Development of Programmable Logic Controller (PLC) Trainer Learning Media for Industrial Automation

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Abstract: This research aims to develop learning media through PLC trainers and job sheets to support practical learning in the subject of Programmed Control Systems at Vocational High School (SMK) Negeri 1 Singosari. The background of this research is the limited real practice media, where students previously only relied on simulations, causing a gap between understanding theory and practical skills. The development model used in this research follows the ADDIE framework, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. Data was collected through interviews, observations, expert validation, and user trials involving 11th-grade students of Industrial Automation Engineering of SMK Negeri 1 Singosari. The results showed that the trainer and jobsheet developed were declared "very feasible" based on the validation of media experts (95.8%), material experts (93.8%), and student trials in small groups (95.6%) and large groups (96.6%). Revisions were made based on expert input, such as adding diodes for safety and evaluation questions on the jobsheet, which improved trial results. The implication of this research shows that integrated and contextual learning media can bridge the gap between theory and practice, improve students' technical competence, and support the achievement of learning objectives.

Abstrak: Penelitian ini bertujuan untuk mengembangkan media pembelajaran berupa trainer PLC dan jobsheet untuk mendukung pembelajaran praktik pada mata pelajaran Sistem Kontrol Terprogram di Sekolah Menengah Kejuruan (SMK) Negeri 1 Singosari. Latar belakang penelitian ini adalah terbatasnya media praktik nyata, dimana siswa sebelumnya hanya mengandalkan simulasi sehingga menimbulkan kesenjangan antara pemahaman teori dan keterampilan praktik. Model pengembangan yang digunakan dalam penelitian ini mengikuti kerangka kerja ADDIE yang terdiri dari lima tahap: Analisis, Desain, Pengembangan, Implementasi, dan Evaluasi. Pengumpulan data dilakukan melalui wawancara, observasi, validasi ahli, dan uji coba pengguna yang melibatkan siswa kelas XI Teknik Otomasi Industri SMK Negeri 1 Singosari.Hasil penelitian menunjukkan bahwa trainer dan jobsheet yang dikembangkan dinyatakan “sangat layak” berdasarkan validasi ahli media (95,8%), ahli materi (93,8%), serta uji coba siswa pada kelompok kecil (95,6%) dan kelompok besar (96,6%). Revisi yang dilakukan berdasarkan masukan ahli yaitu penambahan diode untuk keamanan dan soal evaluasi pada jobsheet memberikan kontribusi terhadap peningkatan hasil uji coba. Implikasi dari penelitian ini menunjukkan bahwa media pembelajaran yang terintegrasi dan kontekstual dapat menjembatani kesenjangan teori dan praktik, meningkatkan kompetensi teknis siswa, serta mendukung pencapaian tujuan pembelajaran.

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A. Introduction

The world will see a country if it can create significant changes through improving the quality of its human resources, and one of the primary keys to achieving this is through education development that is oriented towards the progress and welfare of society (Kardina & Magriasti, 2023). Quality education produces bright individuals and skilled and adaptive human resources in the face of global dynamics (Pradesa et al., 2024). The progress of this education depends on the active involvement of students in the learning process directed at developing competencies that are relevant to the needs of the world of work.

In the context of vocational education, especially in Vocational High Schools (SMK), students' participation in practice-based learning is crucial to equip them with technical and non-technical skills needed by the industry. They can develop problem-solving, collaboration, and independence skills by actively involving students in contextualized learning processes, such as project-based learning or direct practice in the field. This is confirmed by (Ulinuha et al., 2025) in her research, which shows that student involvement in industrial practices and projects can improve work readiness and the suitability of student competencies to the needs of the industrial world.

Vocational education, such as SMK, has a strategic role in producing graduates who have technical skills and are ready to enter the workforce, primarily through implementing teaching factories and industry-based training (Fauzi et al., 2025). SMKs are designed to equip students with vocational skills relevant to technological developments and labor market needs. Especially in the industrial sector, SMKs have great potential to produce skilled and professional workers who can encourage the growth of the national industrial sector.

Vocational High Schools (SMK) are an essential pillar in the education system in Indonesia, especially in preparing skilled and competent human resources to face the challenges of the growing industrial world (Roseno & Wibowo, 2019). In the Industrial Revolution 4.0 era, the demand for skilled labor is increasing, especially in industrial automation engineering. SMK, as a vocational education institution, has a great responsibility to ensure that its graduates have competencies that match the needs of the industry. One of the approaches used in vocational education is practice-based learning, which emphasizes direct experience and active involvement of students in the learning process (Krismadinata et al., 2020).

