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Introduction of the Internet of Things as a Debriefing for Students with Cross Interests in Information and Communication Technology

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Abstract

Hangtuah Tarakan High School is one of the high schools in Tarakan City that has Information and Communication Technology (ICT) cross-interest subjects. This subject is followed by class XI and XII students from the Department of Mathematics and Natural Sciences and Social Sciences. The focus of this study is embedded systems using sensors and microcontrollers. For learning to be optimized and related to current technological developments in the Industry 4.0 era, an introduction to the Internet of Things (IoT) is held to open students' insight and knowledge. The seminar using the presentation method (lecture), which 35 participants attended, was held in the school's computer laboratory. Based on the initial survey on the material presented, the participant's knowledge about the material was categorized as not understanding, with a score of 2.42 on the Linkert 5 scale. The school, in collaboration with the Universitas Ahmad Dahlan through the Master Program of Informatics, held a seminar on the introduction of IoT on August 22, 2022. The 195-minute event from 11.45 AM to 03.00 PM received an enthusiastic welcome from the participants so that their understanding of the material increased. Based on the post-test survey, the participant's level of knowledge increased to a score of 3.64 on a score scale of 5 and entered the criteria for very understanding.

Keywords: Community Service, Cross Interests, Industry 4.0, IoT, Schools.

INTRODUCTION

One of the topics currently being discussed in the current industrial era 4.0 is the Internet of Things or IoT. IoT is a collection of physical devices embedded in electronic devices consisting of various sensors, microcontrollers, actuator computers, and other electronic circuits that allow data collection and exchange (Fahrulnazmi et al., 2021) between devices (Alfian et al., 2020). Industry 4.0 makes the transformation in the field of information technology massive and becomes a new career opportunity (Galina, 2021) in various areas. The existence of IoT makes physical objects able to see, listen, think, do work independently, communicate with each other and share information (Wilianto & Kurniawan, 2018). IoT, essentially a device connected to the internet, has now reached 13.1 billion (Vailshery, 2022) used for smart cities, smart homes, monitoring (Rizal et al., 2018), access control (Qiu et al., 2020), and multimedia (Nauman et al., 2020). The current number of IoT devices, if they can be maximized using artificial intelligence, will produce products that provide significant benefits in the future as did Fidowaty et al (Fidowaty et al., 2022). They have products from community service programs to help residents deal with waste problems by utilizing IoT technology combined with AI that is integrated with smart cities in one area in Bandung City.

IoT can also be used in various ways, such as what Awal and Masruriyah did it (Awal & Masruriyah, 2022). They collaborated with mushroom farmers in Cilamaya, Karawang Regency, to make smart mushroom kumbung using IoT technology to control the temperature and humidity in the kumbung. By using fuzzy logic, the resulting tool can monitor mushroom kumbung via the web in real time, making it easier for farmers to check conditions regularly. Temperature and

humidity control devices have also been made through research conducted by Riadi & Syaefudin (2021). This research produces a tool that can monitor and control temperature and humidity using IoT for the manufacture of tempe. Syafiqoh et al (2018) developed to monitor the quality of water and agricultural land using an IoT-based wireless sensor network. The tool can help monitor the quality of water temperature, pH of water, and agricultural soil so that it becomes more efficient.

The world of education has also begun to discuss, study, and apply IoT technology (Megawati & Lawi, 2021), such as Sebastian et al. (2021) did by giving seminars and workshops on the introduction of IoT at the Kolese De Britto High School. The school has a group of students interested in information technology with a particular topic of IoT. This activity aims to introduce IoT and how it works to students in the school. Gayatri Dwi Santika et al also carried out service activities about the introduction and use of IoT for teachers and students at the State Elementary School 2 Banyuwangi. This activity is carried out to improve the soft skills of teachers and students who, later if they graduate, are expected to have high competitiveness to continue their education to the next level (Santika et al., 2022). Syaifurrahman et al. (2022) did their service at Negeri 1 Singkawang High School to introduce IoT technology to students. The presentation of the material and practice of controlling electronic devices received a warm welcome and enthusiasm from the students who participated in the event. Students are also provided with an electronic module so they can later continue learning IoT independently at school.

