



# Developing Website-Based E-Learning System Using Prototyping Methods for the Surabaya City Civil Service Police Unit

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## ARTICLE INFORMATION

### Article history:

Received April 30, 2026

Revised May 04, 2026

Accepted May 06, 2026

### Keywords:

E-Learning;

Satpol PP;

Prototyping;

Laravel;

User Acceptance Test

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## ABSTRACT

This study aims to create a website-based e-learning system for the Surabaya City Public Order Agency (Satpol PP) to address the time and cost constraints of conventional training for 1,279 personnel. The research focused on the independent distribution of legal materials and operational procedures. The method used was iterative prototyping, encompassing the stages of needs analysis, design, implementation, and system testing. During the implementation process, the system was built using the Laravel framework and a MySQL database. The results of functional testing (Black Box Testing) demonstrated a 100% success rate for all 36 tested features. Furthermore, User Acceptance Test (UAT) on 18 respondents yielded a satisfaction score of 88.55%, placing the system in the "Strongly Agree" or "very suitable for use" category. The conclusion of this study is that the e-learning system successfully provides a flexible and effective training platform for improving personnel competency amidst high mobility in the field.

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## 1. INTRODUCTION

The rapid development of digital technology has significantly transformed the way organizations deliver training and improve human resource competencies. E-learning systems have emerged as a flexible solution that enables users to access learning materials anytime and anywhere, reducing dependency on conventional face-to-face training. This approach is particularly relevant for organizations with high operational demands and limited time availability [1], [2].

The Surabaya City Public Order Agency (Satpol PP) is a government institution responsible for maintaining public order and enforcing local regulations. With a total of 1,279 personnel and high mobility in field operations, conventional training methods are often constrained by time, cost, and scheduling limitations. As a result, not all personnel can access training materials evenly, which may affect the consistency of their competencies, especially in legal knowledge and operational procedures.

Previous studies have widely explored the development of e-learning systems using various approaches, particularly in formal education environments such as schools and universities. These studies generally focus on usability, accessibility, and user satisfaction as key success factors of e-learning systems [3], [4]. However, limited research addresses the implementation of e-learning systems in government institutions with high-mobility personnel, where flexibility, security, and independent learning capabilities are critical factors. In addition, the integration of secure authentication mechanisms, such as One-Time Password (OTP), in training systems remains underexplored in this context.

Based on these gaps, this study aims to develop a website-based e-learning system tailored to the specific needs of high-mobility personnel in the Surabaya City Public Order Agency. The system is designed using a prototyping approach to ensure continuous user involvement and alignment with operational requirements. Furthermore, this study integrates OTP-based authentication to enhance data security and support safe access to training materials.

The contributions of this study lie in the development of a customized e-learning approach specifically designed for high-mobility government personnel, the integration of OTP-based authentication to enhance system security in training environments, and the provision of empirical evaluation results that demonstrate system usability and user acceptance within a real government organizational context.

By addressing these aspects, this research is expected to contribute not only to practical system implementation but also to the development of e-learning strategies suitable for organizations with dynamic operational characteristics, as emphasized in recent studies on usability and effectiveness of digital learning systems [5].

## **2. LITERATURE REVIEW**

### **2.1. E-Learning Systems**

E-learning has become a widely adopted approach in modern education and training environments due to its flexibility, accessibility, and ability to support self-paced learning. It enables users to access educational content regardless of time and location constraints, making it particularly suitable for organizations with dynamic operational activities. Several studies have shown that e-learning systems significantly improve learning effectiveness, user engagement, and knowledge retention when compared to conventional learning methods [6], [7], [8]. In addition, the success of e-learning systems is often influenced by factors such as system usability, content quality, and user satisfaction.

### **2.2. Web-Based Learning Technology**

From a technological perspective, the development of e-learning systems is commonly supported by web-based platforms that integrate learning management features, including content delivery, assessment, and progress tracking. Frameworks such as Laravel have been widely used due to their scalability, security features, and ease of development. Previous studies highlight that the use of modern web frameworks can enhance system performance and maintainability, especially in large-scale applications [9]. Moreover, database management systems such as MySQL play a crucial role in managing structured data efficiently and ensuring data integrity in e-learning platforms.