Practice-based learning allows students to understand and apply theoretical concepts in real situations. This is in line with Kolb (2014) opinion. In his theory of experiential learning, Kolb states that effective learning occurs when students experience directly and reflect on the experience. Therefore, the availability of relevant practical learning media is a key aspect in improving the quality of vocational education. Furthermore, student learning outcomes are an essential indicator in measuring the success of the educational process, especially in practical learning in vocational schools. Learning outcomes include cognitive, psychomotor, and affective aspects that show the extent to

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which students master the competencies set out in the curriculum (Mu'awanah & Nurmala, 2024).

Structured and hands-on practice-based learning has been shown to improve student learning outcomes because it provides a real context for the material being learned (Zhang & Ma, 2023). Thus, developing good practice media will directly improve student learning outcomes. However, in reality, many vocational schools in Indonesia still face serious obstacles related to the availability of practical learning media. Learning media include hardware such as tools and machines, and instruments such as job sheets, modules, and software that support practical activities (Alfia et al., 2023).

The limitations of practical media can hamper the learning process and the low mastery of students' technical competencies, due to the lack of access to technological devices and adequate infrastructure (Darmawan et al., 2025). One concrete example of this problem occurs at SMKN 1 Singosari, a public vocational school located in a strategic area with good accreditation. This school experiences a lack of practical media, especially in the industrial automation engineering department. Based on observations, learning is still limited to theory in the subject of programmable control systems. The practice only uses simulation software, without involving PLC devices directly. The mismatch of practical tools with the theory of PLC delivered by the teacher causes the learning process to be less than optimal. As a result, students do not have a deep understanding of PLC devices (Wahrini & Hasbi, 2022).

Skills in PLC operation and programming are a core competency in industrial automation, which are highly demanded by the world of work (Kurniawan et al., 2022). The World Economic Forum also revealed that technical skills and the utilization of automation technology are two of the ten most needed skills in the future world of work. To overcome these problems, a solution is needed that can answer the needs of practice in the field. One of the solutions offered is the development of practical learning media in the form of a PLC trainer equipped with job sheets that match the learning outcomes.

This trainer is designed to be used independently or in small groups to distribute practice implementation more evenly. In addition, Structured job sheets can guide students in understanding practice steps systematically to increase learning independence (Widyastuti et al., 2023). The results of Eliza (2018) research show that using hands-on practice-based trainers to learn electromagnetic control systems can significantly improve students' understanding and skills. Another study by Uyun & Myori (2021) also confirmed that a good job sheet can increase the effectiveness of practical learning and strengthen technical mastery.

Thus, the development of PLC trainers and job sheets is expected to be the right solution to answer the challenges of practical learning at SMKN 1 Singosari, while directly impacting student learning outcomes. In recent years, various studies have been conducted to develop trainer-based learning media in SMK—for example, the development of a sensor system trainer (Jariyah & Suryono, 2020). However, most of these studies still focus on design aspects and the validity of the media from the technical side, without evaluating the

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media's effectiveness in a classroom with limited practical facilities. In addition, not many studies integrate trainer media with job sheets based on learning outcomes and evaluate their impact on improving student learning outcomes.

This research contributes to developing PLC trainers that not only function as practical aids, but are also equipped with a series of job sheets designed explicitly by learning outcomes. Combining practical learning media such as job sheets and trainers provides a more comprehensive approach to practical learning, allows students to learn independently, and makes it easier for teachers to manage practical learning (Hidayati, 2021).

The gaps addressed in this research include the unavailability of adequate practical learning media at SMKN 1 Singosari for programmable control system subjects. In addition, there is no integration between trainers and job sheets by learning outcomes. The lack of research that examines the effectiveness of PLC trainer media in the context of SMK with limited practical facilities is also an important gap that this research aims to fill. The urgency of this research is even higher in the context of implementing the Merdeka Curriculum, which emphasizes project-based learning and hands-on practice. Project-based learning (PjBL) has increased students' creativity, independence, and critical thinking skills (Kause & Paut, 2024).