Hangtuah Tarakan High School is one of the high schools in Tarakan City of North Kalimantan Province (Admin, 2022). This school has particular ICT cross-interest subjects for class XI and XII students who focus on programming based on embedded systems. This subject focuses on controlling electronic devices using a microcontroller as a data processing center that can be programmed and function as a work control of a system (Rochayati et al., 2012). Embedded devices can now be maximized using IoT technology so that they can interact with each other humans and between machine devices. Before learning about subjects across ICT interests, students need to be equipped with an overview of the latest developments in embedded system technology related to IoT.

The Master Program of Informatics at Universitas Ahmad Dahlan, together with Hangtuah Tarakan High School, held a collaboration to carry out community service, which in this case is referred to as *Program Pemberdayaan Umat* (*Prodamat*). The *Prodamat* activity was born with the theme "Embedded System and Introduction to the Internet of Things," aimed at improving skills (Nusri & Ismail, 2022), providing an overview and insight into knowledge about current IoT technology developments and the need for soft skills to have high competitiveness in the future (Astuti et al., 2022), and the importance of learning embedded systems as a basis of IoT technology.

Before carrying out service activities, the implementing team and supervisors first conducted a pre-test survey to determine the knowledge and insight of students taking ICT cross-interest subjects. Figure 1 is the result of the pre-test conducted on 35 prospective students.

Based on Figure 1, the majority of participants still do not know about technology related to IoT. This can be seen in question 1(a), as many as 42.9% have never heard of the term. Participants who know about IoT are, on average, grade XII students who previously took ICT cross-interest subjects in class XI. In question 1(b), the majority of participants, or as much as 57.1%, answered that they have never used IoT devices in their daily life. This can happen because participants do not know what appliances are included in IoT in their everyday life. At the same time, question 1(c) is to find out the interests of the participants, with a majority of 57.1% and 28.6% answering that they are interested in participating in the presentation about IoT.

Based on the background and the pre-test survey conducted, this Prodamat aims to:

- Introducing current technological developments based on IoT.
- Provide insight and knowledge about IoT-based Industry 4.0 for soft skills when continuing education to the next level.

- Learn IoT with the basics of programming embedded systems using a microcontroller.

This activity is expected to provide participants with the opening students' insight and knowledge about technological developments in the era of the industrial revolution 4.0 and to provide a picture of following the teaching and learning process of subjects across ICT interests.

METHOD

The service activity was held on Monday, August 22, 2022, at the Computer Laboratory at Hangtuah Tarakan High School, located at Jalan RE. Marthadinata RT 13 No 30, Pamusian Village, Central Tarakan District, Tarakan City, North Kalimantan Province. The activity starts from 11.45 AM to 03.00 PM with seminar methods for material presentation, questions and answers, and simple programming trials using a microcontroller.

The implementation of activities consists of three stages, namely preparation, performance, and evaluation (Budiyanto et al., 2021). The details of the stages include:

1. Preparation
   a. Contacting the school about the planned implementation of activities
   b. carry out a pre-test survey
   c. Prepare materials and activity proposals
   d. Prepare correspondence and other needs that support activities
   e. Discuss with subject teachers about participants, time, and place of implementation
   f. Prepare a rundown of activity events
2. Implementation
   a. The activity is carried out with a duration of 195 minutes from 11.45-15.00, consisting of seminars and workshops
   b. Activities are carried out in a blended manner, namely offline and online
   c. Participants consist of students in class XI and XII consisting of the Department of MIA (Mathematics and Natural Sciences) and IIS (Social Sciences) with a total of 35 participants
   d. The material is delivered using PowerPoint, which is equipped with examples of its application in everyday life
   e. Basic microcontroller programming using virtual simulation on the website www.tinkercad.com
   f. Participants fill out a post-test survey as material for evaluating the implementation of activities
   g. Do a photo session together for documentation
3. Evaluation
   a. Conduct an evaluation based on the activity post-test survey, then conclude from the evaluation results
   b. Compile the final report of community service activities
   c. Prepare manuscripts for publication in community service journals

The evaluation stage is done by giving a questionnaire using a google form. This is to draw conclusions and descriptions of the success and benefits of service activities. Guidelines for filling out the questionnaire using the Linkert 5 scale (Rosyidi & Romadhon, 2021) with some adjustments to the needs as shown in Table 1.