### **2.3. Prototyping Method**

In terms of development methodology, the prototyping approach is frequently used in information system development due to its iterative nature. This method allows developers to build an initial version of the system, gather user feedback, and refine the system through continuous evaluation. Several studies have demonstrated that prototyping is effective in capturing user requirements and improving system usability, particularly in environments where user needs are not fully defined at the beginning of the development process [10], [11]. However, most of these studies focus on academic or commercial systems, with limited application in government institutions.

### **2.4. Security in E-Learning (OTP)**

Security is another critical aspect in the development of e-learning systems, especially when dealing with sensitive organizational data. Authentication mechanisms such as One-Time Password (OTP) have been widely implemented to enhance system security by providing an additional layer of verification beyond traditional username and password authentication. Research indicates that OTP-based authentication can significantly reduce the risk of unauthorized access and improve user trust in digital systems [12]. Despite its effectiveness, the integration of OTP in e-learning systems for government training contexts is still relatively limited.

### **2.5. Previous Research**

Previous research on e-learning system development has demonstrated various approaches and outcomes across different domains. For instance, several studies have implemented web-based e-learning platforms in academic environments, emphasizing usability and student engagement as key success factors. These studies report that well-designed interfaces and interactive content significantly improve user satisfaction and learning effectiveness [13], [14]. In addition, other studies have explored the use of prototyping methods in system development, highlighting their effectiveness in accommodating evolving user requirements and improving system quality through iterative feedback [15].

Furthermore, research on secure systems has investigated the implementation of multi-factor authentication, including OTP mechanisms, to enhance data protection and prevent unauthorized access. These studies confirm that OTP-based authentication provides an additional layer of security without significantly impacting usability [16]. However, most of these implementations are applied in financial systems or general web applications rather than in e-learning environments.

Despite these contributions, previous studies generally focus on stable user environments such as students in formal education or users in commercial systems. There is still limited research that integrates e-learning, prototyping development, and secure authentication mechanisms within the context of high-mobility government personnel. This indicates a research gap that has not been sufficiently addressed in the existing literature.

## 2.6. Research Gap

Although numerous studies have explored e-learning systems from various perspectives, most of them are conducted in formal education settings with relatively stable users. There is still a lack of research focusing on e-learning implementation in organizations with high-mobility personnel, such as government field officers, where flexibility, security, and independent learning are essential requirements. Therefore, this study aims to fill this gap by developing and evaluating a web-based e-learning system specifically designed for the operational characteristics of Surabaya City Public Order Agency personnel.

By synthesizing previous research, it can be concluded that while e-learning technologies, prototyping methods, and security mechanisms have been widely studied, their integration into a unified system tailored for high-mobility government personnel remains underexplored. This study attempts to bridge this gap by combining these elements into a single, context-specific solution.

## 3. RESEARCH METHODS

This study adopts a prototyping-based software development methodology to design and implement a web-based e-learning system tailored for the operational characteristics of Surabaya City Public Order Agency (Satpol PP) personnel. The selection of the prototyping approach is based on its iterative nature, which allows continuous interaction between developers and users, making it suitable for environments where user requirements are dynamic and not fully defined at the early stages of development. This research uses the Prototyping software development method. This method was chosen because of its iterative nature, allowing developers and users to actively interact in evaluating the system before the finalization stage. The research methodology flow consists of several main stages, as seen in Figure 1:

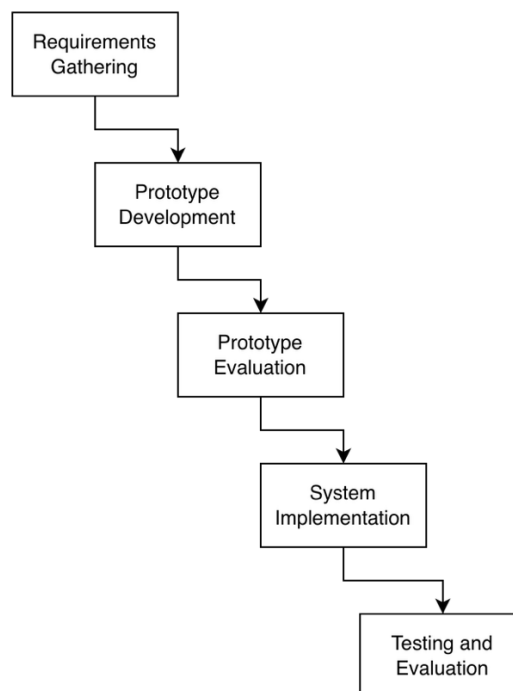


Figure 1. Research Stages

### 3.1. Requirements Gathering

The initial stage was conducted through direct observation and semi-structured interviews with Satpol PP personnel and administrative staff. This process aimed to identify both functional and non-functional requirements. Functional requirements include user authentication, learning material management, quiz and evaluation features, and certificate generation. Non-functional requirements include system security, usability, performance, and accessibility.

