STRATEGY FOR IMPLEMENTING EMBEDDED SYSTEMS PROGRAMMING LEARNING WITH THE STUDENT CENTERED LEARNING METHODS

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Abstract
Student centered learning (SCL) focuses on students achieving learning objectives. This study aims to determine the impact of applying student centered learning (SCL) learning methods in embedded system programming subjects. The student centered learning (SCL) method is used to train creativity and improve student understanding in carrying out practical learning in the classroom. The subjects of this study were 64 students of class XI Electronics Engineering from 2 classes, namely TE 1 and TE 2. This research used descriptive qualitative research methods. The data analysis used is descriptive statistics. In each meeting, students can fulfill the expected learning concepts and fulfill part of the learning outcomes so that the learning objectives and practicum results can be achieved well. The results showed that the application of the student centered learning (SCL) model can improve student learning outcomes by 4,12%, obtained from learning results with an average job sheet work value of 83.71 in the TE 1 class and 84.28 in the TE 2 class. This shows that through the student centered learning (SCL) approach students can understand and practice the learning material well. The application of learning with the student centered learning (SCL) model received a positive response from students because students felt freer in learning and practicing embedded system programming material.

Keywords: *Education, Student Centered Learning, Embedded System Programming*

1. INTRODUCTION

Learning is a collaborative activity between educators, learners, and learning resources (Adriadi & Tarihoran, 2016). Learning is carried out through various activities characterized by (1) being enjoyable, motivating active participation, and challenging, (2) being inspirational and interactive, (3) being collaborative and contextual, (4) enhancing the independence and creativity of learners, and (5) being tailored to the developmental levels and psychology of the learners (Mahmudi, 2015). Learning is conducted by learners to achieve a transformation within themselves from not knowing to knowing (Saifudin, 2016), and the formation of attitudes in learners occurs (Suardi, 2018). Appropriate learning can have a significant impact on learners, including developing creativity, critical thinking skills, analytical abilities, the capacity to apply and identify learning materials, as well as enhancing the ability to build new understandings to improve comprehension of learning materials (Widyanto & Vienlentia, 2022).

Student centered learning (SCL) is a learning approach that focuses on learners achieving learning objectives (Aini & Kurnia, 2023). This demands the active participation of students to be more independent in deepening their learning and seeking information during the learning process. In the SCL model, students are required to actively complete tasks and discuss them with teachers/educators as facilitators. Through student activity, creativity will be nurtured. This condition will encourage educators to

continually develop and adjust learning materials by the advancements in Science and Technology (IPTEK). The implementation of the SCL method in secondary schools is stipulated in the Minister of Education and Culture Regulation Number 36 of 2018.

Teachers are required to effectively perform their roles in the SCL approach. Teachers are not only instructors but also motivators, facilitators, and innovators for students. Teachers are expected not only to teach in front of the class but also to play a role in problem-solving when students encounter difficulties in the learning process (Salay, 2019). The foundation of the SCL approach is that students do not only learn about what topics need to be studied but also how and why those topics are interesting to study. Furthermore, it changes students' mindsets and perceptions regarding the importance of practical experience compared to merely understanding theoretical knowledge (Santyasa, 2018).

According to Santrock, six principles characterize the student centered learning approach, namely: learning process, learning goal, knowledge construction, thinking strategy, metacognition, and learning context (Tyas et al, 2018). The characteristics of the SCL approach according to Sudjana (2017) include learning that emphasizes student activity, activities conducted in learning are based on critical analysis, students have high motivation to learn as they are required to manage information for their knowledge construction, the teacher acts only as a facilitator, the learning process is continuous and relatively long, and the facilities used must be complete to support learning, and the learning conducted is connected to real-life situations.

Vocational High Schools (SMK) are an educational level that provides skill programs or majors for students who wish to enter the workforce immediately after graduation. SMK emphasizes practical and technical learning required in various fields (Susanto & Mauren, 2024). SMK N 2 Pengasih has implemented a learning model with a SCL approach, which emphasizes student activity. Through the application of the student centered learning (SCL) model, students have more freedom in studying the learning material (Tyas et al, 2018). The practical learning conducted at SMK N 2 Pengasih effectively utilizes the SCL approach because the teacher only needs to present an introduction to the practice at the beginning of the practical learning session, after which the students carry out the practice based on the teacher's instructions.

During practical learning, the teacher monitors the students' practical activities and provides guidance and explanations if there are students who encounter difficulties or obstacles in carrying out the practical work. Through the SCL approach, the teacher only needs to provide the material that must be studied and explain the competency standards that must be achieved (Kurniawan et al, 2018). Students who have completed studying the material and have met the competency standards can develop the practical material they have learned to enhance their knowledge and skills in mastering the material provided by the teacher.

The researcher conducted a study on embedded system programming learning in the Electronics Engineering department at SMKN 2 Pengasih. This study aims to understand how the SCL process occurs in practical learning in two classes, namely XI TE 1 and XI TE 2. In addition, this research is conducted to determine what teaching strategies are used by the teacher in presenting and conveying the material to students during the learning process.

