



Learning Evaluation System Using Fisher–Yates Shuffle and Rule-Based Algorithms at SMK Kahuripan 1

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Abstract

SMK Kahuripan 1 faces challenges in conventional learning evaluation, particularly lengthy assessment processes and the potential for subjective evaluation. This study aims to develop a web-based learning evaluation system for Light Vehicle Engine Maintenance (PMKR) by integrating the Fisher–Yates Shuffle and Rule-Based algorithms. The system was developed using the Waterfall model, while the Fisher–Yates Shuffle was applied to randomize question sequences and the Rule-Based System with Forward Chaining was used to automatically evaluate learning outcomes based on predetermined criteria. The results show that the developed system successfully supports question randomization, automated scoring, learning outcome evaluation, and reporting. Black Box Testing confirmed that the main system functions, including login, dashboard access, question bank management, examinations, result reporting, and practice simulations, operated according to the specified requirements. Therefore, the system provides a more efficient, objective, and structured learning evaluation process.

Keywords: Learning Evaluation System, Fisher–Yates Shuffle, Rule-Based System, Forward Chaining, Computer-Based Test.

Introduction

The use of technology in educational evaluation has increasingly been realized through Computer-Based Testing (CBT) as a medium for assessing students' learning outcomes. The implementation of CBT can improve the effectiveness and efficiency of the evaluation process while providing greater convenience in administering assessments. In addition, computer-based evaluation has the potential to support assessment objectivity and encourage students' sportsmanship during the evaluation process (Utomo, 2023). These advantages indicate that computer-based evaluation systems can play an important role in improving the quality of learning evaluation in the digital era.

However, the implementation of computer-based evaluation systems in educational institutions still faces several challenges. The success of digital transformation in education is influenced by technological infrastructure readiness, human resource capabilities, digital literacy, institutional capacity, and policy support (Nashrullah et al., 2025). In practice, CBT systems are often primarily used as tools for administering examinations and have not been fully utilized as comprehensive learning evaluation systems capable of providing structured and objective analyses of students' learning outcomes.

A similar condition was identified at SMK Kahuripan 1. Based on preliminary observations and interviews with the school, SMK Kahuripan 1 has implemented a Computer-Based Test system for Mid-Semester Examinations and Final Semester Examinations. However, the existing system is mainly used to administer examinations and has not been optimally utilized as a learning evaluation medium that allows students to practice and measure their learning achievement before taking the



main examination. In daily learning activities, teachers still provide practice questions manually using paper or handwritten materials without the support of a structured and integrated evaluation system.

To address these problems, a learning evaluation system is needed that not only functions as a medium for student practice but also provides automatic, objective, and structured evaluation of learning outcomes. One approach that can be applied is the Fisher–Yates Shuffle algorithm, which randomizes the sequence of questions so that students can receive different question arrangements. Previous research has demonstrated the application of the Fisher–Yates Shuffle algorithm in computer-based and online testing systems to generate randomized question sequences efficiently (Akram et al., 2020). Through this mechanism, the system can reduce similarities in question sequences among students while maintaining the same question bank.

In addition to question randomization, the evaluation system requires a mechanism for automatically interpreting students' learning outcomes. A Rule-Based System can be used to evaluate student performance according to predetermined rules established by teachers. Rule-based approaches have previously been implemented to support automated evaluation processes and decision-making based on specific criteria (Abdulhaq, 2021). In the present system, this approach is used to classify learning outcomes, determine completion status, and provide remedial recommendations according to students' achievement in particular learning materials. Therefore, students' exercise results can function not only as learning practice but also as a basis for more structured evaluation and follow-up learning decisions.

Previous studies cited in this research have generally applied the Fisher–Yates Shuffle algorithm for question randomization or Rule-Based Systems for automated evaluation as separate approaches (Abdulhaq, 2021; Akram et al., 2020). However, the integration of these two approaches within a web-based learning evaluation system that simultaneously supports question randomization, automatic assessment, learning outcome classification, and remedial recommendations has not been sufficiently addressed in the context of vocational learning evaluation. This condition represents the research gap addressed in the present study.