### **3.2. Prototype Development**

At this stage, an initial prototype of the system was developed based on the identified requirements. System design was carried out using Unified Modeling Language (UML), including use case diagrams, activity diagrams, and sequence diagrams to represent system behavior and interactions. In addition, database design was developed using Entity Relationship Diagrams (ERD) to ensure structured and efficient data management. A preliminary user interface design was also created to provide a visual representation of system functionality.

### **3.3. Prototype Evaluation**

The developed prototype was then presented to selected users for feedback. This evaluation focuses on system usability, feature relevance, and interface clarity. Feedback obtained from users is used to refine and improve the system design. This iterative process may occur multiple times until the system meets user expectations and operational requirements.

### **3.4. System Implementation**

The validated design was translated into a fully functional system. The system was developed using the PHP programming language with the Laravel framework, while MySQL was used as the database management system. Security features were implemented through the integration of Google reCAPTCHA and a One-Time Password (OTP) mechanism delivered via email to enhance authentication security.

### **3.5. Testing and evaluation**

Functional testing was conducted using the Black Box Testing method to ensure that all system features operate according to the specified requirements. In addition, User Acceptance Testing (UAT) was carried out to evaluate user satisfaction and system usability. The UAT involved 18 respondents from Satpol PP personnel who interacted directly with the system. The evaluation was conducted using a structured questionnaire based on a Likert scale to measure aspects such as ease of use, system functionality, and overall user satisfaction.

To ensure the reliability of the evaluation instrument, internal consistency was assessed using Cronbach's Alpha coefficient. Furthermore, the results of the UAT were analyzed quantitatively by calculating the percentage of user satisfaction scores. This analysis provides an indication of the system's acceptance level and its effectiveness in supporting independent learning for high-mobility personnel.

Through this methodological approach, the study ensures that the developed system is not only functionally correct but also aligned with user needs and supported by measurable evaluation results.

## **4. RESULT AND DISCUSSION**

The results section describes the development of an e-learning system for the Surabaya City Public Order Agency (Satpol PP), from the needs analysis stage to the final testing results. The discussion focuses on the process of transforming agency needs into technical features, implementing a website-based interface, and evaluating functionality and user acceptance. Through a prototyping approach, this development is expected to address the challenges of personnel training amidst high mobility in the field. A detailed explanation of the research results is outlined in the following sub-chapters:

### **4.1. System Development Results**

The development of the e-learning system was carried out using a prototyping approach to ensure alignment between system functionality and user requirements. The system supports two main user roles: administrators and personnel. Administrators are responsible for managing learning materials, quizzes, user data, and system configurations, while personnel access learning materials, complete quizzes, and download certificates upon successful completion.

The system integrates several key features, including secure authentication using Google reCAPTCHA and One-Time Password (OTP), learning material management in multiple formats (PDF, images, and videos), quiz-based evaluation, and automated certificate generation. These features are designed to support flexible and independent learning for high-mobility personnel.

### **4.2. Functionality Testing (Use Case Testing)**

Testing was conducted to ensure each system function ran according to the expected scenario. The following tests were used:

- The method used focused on matching input and output without looking at the program code.
- Results: Of the 36 functions tested (including login, master data management, and quizzes), all were declared successful (100%) and error-free.

Table 1. Summary of Use Case Testing Result

No	Function	Number of features	Test Results	Status (Valid/Not)
1	Autentikasi (Login, reCAPTCHA, OTP)	5	According to the scenario	Valid
2	Master Data & Personnel Management	10	According to the scenario	Valid
3	Material Management (Upload PDF/Video)	8	According to the scenario	Valid
4	Learning and Quiz Features	8	According to the scenario	Valid
5	Digital Certificate Features	5	According to the scenario	Valid
Total		36	Success	100%

Based on the data in Table 1, the results of functional testing conducted on all use case scenarios showed a 100% success rate. This testing proved that the system could execute instructions as designed, from OTP code security validation, material data management by admins, to the quiz process by personnel without any technical obstacles or errors. Thus, the system has been declared to have met the functional requirements criteria for use within the Surabaya City Public Order Agency (Satpol PP).

