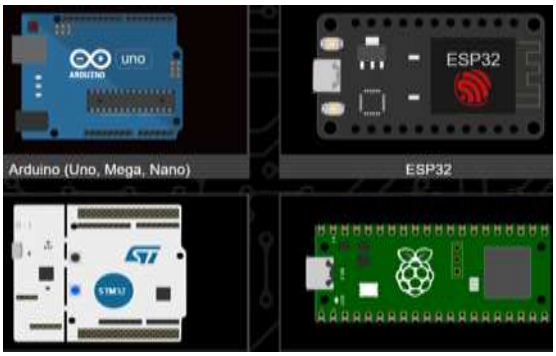


Fig.7 The cloud dashboard of wokwi.com

Based on the cloud educational robotics modules, the students can follow the course well. The monitors show that the design hardware and software can be done remotely. The tutor gave guidance about hardware architecture, algorithm computing, and wiring tasks. The student can understand and have a good comprehend on every steps to making a mobile robot. The learning process is shown in Fig. 8.

Fig. 8 The situation of remote educational robot.

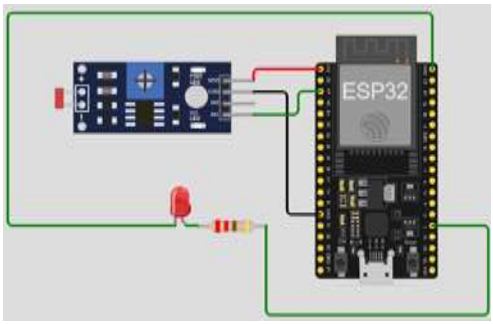


Fig. 9 The wiring process in cloud

Figure 8 shows wiring process of hardware involve Arduino and wokwi is done by student. The use of many needed sensor devices is applied to the mobile robot. Moreover the student have ideas, motivation and own strategy to make the robot robust to any barriers. This courses or training is done for halfday in Pekanbaru, Indonesia. It is a Politeknik Caltex Riau. The students are come from near the campus building area.

4. The Results

The remote educational robotics enable a lot of students attend the course with very low cost. The training or learning process also efficient and can be done at any time and at anywhere. It means the campus only provides the internet connection. It does need to serve hardware components, such battery, processor board, robot kid frame, cables or connectors, and sensor devices. The very low cost in educational robotics course can take place many time per semester with various students area.

If the course cannot be completed at campus because of time limitation, since not all the students understand the use of cloud and programming in simulator application. The adaptation to the cloud technology need times for the new students to make them become familiar with this methods. The completion of homework is a viable manner of student to finish their courses. Most of student can end up the course with perfection. They can simulate their innovatioan, ideas and creativity to real world. This mode of learning vividly empowering them to mastery the new knowledge and skill engaging with modern computation era.

5. Conclusion

The proposed method intends to solve the limitation of student to attend the educatioan robotics because of high cost and limitation access. The decrease rapidly cost help campus and students to learning robotics easier. The educational material such as curriculum, jobsheet and simulator app can be completed very cheap or free. Since the digital data can be read and study clearly. The space to do the course is not very special, the use of computer laboratory very convenient for student to studying. The availability standard learning apparatus such as projector, white board, and audio system make the teacher utter his mind enjoyable.

The half day training gives high contribution to students especially preparing their future brightness can be achieved shorter with a proper struggle and challenges.

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