PLC trainers with job sheets allow PjBL to be implemented more easily and effectively in vocational schools. Based on the background and problem identification above, this research aims to develop practical learning media in the form of PLC trainers equipped with learning outcomes-based job sheets, as a solution to the limitations of practical media at SMKN 1 Singosari. The general objective of this research is to develop practical learning media in the form of PLC trainers to be used in programmed control system learning activities at SMK Negeri 2 Singosari to improve student learning outcomes. Specifically, this research aims to identify the needs of practical learning media for programmable control systems at SMKN 1 Singosari, design and develop appropriate PLC trainers, and compile job sheets based on learning outcomes that can be used with PLC trainers. In addition, this research will also analyze the effectiveness of learning media on improving student learning outcomes and validate the feasibility of trainers and job sheets through expert tests and limited trials.

This research is expected to produce practical learning media that are solution-oriented and innovative, and can be replicated by other SMKs with similar conditions. By developing contextual and applicable learning media, this research makes an important contribution to the development of science in vocational education. Contextually designed learning media allow students to understand the material better because it is directly related to the real situations they face in the world of work. This is in line with the findings in a study by Aini et al (2023), which showed that learning media designed innovatively and interestingly can increase students' enthusiasm for learning and understanding the subject. In addition, research by Wati & Nugraha (2021) also emphasizes the importance of developing technology-assisted interactive learning media in improving the quality of

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learning in SMK. Thus, the development of contextual and applicable learning media supports students' competency achievement and facilitates teachers in effectively managing practical learning.

B. Method

According to Sugiyono (2018), this method aims to produce specific products that can be used to improve the quality of learning. The products developed in this study are PLC Trainers and Jobsheets as supporting media for the teaching and learning process. In the product development process, the ADDIE model was proposed by Branch & Varank (2009). is used. This model comprises five systematic stages: Analysis, Design, Development, Implementation, and Evaluation. The research process was carried out in phases, starting with observation, designing job sheets and PLC trainers, preparing questionnaires, conducting product trials and validation, analyzing data, and concluding the results as the final step in completing the research.

Figure 1. Research Flow

Data collection was conducted using three techniques, namely interviews, observations, and validation questionnaires. The interview process is carried out to explore information related to the problems faced and specific needs in the Industrial Electronics Department of SMK Negeri 1 Singosari. Observation aims to get an overview of student conditions, learning facilities, and facilities and infrastructure in the Industrial Automation Engineering department.

A validity test is carried out by distributing questionnaires to ensure the developed product is suitable. This questionnaire instrument includes media experts, material experts, and students of class XI majoring in Industrial Automation at SMK Negeri 1 Singosari. The assessment from media experts focused on the media's design, technical, and usefulness aspects. The evaluation from material experts included aspects of material feasibility and usefulness. The student assessment included four aspects: material, design, technical, and usefulness. The data obtained from filling out the questionnaire is quantitative. The evaluation uses a four-level Likert scale, which allows respondents to indicate their level of agreement with each proposed statement as follows.

Table 1. Questionnaire assessment criteria

Category	Value Wight
Strongly Agree	4
Agree	3

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Category	Value Wight
Disagree	2
Strongly Disagree	1

Source: Mulyatiningsih (2015)

The formula by Puspita et al (2024) used in calculating the percentage is:

$$\text{Percentage } (\%) = \sum \frac{R}{N} x\ 100\%$$

Explanation:

P = Percentage score

$\sum R$ = Total score count

N = Ideal score count

Table 2. Validity level

Validity Criteria	Validity/Feasibility Level
85,01% - 100,00%	Very Feasible (can be used without revision)
70,01% - 85,00%	Feasible (can be used with minor revisions)
50,01% - 70,00%	Less Feasible (recommended not to use, needs major revisions)
25,00% - 50,00%	Not Feasible (cannot be used)

Source: (Akbar, 2017)

C. Result and Discussion

Result

This research and development procedure refers to the ADDIE model described by Lee & Owens (2004). The stages used in developing this learning media are presented in the illustration below.

