



Pengenalan Gerbang Logika dan Sistem Digital kepada SMA 1 Cikarang Pusat

Introduction Logic Gates and Digital Systems at SMA 1 Cikarang Pusat

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Abstract: The rapid development of the Industrial Revolution (IR) 4.0 and the transition towards Society 5.0 demand an increase in digital literacy and a basic understanding of technology systems starting from secondary education. The Community Service (CS) Program conducted by the Department of Electrical Engineering Universitas Presiden aims to introduce the concepts of logic gates and digital systems to students of SMA 1 Cikarang Pusat. This CS integrates theoretical explanations and simulation practice using the online platform Circuitverse. This CS was evaluated using a Likert scale (1–4) questionnaire instrument, namely Expectation (Importance) and Performance, with a total of 40 student respondents. The analysis results show that all indicators received an average performance score above 3.30, with satisfaction indices ranging from 82.50% to 90.62%, which falls into the very high category. The indicator for the use of appropriate technology received the highest score of 90.62%, indicating the relevance of the material to current technological developments. The Importance–Performance Analysis (IPA) shows that most indicators are in the 'maintain performance' quadrant, indicating alignment between participants' expectations and the activity's performance. These findings suggest that the workshop is effective in enhancing students' understanding of basic digital system concepts while also fostering interest in engineering and technology fields. The activity underscores the strategic role of universities in bridging the technology literacy gap at the secondary education level in response to the challenges of the IR4.0 and Society 5.0.

Abstrak

Perkembangan pesat *Industrial Revolution* (IR) 4.0 dan transisi menuju *Society* 5.0 menuntut peningkatan literasi digital dan pemahaman dasar tentang sistem teknologi mulai dari pendidikan menengah. Program Pengabdian kepada Masyarakat (PkM) yang dilakukan Departemen Teknik Elektro Universitas Presiden bertujuan mengenalkan konsep gerbang logika dan sistem digital kepada siswa SMA 1 Cikarang Pusat. PkM ini mengintegrasikan teori dan praktik simulasi menggunakan Circuitverse. Pengmas ini dievaluasi menggunakan kuesioner skala Likert (1–4), yaitu Harapan (Pentingnya) dan Kinerja, dengan total 40 responden siswa. Hasil analisis menunjukkan semua indikator memperoleh skor kinerja rerata di atas 3,30, indeks kepuasan berkisar antara 82,50% hingga 90,62%, termasuk dalam kategori sangat tinggi. Indikator penggunaan teknologi yang tepat memperoleh skor tertinggi sebesar 90,62%, menunjukkan relevansi materi dengan perkembangan teknologi saat ini. Analisis Importance–Performance (IPA) menunjukkan bahwa sebagian besar indikator berada pada kuadran 'pertahankan kinerja', menunjukkan kesesuaian antara ekspektasi peserta dan kinerja kegiatan. Temuan ini menunjukkan bahwa lokakarya efektif dalam meningkatkan pemahaman mahasiswa tentang konsep dasar sistem digital sekaligus menumbuhkan minat pada bidang teknik dan teknologi. Kegiatan ini menekankan peran strategis universitas dalam menjembatani kesenjangan literasi teknologi di tingkat pendidikan menengah sebagai respons terhadap tantangan IR 4.0 dan Society 5.0.

Keywords: Gerbang Logika; Layanan Masyarakat; Masyarakat 5.0; Revolusi Industri 4.0; Sistem Digital

1. INTRODUCTION

The development of the Industrial Revolution (IR) 4.0 (Budyanto & Silalahi, 2023; Calderon & Izquierdo, 2020) has brought a fundamental transformation to various sectors of life, including industry and public services. The integration of digital technologies (Handayani et al., 2025) such as, Internet of Things (IoT), Artificial Intelligence, Big Data, and automation systems, has changed the way humans work and interact (Aslam et al., 2020; Bhattacharjee et al., 2020; Samsumar et al., 2025). In this global context, the concept of Society 5.0, introduced as a technology-based society model oriented toward human well-being, increasingly emphasizes the importance of digital literacy and mastery of technological systems from an early age.