#### 4.3. User Acceptance Test (UAT)

The UAT was conducted to measure the level of satisfaction and acceptance of end users within the Surabaya City Public Order Agency (Satpol PP). The following are the results of the UAT testing:

- Respondents: 18 Surabaya City Public Order Agency personnel were involved.
- Instrument: A 10-item questionnaire covering aspects of ease of use, appearance, and system usability.
- Data Analysis: The total score obtained was 797 out of a maximum score of 900.

$$P = \left(\frac{797}{900}\right) \times 100\% \approx 88,55\% \tag{1}$$

This resulted in a satisfaction rate of 88.55%.

- Interpretation, with these results, it can be stated that the system is well received and is considered effective in assisting the process of personnel self-training amidst the busy field workload.

Table 2. UAT Scores Results Per Indicator

No	Assessment Indicator	Percentage Score	Actual Score	Maximum
1	Ease of use of the interface	82	90	91,11%
2	Security of login with OTP code	76	90	84,44%
3	Completeness of content	78	90	86,67%
4	Ease of quizzes	80	90	88,89%
5	Clarity of learning materials	79	90	87,78%
6	Ease of quizzes	81	90	90,00%
7	Speed of data and certificate processing	77	90	85,56%
8	Compatibility of digital certificate features	80	90	88,89%
9	Ease of access across devices	81	90	90,00%
10	System benefits for self-paced training	83	90	92,22%
Total		797	900	88,55%

Based on Table II, the test results for 18 respondents showed a total score of 797 out of a maximum of 900. This calculation yielded an average percentage of 88.55%. Referring to the Likert scale criteria, this figure falls into the Strongly Agree/Very Appropriate category, indicating that the e-learning system was very well received by Surabaya City Public Order Agency personnel.

Table 3. UAT Scores Results Per Indicator

Percentage Range	Qualitative Criteria
0%-20%	Strongly Disagree
21%-40%	Disagree
41%-60%	Quite Agree
61%-80%	Agree
81%-100%	strongly agree

Based on the criteria in Table III, the percentage result of 88.55% indicates that the system falls into the "Strongly Agree" category. This result indicates that the system is well-received and considered effective in assisting personnel's independent training process amidst the busy fieldwork.

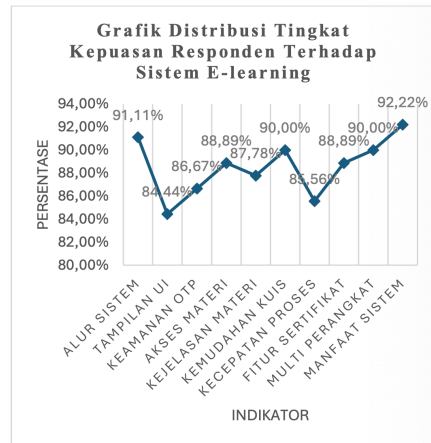


Figure 2. User Acceptance Test (UAT) Results Graph

A visualization of the distribution of respondents' satisfaction levels for the ten e-learning system assessment indicators can be seen in Figure 2. The graph shows that all indicators exceeded the 80% threshold, with the highest score being for the system's usefulness for fieldwork. This confirms that the developed digital solution has strong relevance to the operational needs of Surabaya City Public Order Agency personnel.

#### 4.4. Development Challenges

During the development process, a technical issue was encountered, including an error in the Bootstrap file, which prevented access to certain modules. This issue was successfully resolved through coordination with the Public Order Agency (Satpol PP) IT staff, allowing the system to be fully deployed on the Surabaya Communications and Informatics Agency (Diskominfo) server.

#### 4.5. System Functionality Analysis (Use Case Diagram)

The visualization of the functionality of the Surabaya City Satpol PP e-learning system is explained in the Use Case Diagram attached to Figure 3. The diagram shows the interaction between two main actors, namely the Admin and the Surabaya City Satpol PP Personnel, with the main functions in the system. Both actors can access the Login feature to enter and Logout to exit the system.

Specific functions managed by the Admin include managing personnel, managing admins, managing materials, and managing categories. The Category Management function has an <<include>> relationship with class categories, team categories, and material categories, which means that these specific functions are an integral part of the category management process.