Therefore, the novelty of this study lies in integrating the Fisher–Yates Shuffle algorithm with a Rule-Based System using the Forward Chaining method in a web-based learning evaluation system for the Light Vehicle Engine Maintenance (PMKR) subject at SMK Kahuripan 1. The Fisher–Yates Shuffle algorithm is used to generate different question sequences, while the Rule-Based System is applied to automatically classify students' learning outcomes and provide appropriate remedial recommendations based on predetermined criteria. This integration is expected to contribute to a more efficient, objective, and structured learning evaluation process while assisting teachers in identifying students who require additional learning support.

This research was conducted with the title "Development of a Learning Evaluation System Using the Fisher-Yates Shuffle and Rule-Based Algorithm at SMK Kahuripan 1" with the hope that it can help improve the quality of learning evaluation, the effectiveness of student preparation.

Method

This study employed a system development approach using the Waterfall model, which consists of sequential stages including needs analysis, system design, implementation, testing, and evaluation (Rosa & Shalahuddin, 2018). Data and system requirements were obtained through observation, interviews, literature review, and student learning data at SMK Kahuripan 1. The needs



analysis focused on identifying learning evaluation problems, user requirements, and the functional and non-functional requirements of the system.

The developed system integrates two main algorithms. The Fisher-Yates Shuffle algorithm is applied to randomize the sequence of questions so that students receive different question arrangements from the same question bank. Before the randomization process, question data are validated based on their completeness, answer options, correct answers, subjects, and learning materials.

The Rule-Based System with the Forward Chaining method is used to automatically evaluate students' learning outcomes based on predetermined assessment criteria. The system processes students' scores, determines learning achievement categories and completion status, and provides remedial recommendations when the required criteria are not achieved. Through this integration, the system supports both question randomization and structured learning evaluation.

After implementation, the functionality of the developed system was evaluated using Black Box Testing to ensure that its main features operated according to the specified requirements (Kartono et al., 2024). The testing covered major functions such as login, dashboard access, account and question bank management, examination activities, practice simulations, and learning outcome reports.

Table 1. Material Evaluation Rules

Kondisi	Output
Benar $\geq$ 75%	Menguasai Materi
Benar $<$ 75%	Perlu Pendalaman Materi

Sumber: Dokumen Pribadi (2026)



Figure 1. Algorithm Overall Flowchart



Results and Discussion

To facilitate this research, a data model was made that is easy to understand and flexible in making system designs.

Software Modeling

UML (Unified Modeling Language) is a standard visual modeling language used to design, visualize, construct, and document object-oriented systems (Rosa & Shalahuddin, 2018).

Use cases

A Use Case Diagram is one of the diagrams in Unified Modeling Language (UML) used to illustrate the interactions between actors and the system through its available functions (Rosa & Shalahuddin, 2018). In the Learning Evaluation System at SMK Kahuripan 1, there are two main actors: teachers and students.

Teachers can Login/Logout, manage user accounts (add, edit, and delete accounts), manage subjects, materials, question banks, create and manage exams, and view exam results and analysis per material. Meanwhile, students can Login/Logout, view active exams, take exams that apply the Fisher-Yates Shuffle and Rule-Based Evaluation algorithms, view exam results, view exam results, start exercises, set up exercises, work on exercises, view practice results, and view personal practice history. In addition to the Use Case Diagram, the Use Case Description is also used to provide a more detailed explanation of the flow and function of each process contained in the system so that the needs of the system can be understood more clearly.