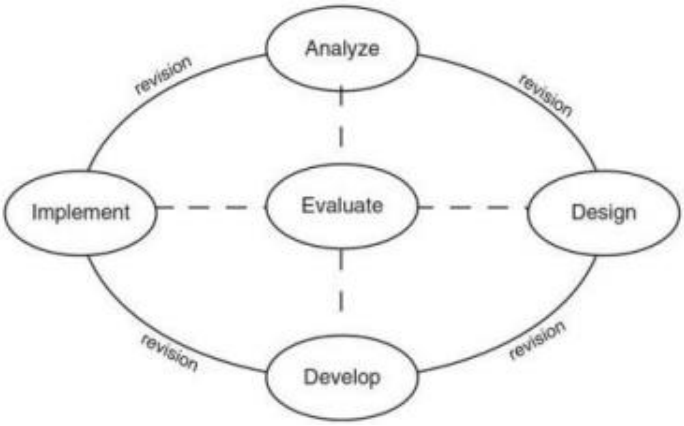

Figure 2. ADDIE Model
Source: Lee Owens (2004)

Analyze

At this stage, an interview was conducted with one of the Programmable Control System subject teachers in Industrial Automation Engineering at SMK Negeri 1 Singosari.

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From the results of these interviews, several obstacles in the learning process were identified. One is the absence of learning media that can encourage students to learn independently and creatively. Currently, students only receive material from teachers in the form of PowerPoint presentations, without the support of adequate practicum activities. To overcome these problems, practicum learning media as a trainer is needed. This tool is necessary in supporting learning and helping students better understand programmable control system material.

The next stage is to formulate the objectives to be achieved. The goal is to develop a PLC trainer and a job sheet as a learning medium. This job sheet is designed for use by grade XI students of the Industrial Automation Engineering Department at SMKN 1 Singosari. Before the development process was carried out, researchers and subject teachers first discussed the material that would be contained in the job sheet. Based on the discussion results and referring to the objectives and flow of learning outcomes obtained from the Programmed Control System subject teacher, the material compiled in the job sheet has been adjusted to the flow of applicable learning objectives.

Design

At this stage, researchers begin designing the main product, which is the core of research activities: PLC trainers and jobsheets used as practicum learning media. The design of PLC trainers is carried out by referring to the needs of students in understanding the concepts and application of programmable control systems in real life. It is intended that students not only master the theory but also be able to implement PLC programming logic directly. In designing the trainer, researchers pay attention to usefulness, design aspects, and ease of use in practicum activities. The trainer has various components such as digital input-output modules, indicator lights, and push buttons.

Along with designing the trainer, researchers also compiled a job sheet as a structured guide for learning activities. This job sheet is designed to be in line with the features and functions of the trainer, as well as adapted to the learning outcomes set. Each job sheet includes several important components, including: clear learning objectives, a description of the subject matter, a list of tools and materials needed, systematic work procedure steps, and an evaluation sheet that can be used to measure the level of understanding and skills of students after carrying out the practicum. The following are some pictures of the results of the design of job sheets and PLC trainers developed in this study.

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Figure 3. Trainer PLC

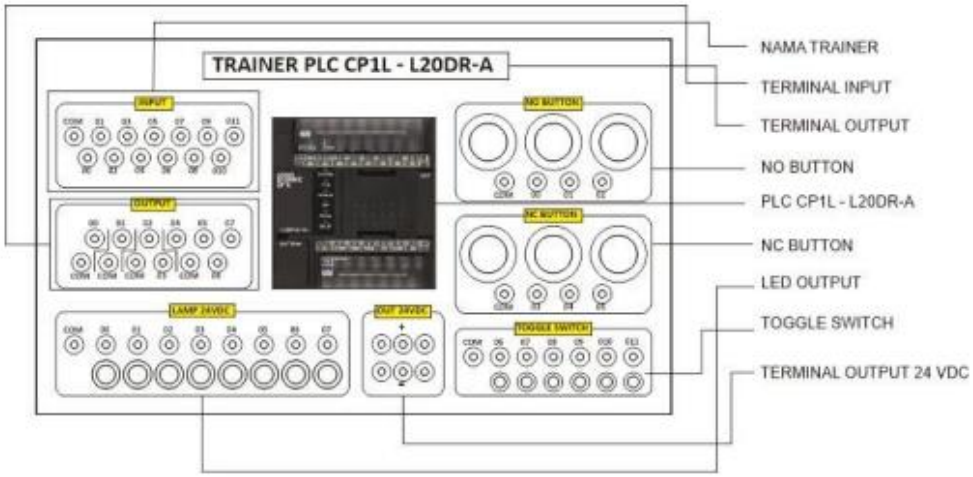
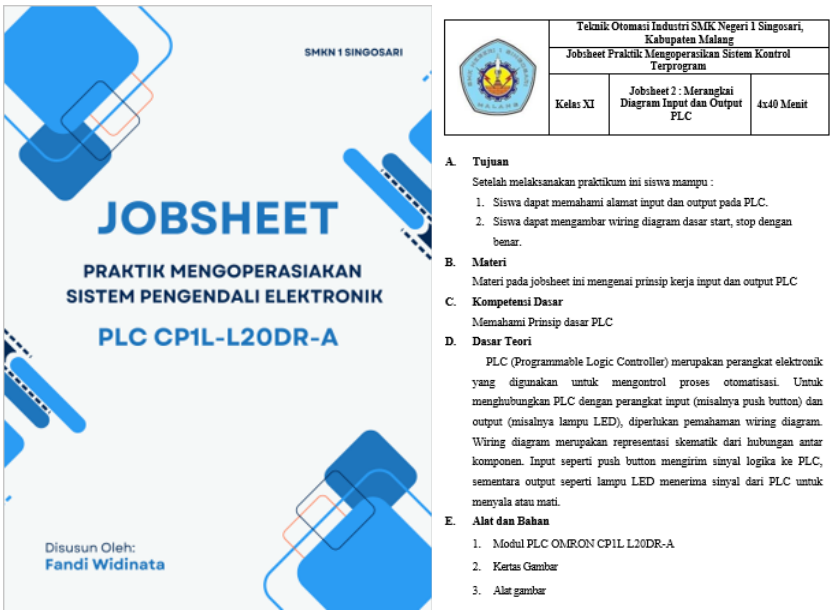