In the role of the Satpol PP Personnel actor, they have access to specific functions to work on quizzes. Based on this interaction structure, the system has been designed with clear access rights boundaries, where the Admin plays a full role in managing content and users, while Personnel focus on the learning evaluation process.

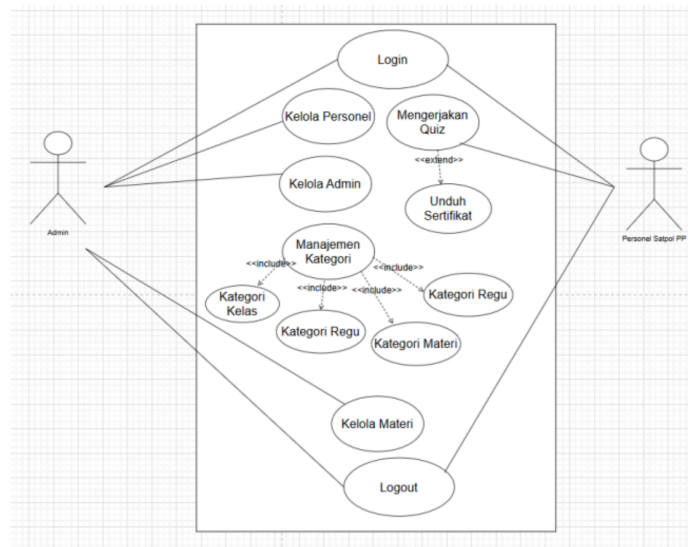


Figure 3. User Case Diagram

Figure 3 displays a use case diagram defining the interaction between users and the e-learning system. There are two main actors, namely the Admin and the Surabaya City Satpol PP Personnel, with different access rights. Both actors share the same basic functions, namely Login and Logout. The Admin's role is crucial in system administration, which includes managing personnel data, fellow admins, and all learning material content. In addition, the Admin has full authority in category management, which includes class classification, teams, and material types, where these three functions are part of a broader category management flow. Meanwhile, the functionality for the Surabaya City Satpol PP Personnel is designed more specifically for evaluation needs, where this actor only has access to take quizzes. The structure of this diagram shows an organized division of tasks between administrators and end users, ensuring good control over the system and training content.

**4.6. Database Modeling (Entity Relationship Diagram)**

In addition to functional design through use cases, the development of this system is also supported by structured database modeling to ensure data integrity. The relationships between entities in the Surabaya City Satpol PP e-learning system database are depicted through the Entity Relationship Diagram (ERD) in Figure 3 below:

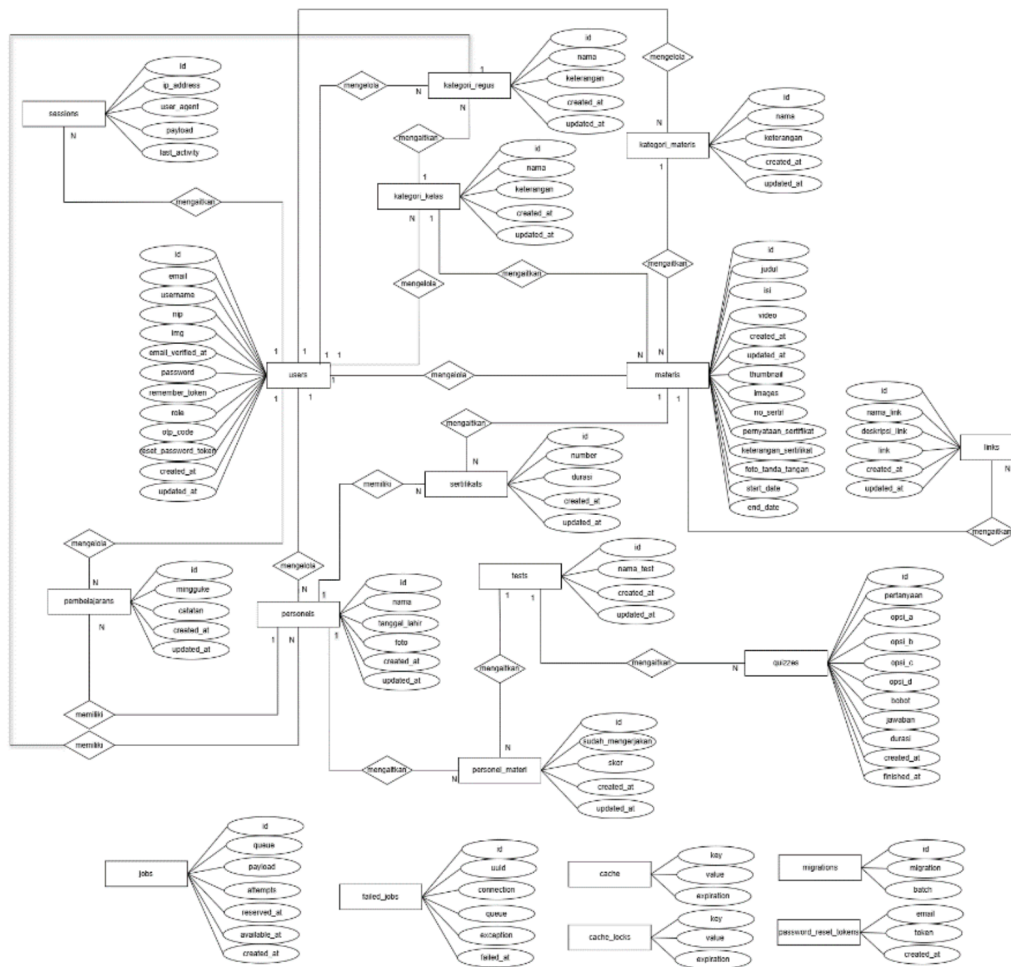


Figure 4. Entity Relationship Diagram (ERD)

The database structure presented in Figure 4 demonstrates the complex yet organized relationships between the main entities in the system. The "users" entity serves as the authentication center, connected to the "personnel" data, to manage individual information for members of the Surabaya City Public Order Agency (Satpol PP). Learning materials are distributed systematically through the linkages between the "category\_material", "team\_category", and "class\_category" entities with the "material" entity, ensuring that each member receives content relevant to their assigned task.

Furthermore, the self-evaluation process is recorded in the "tests" and "quizzes" entities, which are directly connected to the "personel\_material" entity, recording learning progress and scores. This mechanism allows the system to automatically validate personnel eligibility before triggering the issuance of data to the "certificates"

entity. Through the Entity Relationship Diagram (ERD) design integrated into the MySQL database, the system is able to manage large data volumes while maintaining fast access and information security.

#### 4.7. Access Security Implementation (Login & OTP)

Implementing security in the Surabaya City Public Order Agency's e-learning system is a top priority to prevent unauthorized access to personnel data and internal materials. This process is designed with a layered authentication flow that begins with the main login page and continues through real-time identity verification.

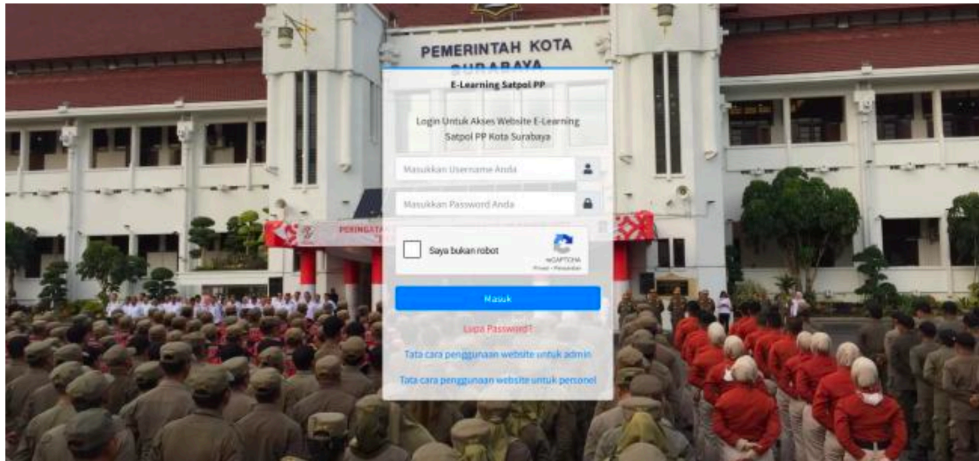


Figure 5. Login Page

In the initial stage, users are required to enter their registered email address and password. To ward off automated attacks or bots, the system integrates Google reCAPTCHA v2 as the first layer of validation. Once the credentials are declared valid, the system does not immediately grant access to the dashboard, but instead triggers the automatic sending of a One-Time Password (OTP) code via SMTP (Simple Mail Transfer Protocol) to the relevant personnel's email address. This unique code has a limited validity of 5 minutes to ensure that access is granted by the legitimate account owner. Through this multi-layered security mechanism, the risk of data leaks due to password theft can be minimized, while also providing a sense of security for personnel in carrying out the digital self-training process.