Teacher use cases

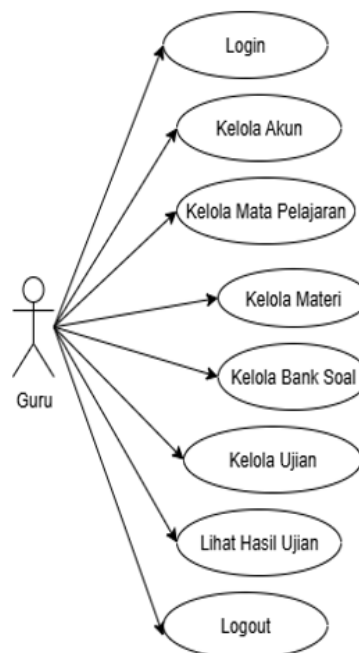


Figure 2. Use Case Teacher



Student use cases

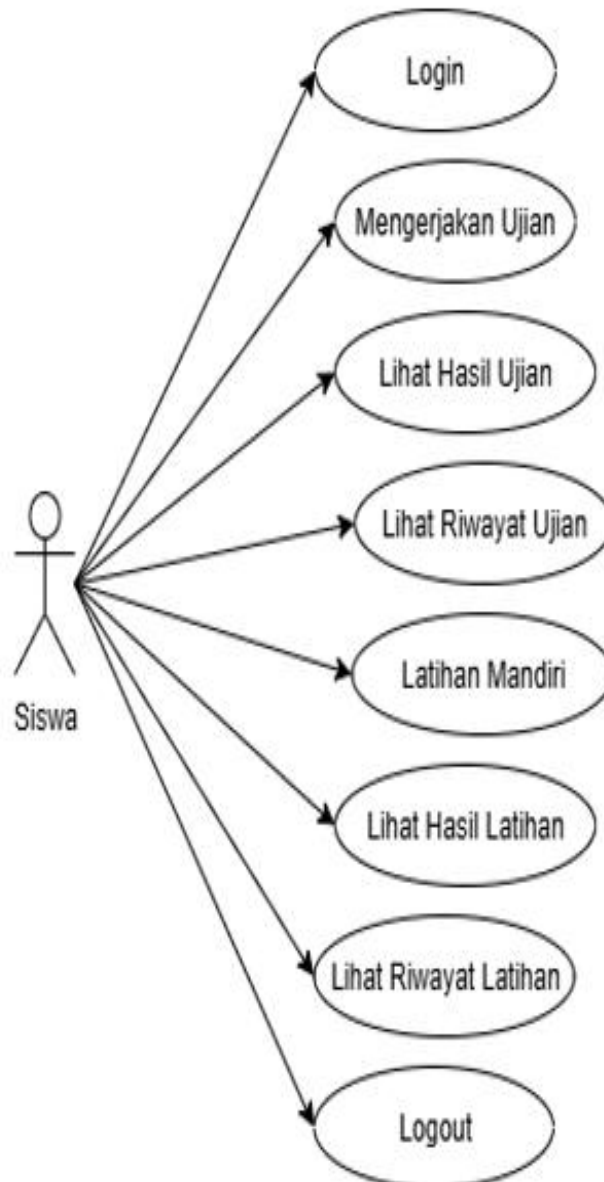


Figure 3. Student Use Cases



Class diagram

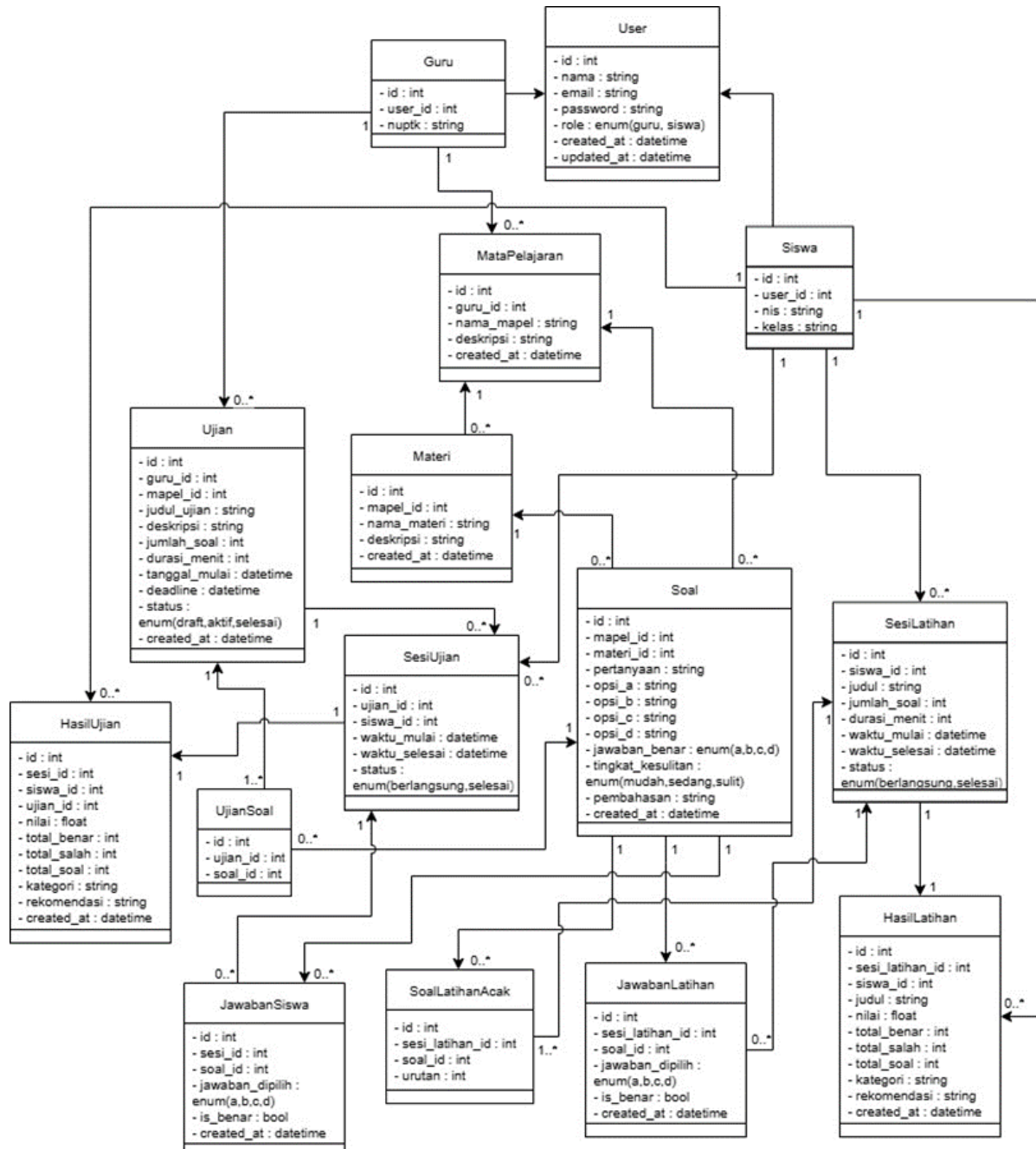


Figure 4. Class diagram



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Login View

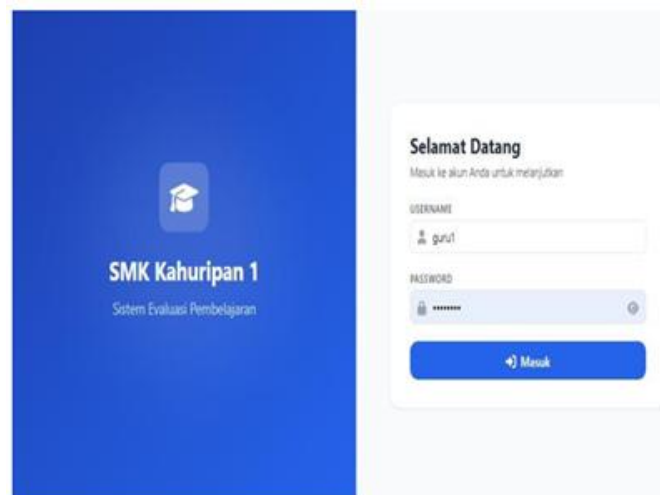


Figure 5. Login View
Source : Author

The login view appears when the program or app is running. Used for verification before using the program. Verification is done by entering a username and password.