Figure 4. PLC Trainer Parts Section



	Teknik Otomasi Industri SMK Negeri 1 Singosari, Kabupaten Malang		
	Jobsheet Praktik Mengoperasikan Sistem Kontrol Terprogram		
	Kelas XI	Jobsheet 2 : Merangkai Diagram Input dan Output PLC	4x40 Menit

A. Tujuan

Setelah melaksanakan praktikum ini siswa mampu :

1. Siswa dapat memahami alamat input dan output pada PLC.
2. Siswa dapat mengambar wiring diagram dasar start, stop dengan benar.

B. Materi

Materi pada jobsheet ini mengenai prinsip kerja input dan output PLC

C. Kompetensi Dasar

Memahami Prinsip dasar PLC

D. Dasar Teori

PLC (Programmable Logic Controller) merupakan perangkat elektronik yang digunakan untuk mengontrol proses otomatisasi. Untuk menghubungkan PLC dengan perangkat input (misalnya push button) dan output (misalnya lampu LED), diperlukan pemahaman wiring diagram. Wiring diagram merupakan representasi skematik dari hubungan antar komponen. Input seperti push button mengirim sinyal logika ke PLC, sementara output seperti lampu LED menerima sinyal dari PLC untuk menyala atau mati.

E. Alat dan Bahan

1. Modul PLC OMRON CP1L L20DR-A
2. Kertas Gambar
3. Alat gambar

Figure 5. Jobsheet Trainer PLC

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Development

The development stage is the implementation phase of the previously designed plan. At this stage, the learning module that has been prepared is developed into a complete product that is ready to be validated by experts. This validation aims to assess the extent to which the module is feasible to use, both in terms of material and media, before being applied in student learning activities. Researchers involved lecturers from the Department of Electrical Engineering, Faculty of Engineering, State University of Malang (UM), with competence and experience in electrical engineering and learning media development for the media validity test.

Meanwhile, the material validity test was conducted by a programmable control system subject teacher from the Department of Industrial Automation Engineering, who was responsible for assessing the feasibility of the job sheet material. The instrument used in the validation process is a questionnaire, which is designed based on the theories of the experts. The questionnaire for media validation refers to the Walker and Hess theory in Arsyad (2007), which emphasizes the technical quality aspects of learning media. At the same time, the questionnaire for material validation was developed with additional indicators from Akbar (2017), including content and learning. The following presents the processed results of quantitative data obtained from filling out the questionnaire by expert validators.