The IR 4.0 and Society 5.0 (Adel, 2022; Barbazzeni & Friebe, 2021) require users to understand the basic principles of digital systems that form the foundation of all modern electronic devices. Therefore, understanding the basic structure of digital circuits becomes a fundamental competence in building readiness to face the era of technological transformation.

The active role of the Department of Electrical Engineering Universitas Presiden in Community Service (CS), along with lecturers specializing in Control Systems (Bukhori et al., 2026; Sim et al., 2025), Communication Systems (Galina et al., 2022, 2023; Vincent et al., 2021), Power Systems (Silalahi et al., 2024), as well as Electronics and Embedded Systems (Sitompul et al., 2026; Turnip et al., 2025) in introducing basic digital system concepts to high school students (SMA 1 Cikarang Pusat), is a strategic step in building a stronger foundation of technology literacy because they are in a transitional phase that determines the direction of education and career.

However, the gap in information regarding advanced technological developments and industry competency requirements still remains a challenge. Many students use digital devices in their daily lives but do not understand the basic working principles. Therefore, understanding the concepts of logic gates and digital systems can provide insight into how modern technology is built and developed (Budyanto et al., 2024; Chandra et al., 2024; Sepsamli et al., 2025).

This activity aims to bridge the gap by providing a conceptual understanding of the fundamentals of digital systems, which are the backbone of IR 4.0 technology (Imelda U. V. Simanjuntak et al., 2024; Lukman Medriavin Silalahi et al., 2023; Silalahi et al., 2023), while also fostering students' motivation to explore the fields of engineering and technology as part of contributing towards Society 5.0.

This workshop activity is expected to provide the following benefits and objectives:

- a. Student participants of the Activity
 - 1) Introduce students to how basic logic circuits work.
 - 2) Enable students to understand basic electronic circuits that seem complicated in a simpler way. Through this activity, it will introduce Electrical Engineering with a simple approach and provide insights to the participants.
 - 3) Allow students to experiment by assembling circuits using an online simulator.
- b. SMA 1 Cikarang Pusat
 - 1) This activity helps the school to instill understanding of technology that is very close to everyday life, namely electrical engineering and computer sciences.
 - 2) Provides information and inspiration for the school in developing extracurricular activities that students can participate in, including such as robotics and IoT.

2. METHODS

This workshop is divided into two main sessions. The instructor will teach and simulate the circuits so they can be applied directly. In this session, a device demo will be presented along with an explanation until the circuit is operational.

Students are introduced to and simulate various logic circuits using the online Circuitverse simulator (<https://circuitverse.org/>). The instructor will guide participants to try out the simulator and create according to the students' ideas and creativity. The material for each session has been designed to make it easier for students to understand logic circuits. Starting from the initial session that discusses simple circuits, the stages gradually develop into more complex circuits in subsequent sessions, until participants are able to fully understand the concept of circuits.

The workshop discussion topics are detailed as follows: Stimulate students' interest in the field of electrical technology based on the application of research results and simple practical training. After this workshop, participants are expected to: Understand the theory and working principles of Basic Logic Gates; Understand the theory of digital systems and perform simple digital operations; Perform a simple simulation via Circuitverse simulator.

In order to provide education to the community about the Introduction to Logic Gates and Digital Systems at SMA 1 Cikarang Pusat, the solution design method offered are:

Location and Time of Implementation

CS is held in 1 (one) day *offline*, on Wednesday, 10th December 2025 from 09.30 – 15.30 WIB. SMA 1 Cikarang Pusat is located at Perum Cikarang Baru, Jl. Beruang Raya No.9,

Cikarang Pusat District, Bekasi Regency, West Java.

Target Audience

The participants of this training are the students of SMA 1 Cikarang Pusat. It is expected that the participants will feel the impact of changes in the learning system.