Main Menu View

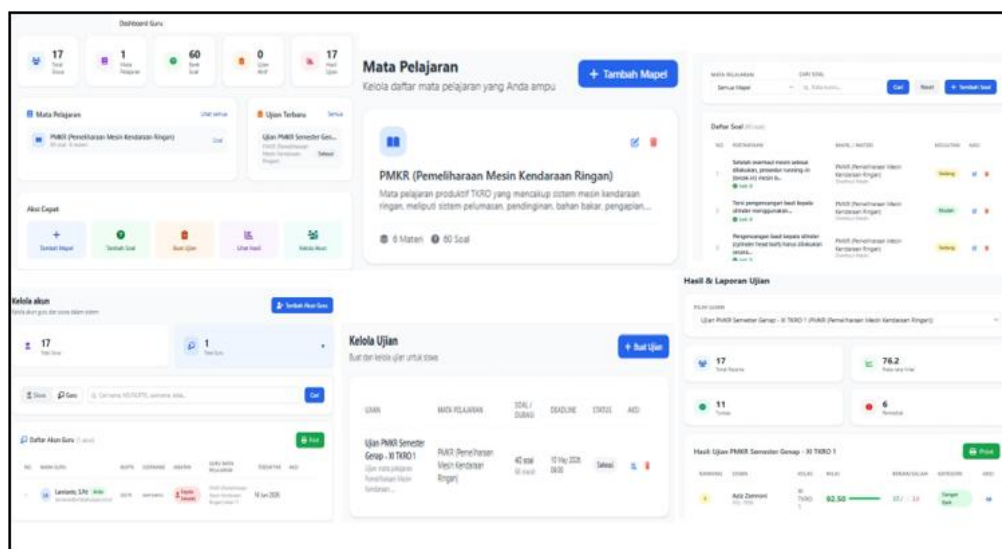


Figure 6. Teacher Dashboard
Source : Author

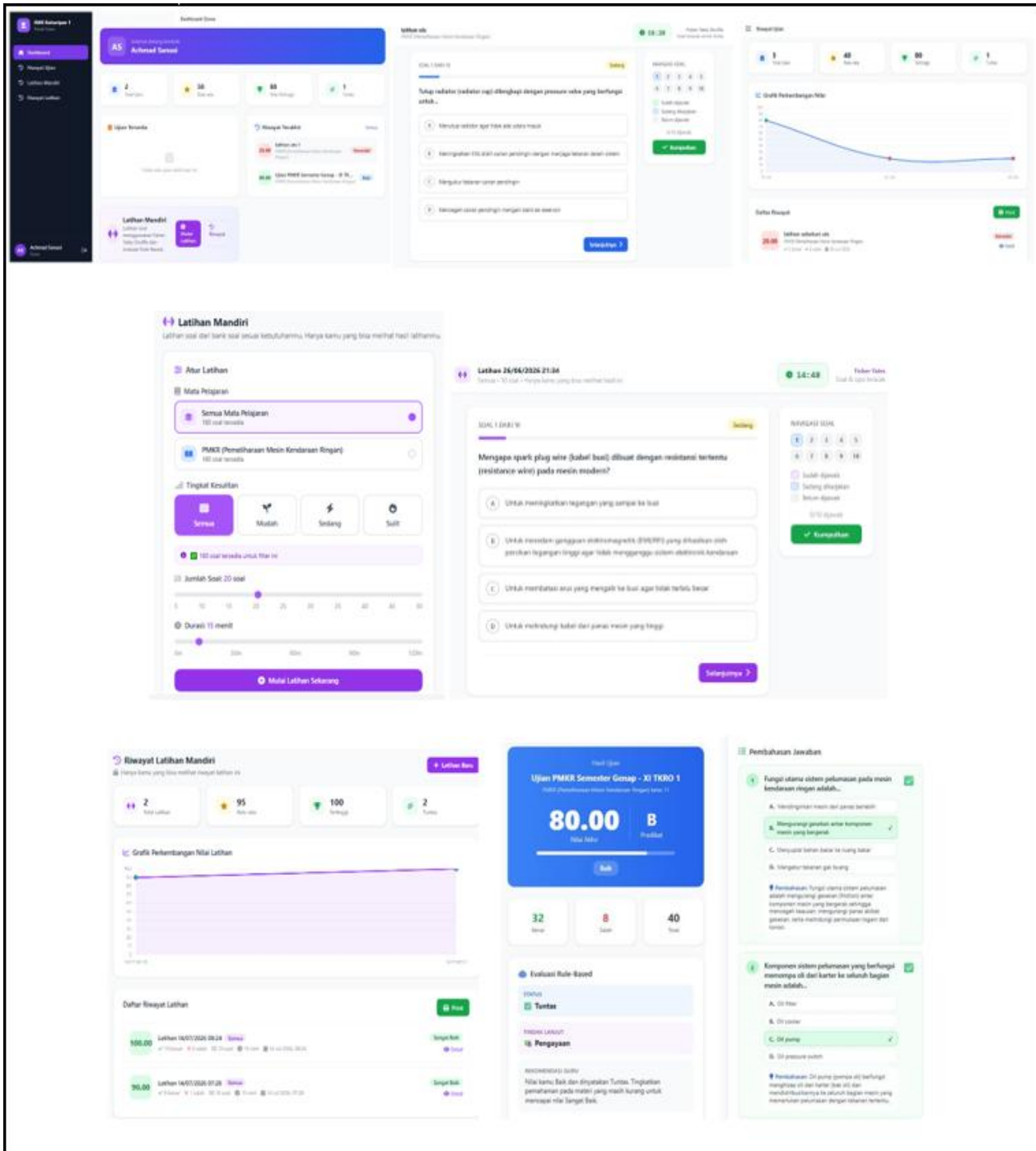


Figure 7. Student Dashboard
Source : Author



Report View



YAYASAN PENDIDIKAN KAHURIPAN
SMK KAHURIPAN 1
Bidang Keahlian : Teknik Manufaktur dan Rekayasa
Konsentrasi Keahlian : Teknik Kendaraan Ringan
Program Studi : Teknik Otomotif
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LAPORAN DAFTAR AKUN GURU
Tahun Ajaran 2026