#### 4.8. Dashboard and Data Management Implementation

The next stage is the implementation of an admin interface designed to simplify the monitoring and management of learning content. This interface serves as the control center for all operational activities of the e-learning system.

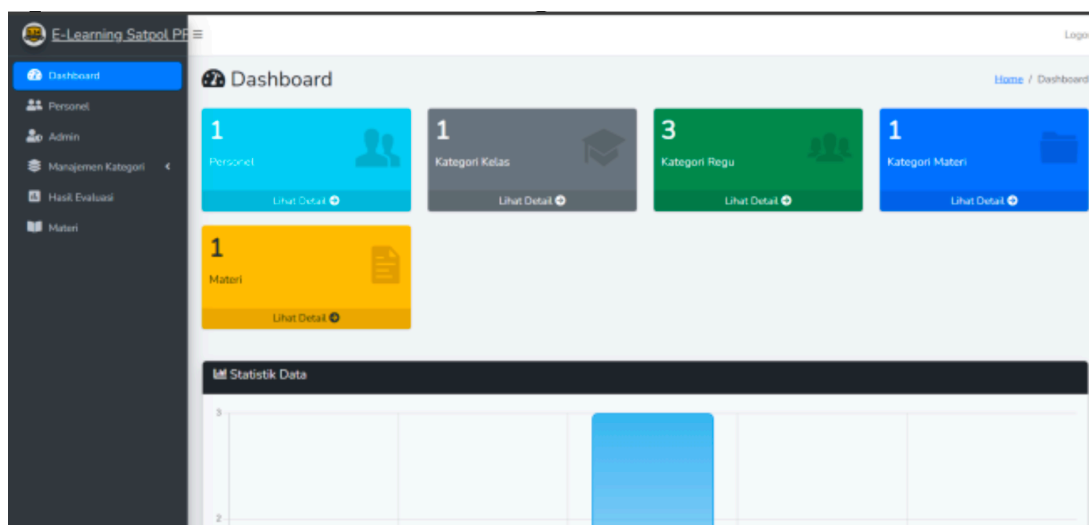


Figure 6. Admin Dashboard Page

The dashboard interface in Figure 6 presents a visual summary of system usage statistics, including the number of active personnel and quiz completion status. In addition to monitoring functions, the system provides comprehensive data management features, one of which is the material management module. Through this interface, administrators can perform Create, Read, Update, and Delete (CRUD) operations on training modules, whether in the form of PDF documents or learning video links. This management system integrates classification based on squad and class categories, ensuring a well-organized distribution of materials. The ease of navigation on this management panel ensures administrators can update training content quickly and accurately to meet the dynamic needs of the Surabaya City Public Order Agency (Satpol PP).

#### 4.9. Learning and Evaluation Interface Implementation

The final part of the interface implementation is the user (personnel) side, which is designed to provide a focused and interactive self-learning experience. This interface includes a list of modules and a learning outcome evaluation process.