Table 1. Survey filling score guide

Score	Assessment	Description
5	Totally Agree	SSS
4	Strongly agree	SS
3	Agree	S

Score	Assessment	Description
2	Don't agree	TS
1	Strongly disagree	STS

Data from the results of filling out the questionnaire was processed by converting the average score (X) into criteria for the level of understanding using five criteria with a range of values, as shown in Table 2 (Saputra et al., 2022).

Table 2. Conversion of grades based on level of understanding

Average(x)	Understanding Criteria	Description
X ≥ 4.2	Very Understood	SPS
3.4 < X < 4.2	Very Understand	SP
2.6 < X < 3.4	Understand	P
1.8 < X < 2.6	Do not understand	TP
X ≤ 1.8	Really Don't Understand	STP

RESULT and DISCUSSION

This service activity was carried out at the Hangtuah High School Computer Laboratory on August 22, 2022, in a blended manner from 11.45 AM to 03.00 PM. The activity supervisor is present online through the google meet application, then gives a speech and opens the event. School representatives attended by teachers from the curriculum section who gave remarks and support for this event. The presenters are present offline in the laboratory by providing presentations (lectures) of material for 45 minutes, followed by a workshop to practice programming the microcontroller. The number of participants who attended this activity was 35, according to those who filled out the pre-test survey. Documentation of the presence of lecturers and teachers in giving remarks and implementing partners can be seen in Figure 2. Figure 2a) shows school representatives, namely teachers from the curriculum section providing comments and support for implementing the activities. Figure 2b) illustrates the supervisor who gave a speech and opened the event, which the movement organizers also attended.

The presentation of the material, which was carried out offline, got the attention and enthusiasm of the participants. Shown in Figure 3 is the atmosphere of the presentation of the material using a power point displayed on the LCD Projector until the completion of the activity. Figure 3a) is the initial presentation of the material presented. Figure 3b) enters the workshop stage, where the participants try to program the microcontroller in a simulation using the website www.tinkercad.com. Figure 3c) shows a student getting merchandise in the form of a flash card because she is enthusiastic about asking about the material provided. Figure 3d) is the closing session of the activity where a group selfie is carried out for the activity documentation report.

Before the closing session, the participants were allowed to fill out a survey in the form of a post-test questionnaire using a google form. This questionnaire is essential to evaluate how beneficial this activity is and how far participants understand the material provided (Afriliana et al., 2022). The questionnaire contains six questions that participants must answer by choosing answers based on the references in Table 1. The results of filling out the questionnaire for evaluation materials are shown in Table 3.

Table 3. Post-test questionnaire survey results

No	Statement	STS Skor= 1	TS Skor= 2	S Skor= 3	SS Skor= 4	SSS Skor= 5	Total Skor	Average (x)
1	This training gave me additional IoT knowledge/insight	0	1	15	10	9	132	3.77

No	Statement	STS Skor= 1	TS Skor= 2	S Skor= 3	SS Skor= 4	SSS Skor= 5	Total Skor	Average (x)
2	This training let me know the devices that belong to IoT	0	0	16	13	6	130	3.71
3	This training made me learn IoT more structured	0	0	20	10	5	125	3.57
4	This training made me feel that IoT devices can be more optimized	0	0	17	12	6	129	3.69
5	This training made my ability to understand IoT improve	1	0	15	13	6	128	3.66
6	IoT training like this, if held again, I want to come back	0	4	16	10	5	121	3.46
Total Score and Average (x)							**765**	**3.64**
Percentage (%)							**60.71%**	

Based on Table 3, the participant's level of understanding after the service activities was 765 based on the post-test survey score or if the average was 3.64. When using a Likert scale, this value gets a value of 60.71%. Referring to Table 2, if the value is converted into a criterion for the level of understanding, it is in the category of Very Understanding (SP). This indicates that participants can understand the material provided well so that it is included in the SP criteria, and the activity offers promising benefits for participants.