Total Guru	:	1
Tanggal Cetak	:	14-07-2026 08:01

No	Nama	NUPTK	Username	Jabatan	Guru Mata Pelajaran	Email
1	Lanrianto, S.Pd	12176	lanrianto	kepala sekolah	PMKR (Pemeliharaan Mesin Kendaraan Ringan) kelas 11	lanrianto@smk.kahuripan.sch.id

Jakarta, Selasa 14 Juli 2026
Nama Kepala Sekolah

Lanrianto, S.Pd



YAYASAN PENDIDIKAN KAHURIPAN
SMK KAHURIPAN 1
Jl. Nangka No. 17 Tanjung Barat Jakarta Selatan

LAPORAN HASIL UJIAN

Judul Ujian : Ujian PMKR Semester Genap - XI TKRO 1
Mata Pelajaran : PMKR (Pemeliharaan Mesin Kendaraan Ringan) kelas 11
Bentuk : Tes Tertulis
Tanggal Ujian : 13 Juli 2026 08:15

No	Nama	Nilai	Benar	Salah	Nilai	Status
1	Achmad Sanusi	100	10	0	100.00	Sangat Baik
2	Muhammad Rizki	100	10	0	100.00	Baik
3	Muhammad Ridwan	100	10	0	100.00	Baik
4	Achmad Sanusi	100	10	0	100.00	Baik
5	Muhammad Rizki	100	10	0	100.00	Baik
6	Achmad Sanusi	100	10	0	100.00	Baik
7	Muhammad Rizki	100	10	0	100.00	Baik
8	Achmad Sanusi	100	10	0	100.00	Baik
9	Muhammad Rizki	100	10	0	100.00	Baik
10	Achmad Sanusi	100	10	0	100.00	Baik
11	Muhammad Rizki	100	10	0	100.00	Baik
12	Achmad Sanusi	100	10	0	100.00	Baik
13	Muhammad Rizki	100	10	0	100.00	Baik
14	Achmad Sanusi	100	10	0	100.00	Baik
15	Muhammad Rizki	100	10	0	100.00	Baik
16	Achmad Sanusi	100	10	0	100.00	Baik
17	Muhammad Rizki	100	10	0	100.00	Baik
18	Achmad Sanusi	100	10	0	100.00	Baik
19	Muhammad Rizki	100	10	0	100.00	Baik
20	Achmad Sanusi	100	10	0	100.00	Baik

Jakarta, Senin 13 Juli 2026
Guru Mata Pelajaran

Lanrianto, S.Pd



YAYASAN PENDIDIKAN KAHURIPAN
SMK KAHURIPAN 1
Bidang Keahlian : Teknik Manufaktur dan Rekayasa
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LAPORAN RIWAYAT UJIAN SISWA
Tahun Ajaran 2026

Nama Siswa : Achmad Sanusi
NIS : 1904
Kelas : XI TKRO 1
Total Ujian : 1
Rata-rata Nilai : 80
Nilai Tertinggi : 80
Total Tuntas : 1
Tanggal Cetak : 14 July 2026 08:10

No	Judul	Mata Pelajaran	Benar	Salah	Nilai	Status	Tanggal
1	Ujian PMKR Semester Genap - XI TKRO 1	PMKR (Pemeliharaan Mesin Kendaraan Ringan) kelas 11	32	8	80.00	Baik	16-06-2026 18:54

Jakarta, Selasa 14 Juli 2026
Nama Wali Kelas

Lanrianto, S.Pd



YAYASAN PENDIDIKAN KAHURIPAN
SMK KAHURIPAN 1
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LAPORAN RIWAYAT LATIHAN MANDIRI SISWA
Tahun Ajaran 2026