Type of Activity

The types of activities carried out are exposure to the concept of Simple Logic Gates, carrying out practicum based on simulator via Circuitverse simulator that have been designed and evaluation of this CS activity, while the stages of CS activities are clearly explained as follows: Participants enter the classroom, obtain the module, and fill in the training attendance form. Theoretical explanation brought by the CS Lecturer team speaker. Division of groups to perform a simple simulation via Circuitverse simulator. Question and answer session, filling out questionnaires, and giving training certificates.

Activity Techniques

Science and Technology dissemination technique on Logic Gates and Digital System at SMA 1 Cikarang Pusat are: Presentation of the CS to trainees consisting of Elementary Logic Gates; Workshop main session with title is Logic Devices; The Internet of Things training was very enthusiastic as shown in figure 1.



Figure 1. Workshop activity.

Table 1 shows the techniques CS at SMA 1 Cikarang Pusat.

Tabel 1. Community Service Programme Activity Technique.

Time	Duration	Activity	Note	PIC
09.30 - 10.00	30'	Committee Gather	Briefing for Committee	EO
10.00 - 10.30	30'	Preparation and Rehearsal	Open gate, Final Checklist	EO, PR, Logistic
10.00 - 10.40	10'		Opening	
10.30 - 10.32	2'	Opening by MC	Opening Talk and Introducing this event	PR, EO
10.32 - 10.36	4'	Speech by PM	PM	PR, PM
10.36 -	4'	Speech by Head	Ir. Mia Galina S.T.,	Lecturer PR,

10.40		of Study Program	M.T., IPU	
10.40 - 11.20	40'	1 st Main Session: Elementary Logic Gates	Starting 1 st Session	Prof. Dr.-Ing. Erwin Sitompul, S.T., M.Sc
11.20 – 12.00	40'	Exercise 1	Exercise for 1 st session	PUMA and EEN Lecturer
12.00 - 12.30	30'	BREAK		
12.30 - 13.30	60'	2 nd Main Session: Logic Devices	Starting 2 nd Session	Ir. Iksan Bukhori, S.T., M.Phil
13.30 – 13.50	20'	Exercise 2	Exercise for 2 nd session	PUMA and Lecturer
15.10 - 15.25	15'	Conclusion and Closing the Event	Committee/Participants give conclusion of the event.	All Committee and Participants



Figure 2. Activity Result.

3. RESULTS AND DISCUSSION

Activity Result

The CS activity has been successfully implemented offline at SMA 1 Cikarang Pusat which is shown in Figure 2. The event began with remarks from Drs. H. Akhmad Sayuti M.M as the Principal of SMA 1 Cikarang Pusat, then remarks from Ir. Mia Galina S.T., M.T., IPU as the Head of Study Programme of Universitas Presiden.

Discussion

After the CS opening event was completed, the participants were then divided into groups according to the training classes that had been arranged, following the schedule shown in Table 2.

Tabel 2. Training Schedule.

No	Activity
1	Workshop 1. 1 st Main Session: Elementary Logic Gates 2. 2 nd Main Session: Logic Devices
2	Questionnaire Filling
3	Certificate Distribution
4	Photo with training participants

Then, the questionnaire activity was carried out after the workshop session was completed, using the list of questions shown in Table 3 below.

Tabel 3. List of Questions.

No	Question	Type of Answer
1	Email.	Short answer
2	Gender.	<input type="checkbox"/> Male <input type="checkbox"/> Female
3	Age.	Short answer
4	Solving the problems faced by the community by utilizing the relevant expertise of the academic community.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4
5	Utilizing appropriate technology.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4
6	Useful for the development of science and technology.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4
7	Increasing knowledge.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4
8	Changing behavior in a positive direction.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4
9	Improving the quality of the environment and knowledge.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4
10	The material presented by the speaker through the Community Service activities is beneficial for the participants.	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4
11	Suggestions and feedback from Participants	Long answer

Next, the results of the questionnaire are used as the basis for measurement using the Likert method with the scale applied being:

a. Importance

- 1) 1 = Not Important
- 2) 2 = Moderately Important
- 3) 3 = Important
- 4) 4 = Very Important

b. Performance

- 1) 1 = Not Satisfied
- 2) 2 = Satisfied Enough
- 3) 3 = Satisfied
- 4) 4 = Very satisfied

Then, the results of the average analysis based on questionnaire questions 4 to 10 are shown in Table 4 based on a total of 40 respondents/students.