Figure 7. Learning Page

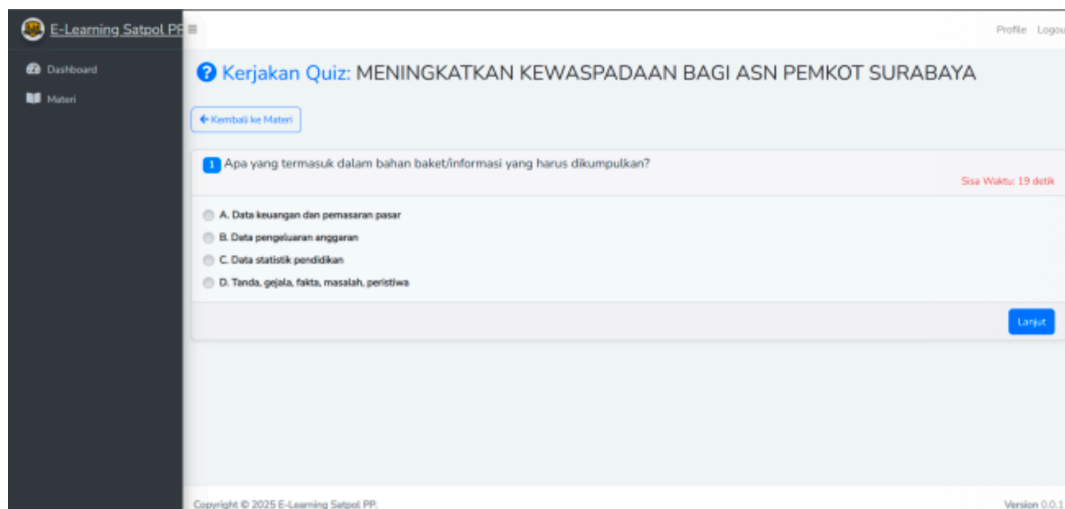


Figure 8. Evaluation Page

The learning interface is designed with a responsive layout so that personnel can access the material across various devices. On the material list page, each module is presented based on each personnel's task unit category to ensure content relevance. After personnel complete the in-depth material stage, the system provides access to a quiz page as an evaluation instrument. This quiz interface features a timer and answer key mechanism to ensure the integrity of the assessment process. The results of this quiz are processed automatically by the system, where the final score will determine whether personnel are entitled to a digital permit certificate or must complete more material. This simple yet functional interface design aims to reduce cognitive barriers so personnel can fully focus on mastering the training material.

#### **4.10. Discussion**

The results of this study indicate that the proposed e-learning system is effective in addressing the challenges of training high-mobility personnel. The high UAT score reflects that users perceive the system as easy to use, secure, and beneficial for their learning needs. This finding is consistent with prior research emphasizing the importance of usability and accessibility in the success of e-learning systems.

One notable aspect of this study is the integration of OTP-based authentication, which enhances system security without significantly affecting usability. This demonstrates that security mechanisms can be effectively incorporated into e-learning systems without compromising user experience.

In addition, the use of the prototyping method allows continuous user involvement during system development, which contributes to the alignment between system features and user needs. This iterative approach is particularly suitable for organizations with dynamic operational conditions, such as government agencies with field personnel.

However, several limitations should be acknowledged. First, the number of respondents involved in the UAT is relatively small, which may limit the generalizability of the findings. Second, the evaluation primarily focuses on user perception and does not include objective performance metrics such as learning outcome improvement. Future studies are recommended to incorporate larger sample sizes and additional evaluation methods, such as System Usability Scale (SUS) or User Experience Questionnaire (UEQ), to obtain more comprehensive results.

Overall, the findings suggest that the developed system not only meets functional requirements but also provides a practical and effective solution for supporting independent learning in high-mobility organizational environments.

### **3. CONCLUSION**

This study developed a web-based e-learning system for the Surabaya City Public Order Agency (Satpol PP) using a prototyping approach to address the challenges of training high-mobility personnel. The system provides flexible access to learning materials, integrated evaluation features, and secure authentication using OTP, ensuring alignment with user needs through iterative development.

The results show that all system functions operate correctly, and the User Acceptance Test (UAT) achieved a satisfaction score of 88.55%, indicating high user acceptance. These findings demonstrate that the system effectively supports independent learning and improves accessibility for personnel with dynamic operational conditions.

This study contributes by proposing an e-learning approach tailored for high-mobility environments, integrating security mechanisms, and providing empirical usability evaluation in a government context. However, the limited number of respondents and focus on subjective evaluation remain constraints. Future research should involve larger samples, apply standardized evaluation methods such as SUS or UEQ, and measure learning outcomes more objectively.

Overall, the developed system offers a practical and effective solution for supporting training activities in high-mobility organizational environments.

### **ACKNOWLEDGEMENTS**

The authors would like to express their sincere gratitude to the Surabaya City Public Order Agency (Satpol PP) for their support, cooperation, and willingness to provide data and participate in the system testing process. The authors also thank the Faculty of Vocational Studies, Universitas Negeri Surabaya, for providing the facilities and academic support necessary to conduct this research.


Appreciation is also extended to all respondents who participated in the User Acceptance Test (UAT), as well as to colleagues and all parties who contributed, either directly or indirectly, to the successful completion of this study.

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