Table 3. Media expert validation

Indicator	Question Number	Empiric Total Score	Expected Total Score	Total (%)	Description
Notation Description	1-2	7	8	87.5	Very Feasible
Component Layout	3-5	11	12	91.7	Very Feasible
Attractiveness	6-7	8	8	100	Very Feasible
Applicative Functic	8-9	8	8	100	Very Feasible
Technical Operation	10-11	8	8	100	Very Feasible
Ease of Use	12-14	10	12	83.3	Very Feasible
Ease of maintenance	15-16	8	8	100	Very Feasible
Efficient	17-18	8	8	100	Very Feasible
Security	19-20	8	8	100	Very Feasible
Total		76	80	95.8	

Table 4. Material expert validation

Indicator	Question Number	Empiric Total Score	Expected Total Score	Total (%)	Description
Suitability of material with learning outcomes	1-2	8	8	100	Very Feasible
Suitability of material with learning objectives	3-4	8	8	100	Very Feasible
Support material delivery	5-6	7	8	87.5	Very Feasible

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Indicator	Question Number	Empiric Total Score	Expected Total Score	Total (%)	Description
Add insight into knowledge	7-8	8	8	100	Very Feasible
The conciseness of the material	9-10	7	8	87.5	Very Feasible
Suitability of material to student needs	11-12	8	8	100	Very Feasible
Make it easier for the teacher	13-14	7	8	87.5	Very Feasible
Shorten learning time	15-16	7	8	87.5	Very Feasible
Clarify student understanding	17-18	7	8	87.5	Very Feasible
Fosters student interest in learning	19-20	8	8	100	Very Feasible
Total		75	80	93.8	

Impelmentation

At the implementation stage of the research, user trials were conducted to evaluate student responses toward the developed learning module, which integrated a PLC trainer and structured job sheet. These trials were essential to assess not only the functionality of the media but also its reception by students in real classroom settings. The trials were carried out in two stages: a small group trial and a large group trial, enabling the researchers to progressively refine the learning module based on user feedback. The small group trial involved 10 students from class XI Industrial Automation Engineering at SMK Negeri 1 Singosari. These participants were selected using a simple random sampling technique, ensuring that each student had an equal probability of being chosen as a respondent (Sugiyono, 2018).

This method of sampling minimized potential biases and allowed for representative feedback. The primary objective of the small group trial was to identify initial issues, both technical and instructional, that might affect the learning experience. Feedback from this stage was a critical input for improving the module before it was implemented on a larger scale. Following revisions based on the findings from the small group, a large group trial was conducted involving 24 students from the same class level and program. This phase aimed to evaluate the module's overall feasibility, practicality, and effectiveness in a broader classroom environment. At this stage, the research focused on how well the learning media supported instructional delivery, student engagement, and technical usability.

To gather data during the user trials, the researchers developed a questionnaire instrument based on the evaluation indicators proposed by Walker and Hess in Arsyad (2007). These indicators included key dimensions such as material quality (clarity, relevance, and accuracy of the content), module usefulness (its ability to support learning goals), technical quality (reliability and safety of the trainer hardware), and design appearance (visual layout, readability, and instructional clarity of the jobsheet). The trial implementation involved close coordination with both subject teachers and students to

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ensure that the process ran smoothly and aligned with the school's instructional schedule. The mechanism began with a structured orientation session, where students were introduced to the PLC trainer and instructed on using the jobsheet as a guide during practical tasks. Students then conducted hands-on activities individually or in pairs, following step-by-step instructions in the job sheet.

Upon completion of the practical session, students were asked to complete the user trial questionnaire, guided by the researcher to ensure accurate and thoughtful responses. This systematic approach enabled collecting rich, reliable data on the students' experiences using the module. The results of this quantitative data collection provide essential insights into the effectiveness of the developed learning media and are presented in the next section for detailed analysis and interpretation. In this phase, the data analysis process is systematically conducted by referring to the validation results provided by three key assessor groups: media experts, material experts, and students, as the primary users of the jobsheet.

Including these three perspectives ensures a comprehensive evaluation that considers both the technical and pedagogical quality of the job sheet and its practicality and effectiveness in real classroom scenarios. This analysis aims to derive an objective, well-rounded understanding of the overall feasibility and appropriateness of the developed jobsheet as a learning tool for practical sessions in automatic control systems. A specific set of criteria is applied to determine whether the product meets the predefined quality standards. The jobsheet is considered valid and suitable if it achieves a minimum overall validity score of 70%. Moreover, each item within the evaluation rubric covering aspects such as clarity, accuracy of content, instructional design, visual appeal, and usability must obtain a score of at least three on a 4-point Likert scale. A score of 3 signifies that the corresponding aspect falls within the "feasible" category, indicating its adequacy and alignment with practical learning media principles. These thresholds are critical benchmarks in assessing whether the jobsheet fulfills the required standards across content quality, media design, and practical applicability in vocational learning environments.