2. LITERATURE REVIEW

2.1. Education

Education is a very important aspect of community life. With education, an individual is capable of self-actualization (Indy et al, 2019). According to Law Number 02 of 1989, education is a conscious effort to prepare learners through guidance, learning, and training activities for their roles in the future. Education is a conscious endeavor to realize a generation as a role model for the next generation (Rahman et al, 2022). It can be concluded that education is essential for future generations in various ways of its delivery.

2.2. Vocational

Vocational education is a higher education program that prepares competencies and skills by its field (Sukoco et al, 2019). Vocational education is a process where this activity focuses on development through both theory and practice. The objective of vocational activities is to develop interests and talents in a specific field to be able to compete in the job market (Supriyanto, 2020). Based on these two opinions, it can be concluded that vocational education is necessary in preparing graduates to enter the workforce in their chosen field.

2.3. Embedded System Learning

Embedded System Learning is an opportunity in education that utilizes technology in the learning process for students (Purnamawati et al, 2021). In the current digital era, Embedded Systems play a crucial role in enhancing efficiency, productivity, and the comfort of human life. Embedded Systems are applied in various fields such as the Internet of Things (IoT), automotive, industrial systems, and healthcare. The embedded systems are installed and consist of hardware and software that are well-integrated and designed to perform specific tasks (FTIK, 2023). Therefore, it can be concluded that Embedded System Learning is essential to facilitate humans in various fields, particularly in advancing education.

3. RESEARCH METHODS

The method used in this research is a qualitative descriptive research method. Descriptive research is research used to describe and interpret something, such as existing conditions or relationships, prevailing opinions, ongoing processes, resulting consequences or effects, or current trends (Linarwati et al, 2016).

3.1. Steps of Research

In this study, the researcher describes the existing conditions regarding the process and outcomes of student centered learning (SCL) in the subject of embedded systems programming. The steps taken by the researcher are shown in the following figure 1:
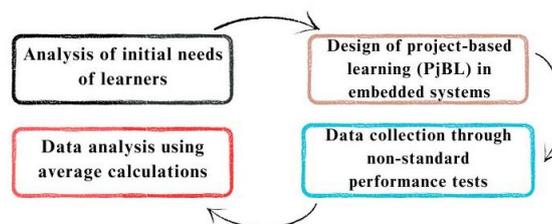

Figure 1. Steps for SCL research

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3.2. Implementation of Research

The research was conducted during the practical learning process of embedded systems programming in the Electronics Engineering workshop at SMKN 2 Pengasih. The learning consisted of 10 meetings, with each meeting lasting 6 JP (6 x 45 minutes). The instruments used to collect data included performance tests and non-standard learning evaluation tests administered to students according to the material being studied. The type of data analysis used in this research involved descriptive statistical calculations presented in the form of percentage tables of the average final scores of students in each meeting and practical activity. Furthermore, the obtained data is presented in the form of tables and graphs and described by the researcher to ensure that the information presented is easily understood

4. RESULTS AND DISCUSSION

The implementation of practical learning in embedded system programming with the subject of digital input-output programming in the Electronics Engineering Department at SMKN 2 Pengasih begins with the process of creating learning objectives (LO) using Microsoft Word software. The learning objectives (LO) are formulated according to the format of the learning objectives (LO) for the embedded system programming practical subject in the Electronics Engineering Department at SMKN 2 Pengasih. After the process of creating the learning objectives (LO) is completed, it is followed by the process of creating the learning objective flow (LOF) using Microsoft Word software. The learning objective flow (LOF) is created by the format of the learning objective flow (LOF) for the embedded system programming practical subject in the Electronics Engineering Department at SMKN 2 Pengasih. The subsequent process after the completion of the learning objective flow (LOF) is the creation of the Teaching Module (TM) using Microsoft Word software. The format of the teaching module used in the learning process has been determined by the school.

After the process of creating and consulting on the Teaching Module (TM) is completed, the next process is the creation of presentation-based learning media using Microsoft PowerPoint software. The forms of learning media used are as follows:

Figure 2. Creation of learning media with presentations using Microsoft PowerPoint software

The material presented in the learning media is adjusted to the content written in the teaching module (MA). The learning method used in the subject of embedded systems programming practice is the student centered learning (SCL) model, utilizing Microsoft PowerPoint slide presentations on a projector screen and practical programming job sheets.