Tabel 4. Results of Average Analysis.

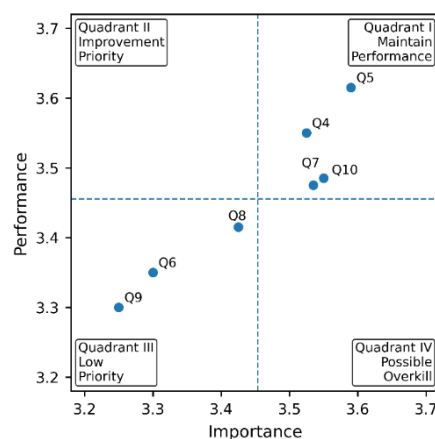
Indicators	Total Importance	Total Performance	Mean Importance	Mean Performance	Satisfaction Index (%)
Q4	141	142	3.525	3.550	88.75%
Q5	144	145	3.600	3.625	90.62%
Q6	132	134	3.300	3.350	83.75%
Q7	142	139	3.550	3.475	86.88%
Q8	137	137	3.425	3.425	85.62%
Q9	130	132	3.250	3.300	82.50%
Q10	141	139	3.525	3.475	86.88%

The evaluation of the Community Service activity with the theme "Introduction to Logic Gates and Digital Systems" was conducted using a Likert scale (1–4) instrument measuring two dimensions, namely Importance and Performance. The respondents consisted of 40 students from grades 10 and 11 at SMAN 1 Cikarang Pusat.

Based on Table 4, all indicators obtained an average performance score above 3.30, with satisfaction indexes ranging from 82.50% to 90.62%. These values fall into the very good category. The indicator "Utilizing appropriate technology" received the highest index at 90.62%, indicating that participants consider the material provided to be highly relevant to current technological developments. This aligns with the urgency of the Industrial Revolution 4.0 and the need for digital system literacy from secondary education levels.

The indicator 'Improving the quality of the environment and knowledge' obtained the lowest index at 82.50%, yet it still falls within the very good category. This finding indicates that the impact of activities on social and environmental aspects can still be strengthened through more practical follow-up activities.

Based on Figure 3, it shows the results of the analysis using the Importance–Performance Analysis (IPA) method. These results indicate that most indicators are in the 'maintain performance' quadrant, meaning the activity's performance has met participants' expectations. No significant gap was found between expectations and performance, so this activity has been carried out effectively and meets expectations.

**Figure 3.** IPA Analysis.

Overall, the integration of Likert analysis and IPA shows that the community service activities have successfully enhanced participants' understanding of logic gate concepts and digital systems, as well as being highly relevant and applicable in the context of modern technological developments. This strengthens the role of higher education institutions in bridging the technology literacy gap at the senior high school level.

4. CONCLUSION

Based on the results of the Community Service activity at SMA 1 Cikarang Pusat, it can be concluded that this program successfully achieved the objectives that had been formulated. Evaluation using the Likert Scale method (1–4) showed that all indicators received an average performance score of above 3.30, with a satisfaction index ranging from 82.50% to 90.62%, which falls into the very good category. The indicator "Utilizing appropriate technology" received the highest index (90.62%), confirming that participants considered the workshop material relevant to technological developments in the era of the Industrial Revolution 4.0. Meanwhile, indicators with relatively lower values still fall into the very good category, indicating that overall the activities have met participants' expectations. The integration of Likert and IPA analysis shows that there is no significant gap between expectations and performance. Most indicators are in the "maintain achievement" quadrant, indicating alignment between participants' expectations and the quality of the activity implementation. This demonstrates the effectiveness of a learning design that combines conceptual approaches with technology-based simulation practice. Academically, this activity contributes to enhancing students' technological literacy at the secondary education level and strengthens the role of universities in supporting technology-based educational transformation. This program can be recommended for sustainable replication with the reinforcement of advanced practical aspects to increase its affective and applicative impact.

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