The validation process results, comprising detailed expert feedback and empirical data from student trials, have been compiled and summarized in the following section. This consolidated data plays a crucial role in informing subsequent decisions regarding the learning product's refinement, enhancement, and final implementation. By grounding improvements in structured evidence and multi-perspective feedback, the development process upholds the principles of iterative design and continuous quality assurance, ultimately aiming to produce a learning medium that is theoretically sound, practically effective, and user-friendly.

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Table 5. Small Group Tests

Aspect	Question Number	Empiric Total Score	Expected Total Score	Total (%)	Description
Material quality	1-11	410	440	93.2	Very Feasible
Display Design	12-14	115	120	95.8	Very Feasible
Technical	15-19	189	200	94.5	Very Feasible
Usability	20-24	158	160	98.8	Very Feasible
Total		872	920	95.6	

Table 6. Large Group Tests

Aspect	Question Number	Empiric Total Score	Expected Total Score	Total (%)	Description
Material quality	1-11	413	440	93.9	Very Feasible
Display Design	12-14	118	120	98.3	Very Feasible
Technical	15-19	190	200	95.0	Very Feasible
Usability	20-24	159	160	99.4	Very Feasible
Total		880	920	96.6	

In the final stage of the research, researchers conducted a limited trial in a large group using the revised PLC trainer jobsheet learning media based on the results of the previous evaluation in the small group. This trial was conducted in class XI TOI 1, consisting of 24 students majoring in Industrial Automation Engineering, located in the analog workshop room on Monday, March 28, 2025.

In this activity, students were given Job Sheet 4: PLC Program Simulation to Control LED Lights. Furthermore, researchers assessed each student's performance using an assessment rubric that included four aspects: circuit suitability, program correctness, work neatness, and independence. Each aspect was scored in the range of 1-4.

Table 7. Percentage of Learning Outcomes of 24 Students of Class XI TOI 1 Regarding the Use of Jobsheet 4

Student Name	Circuit Suitability	Program Correctness	Work neatness	Problem Solving	Total Score	Final Grade (0-100)
Student 1	4	3	4	3	14	88
Student 2	4	4	3	4	15	94
Student 3	4	3	4	4	15	94
Student 4	4	3	4	4	15	94
Student 5	4	3	4	4	15	94
Student 6	3	4	4	3	14	88
Student 7	4	4	3	4	15	94
Student 8	4	4	4	3	15	94
Student 9	4	4	4	4	16	100

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Student Name	Circuit Suitability	Program Correctness	Work neatness	Problem Solving	Total Score	Final Grade (0-100)
Student 10	3	3	4	4	14	88
Student 11	4	4	3	4	15	94
Student 12	4	3	4	3	14	88
Student 13	4	3	4	4	15	94
Student 14	4	4	3	4	15	94
Student 15	4	3	4	3	14	88
Student 16	4	3	4	4	15	94
Student 17	4	3	4	4	15	94
Student 18	4	4	3	3	14	88
Student 19	4	4	3	4	15	94
Student 20	4	4	4	4	16	100
Student 21	4	4	4	3	15	94
Student 22	4	4	4	4	16	100
Student 23	4	4	4	4	16	100
Student 24	4	3	4	4	15	94

The total student score is calculated using the formula:

$$\text{Total score} = \text{Total Score of Four Aspects}$$

Then, the final score is converted to a 0-100 scale using the formula:

$$\text{Final Value (0-100)} = \left(\frac{Total\ Score}{16}\right)*100$$

The number 16 is obtained from the maximum score (4) multiplied by the number of aspects (4). The results of this assessment are used to determine the extent of the increase in student learning outcomes after using the learning media.

Figure 6. Learning using the PLC Jobsheet Trainer

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Evaluate

In this phase, the data analysis process is systematically conducted by referring to the validation results provided by three key assessor groups: media experts, material experts, and students, as the primary users of the jobsheet. Including these three perspectives ensures a comprehensive evaluation that considers both the technical and pedagogical quality of the job sheet and its practicality and effectiveness in real classroom scenarios. This analysis aims to derive an objective, well-rounded understanding of the overall feasibility and appropriateness of the developed jobsheet as a learning tool for practical sessions in automatic control systems.