For comparison, the participant's understanding of the material can be seen in Figure 4 based on the results of the pre-test and post-test surveys. From the graph in Figure 4, it can be seen that the participant's understanding of the material during the pre-test survey before the activity was in the TP position, with a score of 2.42. After preparing the material and presenting it at the service activity seminar, the participant's level of understanding increased. It is included in the SP category with a score of 3.64.

CONCLUSIONS AND FUTURE WORKS

The implementation of service activities at Hangtuah Tarakan High School went smoothly. There were only small obstacles in the opening session because it was carried out in a blended manner, and there were internet network problems. Insights and knowledge of participants can be increased due to the delivery of material that is easy to understand so that those who initially fall into the criteria of not understanding become very understanding based on the pre-test and post-test surveys. In the future, it is hoped that this activity can be carried out again or provide assistance to subjects across ICT interests to open students' horizons and improve their soft skills and hard skills in facing the challenges of development and the needs of the industrial era 4.0.

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APPENDIX

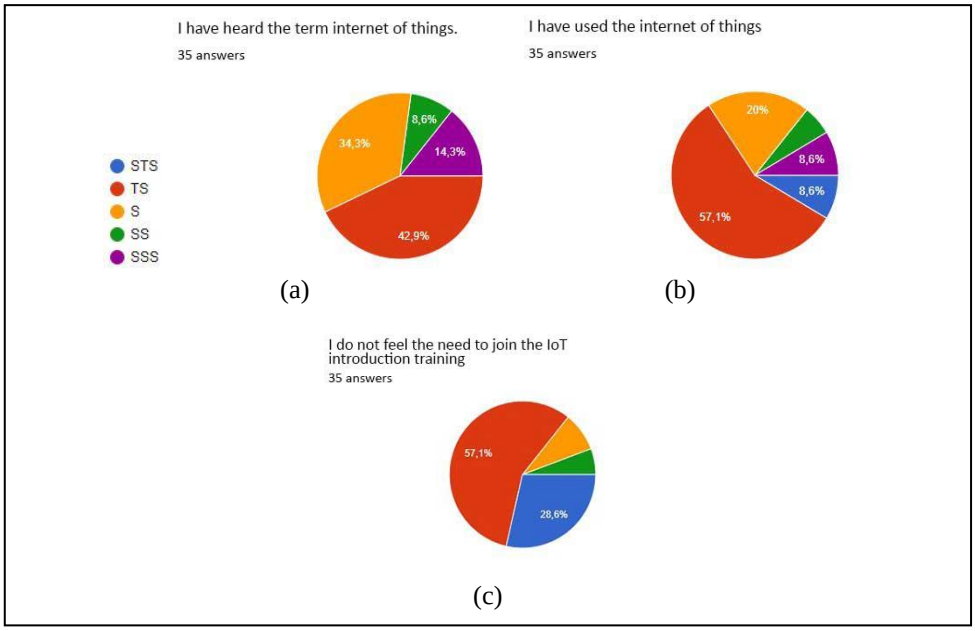

Figure 1. Student knowledge of IoT

Figure 2. The presence of lecturers, teachers, and implementing partners offline and online

Figure 3. The atmosphere of service activities in the lab

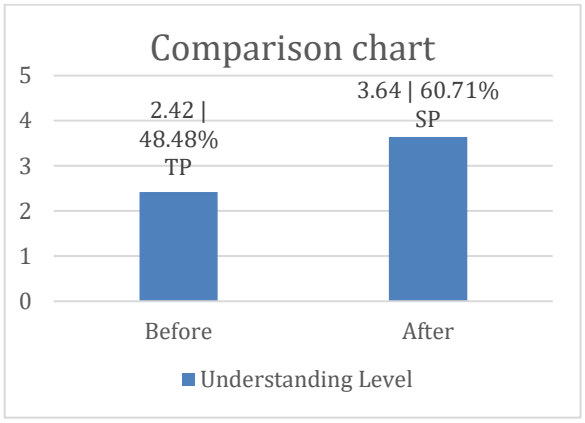

Figure 4. Comparison chart of understanding