Students work on the programming practice job sheets and conduct practical work in the computer lab of the Electronics Engineering Department.
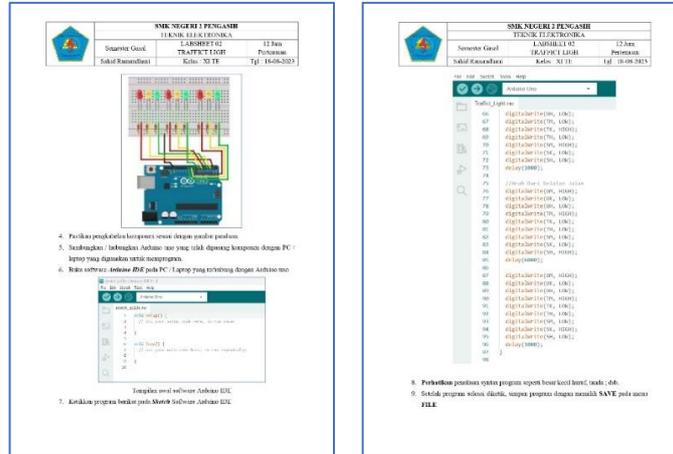

Figure 3. Job sheet for embedded system programming practice

The embedded systems programming practice is conducted in the computer lab using the tools and materials provided in the workshop of the Electronics Engineering department at SMKN 2 Pengasih. The purpose of the embedded systems programming practice in the Electronics Engineering department at SMKN 2 Pengasih is to provide knowledge and understanding to the eleventh-grade students of the Electronics Engineering department regarding microcontroller programming practices. The practical job sheets are designed in such a way as to meet the established competency and skill standards. The eleventh-grade students are also provided with knowledge and soft skills through group practical work to encourage discussion and enhance their understanding of the practical learning material. This learning method also serves to develop the Pancasila student profile among the eleventh-grade students of the Electronics Engineering department at SMKN 2 Pengasih.

Figure 4. The practice of embedded system programming learning takes place in the computer workshop room of the Electronics Engineering program

4.1. Research Results

After the embedded system learning process has been conducted, the next step is to carry out an evaluation process to determine the learning outcomes of students for each material provided. The learning outcomes of the students in class XI TE SMKN 2 Pengasih are presented in the following table 1:

Table 1. Average Score of Job sheet

Class	Minimum Completeness Criteria	Average Score of Job sheet				Last Average
		1	2	3	4	
XI TE 1	75	81,61	83,47	84,39	85,39	83,71
XI TE 2	75	82,56	84,11	84,94	85,52	84,28
Average	75	82,08	83,79	84,67	85,46	

Based on Table 1, the average score of student learning outcomes through the job sheet provided. The results obtained by the students indicate an above-average learning capability in materials 1, 2, 3, and 4, both in class XI TE 1 and XI TE 2, using a student centered learning approach. The average achievement results obtained by the students are as follows: for material 1, a score of 82.08 (above average), for material 2, a score of 83.79 (above average), for material 3, a score of 84.67 (above average), and material 4, a score of 85.46 (above average). Meanwhile, the presentation of the comparison of student learning outcomes is depicted in Figure 5.
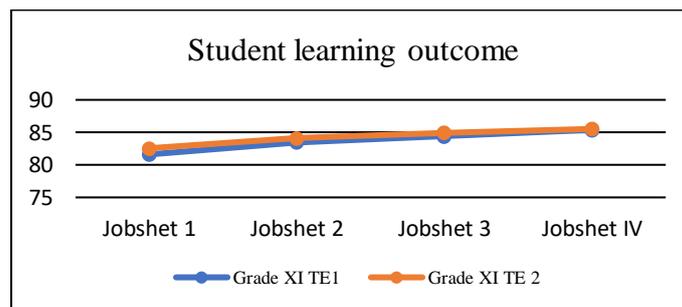

Figure 5. Graph of Student Learning Outcomes

4.2. Discussion

Based on the results obtained during the research, the implementation of the student centered learning method in the subject of embedded system programming at SMKN 2 Pengasih achieved results above the predetermined average. The findings of the researcher provide insights into the implementation of practical learning in embedded system programming, considering several aspects as follows:

a. Program design for learning.
b. Implementation of the learning process.
c. Evaluation of performance results.

The average results indicate that in material 1 on Blink LED, the average score obtained was 82.08 (above average), in material 2 on Traffic Light the average was 83.79 (above average), in material 3 on stepper motor control the average was 84.67 (above average), and in material 4 on DC motor control the average was 85.46 (above average), with the overall total of students achieving results above the established standard. These results were influenced by the learning program design prepared by the teacher during the classroom learning process.

    d. Supporting factors for the success of the learning program.
    e. Hindering factors for the success of the learning program.

5. CONCLUSION

The student centered learning (SCL) model can assist students in enhancing their understanding of the learning material. The student centered learning (SCL) approach improves the knowledge, skills, and comprehension of material related to embedded system programming for students in class XI TE of the Electronics Engineering program at SMKN 2 Pengasih. Through the student centered learning (SCL) approach, students in class XI TE of the Electronics Engineering program at SMKN 2 Pengasih are more interested and find it easier to understand the material presented. This is evidenced by the student's academic achievements in job sheets 1–4, which have consistently improved. It is expected that learning using the student centered learning (SCL) model will increase the motivation of students in class XI TE of the Electronics Engineering program at SMKN 2 Pengasih, thereby enabling them to understand the importance of knowing and mastering embedded system programming before entering the workforce.

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