A specific set of criteria is applied to determine whether the product meets the predefined quality standards. The jobsheet is considered valid and suitable if it achieves a minimum overall validity score of 70%. Moreover, each item within the evaluation rubric covering aspects such as clarity, accuracy of content, instructional design, visual appeal, and usability must obtain a score of at least three on a 4-point Likert scale. A score of 3 signifies that the corresponding aspect falls within the "feasible" category, indicating its adequacy and alignment with practical learning media principles. These thresholds are critical benchmarks in assessing whether the jobsheet fulfills the required standards across content quality, media design, and practical applicability in vocational learning environments.

The validation process results, comprising detailed expert feedback and empirical data from student trials, have been compiled and summarized in the following section. This consolidated data plays a crucial role in informing subsequent decisions regarding the learning product's refinement, enhancement, and final implementation. By grounding improvements in structured evidence and multi-perspective feedback, the development process upholds the principles of iterative design and continuous quality assurance, ultimately aiming to produce a learning medium that is theoretically sound, practically effective, and user-friendly.

Table 8. Validity Test Results

Validation Test	Percentage of validity (%)	Criteria
Media Expert Test	86	Very Feasible
Material Expert Test	95	Very Feasible
Small Group Test	95	Very Feasible
Large Group Test	96	Very Feasible
Average	93	Very Feasible

Discussion

The development of learning media in the form of Programmable Logic Controller (PLC) trainers and structured job sheets has shown substantial potential in addressing long-standing challenges in practical learning, particularly within Programmable Control Systems. One of the primary issues vocational schools face is the lack of access to real

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industrial equipment, which results in a reliance on simulations and theoretical instruction. While these methods can convey basic concepts, they often fail to provide the hands-on experience necessary to develop practical skills in automation technology.

This gap significantly hampers students' ability to internalize control logic, understand hardware-software integration, and practice troubleshooting in realistic contexts. To overcome these limitations, a tangible and context-based instructional media consisting of a PLC trainer and detailed job sheets was developed to facilitate direct engagement with automation systems. This media was validated through expert reviews and received high feasibility scores: 95.8% from media experts and 93.8% from subject matter experts.

These ratings underscore the tool's alignment with content accuracy, technical safety, and pedagogical effectiveness (Akbar, 2017). The trainer's design reflects curriculum objectives, with robust technical features ensuring operational safety, while the job sheets are pedagogically structured to promote step-by-step learning and reflection. The validation process informed crucial revisions. Media experts recommended integrating diode components into the lighting circuits to prevent reverse current damage, which is often overlooked but a critical safety feature in electrical systems. This not only improved the hardware's longevity and safety but also introduced students to best practices found in industrial settings (Darus et al., 2024).

Additionally, content experts emphasized including evaluation questions in the job sheets to foster self-assessment and deeper cognitive engagement, thus encouraging learners to reflect and consolidate their understanding (Anderson & Krathwohl, 2001). The media's effectiveness was demonstrated through student trials, with average performance increasing from 95.6% in the small group test to 96.6% in the large group trial. Specific improvements were observed in material quality, display design, technical performance, and usability. For instance, material quality rose from 93.2% to 93.9%, attributed to better content clarity and evaluation tasks; display design improved from 95.8% to 98.3%, due to enhancements in visual layout and instructional sequencing. These results support existing research showing that combining physical instructional tools with guided worksheets significantly enhances student engagement and conceptual mastery in technical education environments (Pratama et al., 2022). Such integration leads to higher learning motivation and practical competence in vocational students studying PLC systems. In summary, the PLC trainer and structured jobsheet offer an innovative and validated solution for vocational education. By bridging the gap between theory and practice, and aligning with both pedagogical principles and industrial needs, this learning media promotes student-centered learning that is safe, effective, and industry-relevant.

D. Conclusion

This research aims to develop learning media through PLC trainers and job sheets that are valid, practical, and feasible to support practical learning in Programmed Control Systems subjects at SMK. Based on the development process that follows the ADDIE model,

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the products produced have met these objectives. The trainers and job sheets developed can become applicable and contextual learning tools, facilitating understanding of concepts and encouraging students' practical skills in operating PLC-based automatic control systems.

This research implies that integrating physical learning media and systematic worksheets can improve the overall quality of vocational learning. This media provides an alternative solution to the limitations of practice in schools and strengthens the role of teachers in facilitating competency-based learning activities. In addition, using validated trainers and job sheets can also improve students' readiness to face the industrial workforce that demands mastery of technical skills.

For future research, it is recommended that learning media like this be developed more broadly in various other engineering subjects. Further research can also explore the effectiveness of this media in the long term through quasi-experimental studies and assess its impact on improving learning outcomes.

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