Nama Siswa : Achmad Sanusi
Total Latihan : 2
Rata-rata Nilai : 95
Nilai Tertinggi : 100
Total Tuntas : 2

No	Judul	Mata Pelajaran	Benar	Salah	Nilai	Status	Tanggal
1	Latihan 14-07-2026 08:24	PMKR (Pemeliharaan Mesin Kendaraan Ringan) kelas 11	10	0	100.00	Sangat Baik	14-07-2026 08:24
2	Latihan 14-07-2026 07:28	PMKR (Pemeliharaan Mesin Kendaraan Ringan) kelas 11	9	1	90.00	Sangat Baik	14-07-2026 07:28

Jakarta, Selasa 14 Juli 2026
Nama Wali Kelas

Lanrianto, S.Pd

Figure 8. Report View

Source : Author

Testing

The developed system was evaluated using Black Box Testing to verify whether its main functions operated according to the specified requirements (Kartono et al., 2024). The testing focused on the functionality of the system from the user perspective, including login, dashboard access, account management, subject and question bank management, examinations, practice simulations,

and learning outcome reporting. The results of the functional testing are presented in Table 3.

Table 2. Test results

Testing		result	Remark
Activity	Detail		
Login	Log in	Able verification	pass
Teacher Dashboard	Use main menu	Able to use main menu	pass
Manage account	Add and edit account data	Save data appears in the table	pass
Subject	add and edit Subject	Save data appears in the table	pass
Question Bank	Add and edit the question bank	Save data appears in the table	pass
Manage Test	Test	Can perform a test	pass
Result & Report test	Test result and report	Can provide result dan report test	pass
Student Dashboard	Use main menu	Able to use main menu	pass
Exam	See and answer question	Can perform a test	pass
Practise simulation test	See and answer question	Can perform a sumulation test	pass

The Black Box Testing results show that all main functions of the developed system operated according to the specified requirements, including login, dashboard access, account and question bank management, examination activities, practice simulations, and learning outcome reporting. These results indicate that the integration of the Fisher–Yates Shuffle and Rule-Based System can be implemented functionally within a web-based learning evaluation system. More importantly, the system does not only provide an examination interface but also connects question randomization, automatic scoring, learning outcome evaluation, and follow-up recommendations within a single evaluation process.

The implementation of the Fisher–Yates Shuffle enables students to receive different question sequences even when they use the same question bank. This mechanism supports a more varied examination process and reduces similarities in the order of questions received by students. This finding is consistent with Akram et al. (2020), who applied the Fisher–Yates Shuffle algorithm to an online test learning system for question randomization. However, the present study extends this application by integrating the randomization mechanism with a Rule-Based System for evaluating learning outcomes.

The Rule-Based System also provides an important contribution because students' scores are not only recorded but are further interpreted according to predetermined evaluation rules. The system can classify learning achievement, determine completion status, and provide remedial recommendations when students do not achieve the required criteria. This function is consistent with the application of rule-based evaluation reported by Abdulhaq (2021). The distinction of the present study lies in combining rule-based evaluation with Fisher–Yates question randomization in the context of Light Vehicle Engine Maintenance (PMKR) learning.

From a practical perspective, the developed system supports teachers in managing



examinations and identifying students who require additional learning assistance, while students can use the system for both examinations and practice activities. Therefore, the contribution of the system lies not only in digitalizing the examination process but also in providing a more structured learning evaluation and follow-up mechanism. This development also extends the role of Computer-Based Testing from an examination medium, as discussed by Utomo (2023), toward an integrated evaluation system that supports assessment and remedial decision-making.

Conclusion

The study successfully developed a web-based learning evaluation system for Light Vehicle Engine Maintenance (PMKR) at SMK Kahuripan 1 by integrating the Fisher–Yates Shuffle algorithm and a Rule-Based System with Forward Chaining. The system supports randomized question sequences, automatic evaluation of learning outcomes, and remedial recommendations based on predetermined criteria. Black Box Testing showed that the main system functions operated according to the specified requirements. Practically, the system provides teachers with a more structured mechanism for managing examinations and evaluating student achievement while allowing students to access examinations and practice activities within the same platform. However, the study was limited to functional system testing and implementation in a specific subject and school context. Future research is therefore recommended to evaluate system usability, user satisfaction, and learning effectiveness with broader participants and different educational contexts, as well as to further develop the system with additional evaluation and reporting features.

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