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Development of a web-based training information system for halal product process assistants using rapid application development

Yusrina Mastura[1,*], Dwi Otik Kurniawati[1], Esti Wahyu Widowati[2], Agung Fatwanto[1], Nia Maharani Raharja[1]
[1]Informatics Study Program, Universitas Islam Negeri Sunan Kalijaga Yogyakarta, Yogyakarta 55281, Indonesia
[2]Halal Center, Universitas Islam Negeri Sunan Kalijaga Yogyakarta, Yogyakarta 55281, Indonesia

ABSTRACT

The acceleration of halal certification for micro and small enterprises (MSEs) through the self-declare scheme depends on institutions that train halal product process assistants (PPPH). At the Halal Center of UIN Sunan Kalijaga, PPPH training administration is still spread across Google Forms, WhatsApp groups, a third-party examination platform, and local spreadsheets. This situation causes duplicated participant data, recapitulation errors, and delays in graduation verification. This study developed a web-based training information system that brings the entire PPPH training workflow into one centralized database, from registration to certificate issuance. The system was built using the rapid application development (RAD) method in two prototype iterations reviewed by the training managers. It was then evaluated at three levels. All 20 black-box test cases passed, and all 14 independent paths in five critical modules passed basis path testing. User acceptance testing (UAT) with 44 respondents in the participant role produced an overall mean of 4.47 out of 5.00, which falls in the very good category. The instrument was valid and reliable, with a Cronbach's alpha of 0.931. The lowest score (4.11) concerned occasional system interruptions. These results show that the system works correctly and is accepted by participant-side users within the evaluated scope. Performance testing, administrator acceptance, and quantitative measurement of efficiency still need to be carried out.

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Yusrina Mastura,
Dwi Otik Kurniawati,
Esti Wahyu Widowati,
Agung Fatwanto,
Nia Maharani Raharja

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*Corresponding Author
E-mail address: 22106050046@student.uin-suka.ac.id

1. INTRODUCTION

Indonesia has the largest Muslim population in the world, so the halal status of products is an important part of everyday life. Halal is understood not only as compliance with religious teachings but also as an assurance of quality, safety, and consumer trust [1]. Law No. 33 of 2014 on Halal Product Assurance requires products circulating in Indonesia to be halal certified, which protects Muslim consumers and strengthens the competitiveness of the national halal industry [2]. The Halal Product

Assurance Agency (BPJPH) targeted the certification of ten million products, most of them from micro and small enterprises (MSEs) [3]. One of its main instruments is the self-declare scheme, which allows MSEs to declare the halal status of their products with the guidance of certified assistants [4].

To provide these assistants, BPJPH works with Islamic universities to establish Halal Product Process Assistance Institutions (LP3H) that train Halal Product Process Assistants (PPPH). The Halal Center of UIN Sunan Kalijaga Yogyakarta is one of these partners and is accredited as both a Halal Inspection Institution (LPH) and an LP3H [5], training assistants who guide business actors through the certification process [6]. However, its training administration is still manual and fragmented, even though the number of batches and participants keeps growing. Participants register through a Google Form, record attendance on a different form in each session, and complete another form to apply for a certificate. Schedules and materials are shared through WhatsApp groups, while examination scores are copied manually from a third-party platform into spreadsheets. These separate channels cause duplicated data and recapitulation errors and delay participant verification and certificate issuance, which may reduce the accountability of the LP3H as a strategic partner of BPJPH.

An effective information system collects, processes, and distributes information efficiently to support coordination and decision making [7]. Web-based systems and the Rapid Application Development (RAD) method have been applied to many training, educational, and organizational information systems, but none of them addresses the PPPH training workflow. In this workflow, a certificate may only be issued after the attendance and examination requirements are met and the administrative data required by BPJPH are complete.

Based on these conditions, this study proposes a web-based PPPH training information system developed with the RAD method. Unlike conventional training and learning management systems, which usually handle registration or learning materials separately, the proposed system applies business rules specific to PPPH training: minimum attendance, a minimum examination score, complete bank account data, and one-time certificate issuance with a unique serial number. As a result, graduation decisions and certificates are produced automatically from the data recorded in earlier stages.

This study makes two main contributions. The first is an integrated system that covers the entire PPPH training workflow in one centralized database. The second is a complementary three-level evaluation: functional testing with black-box testing, structural testing with basis path testing of the modules that implement the business rules, and user acceptance testing (UAT) with an instrument tested for validity and reliability. Through this approach, the study aims to support the digital governance of PPPH training at the Halal Center of UIN Sunan Kalijaga.

2. LITERATURE REVIEW

Previous studies have shown that digital systems can improve the efficiency of administrative processes and reduce the recording errors of manual systems. Ruswitasari and Dores applied the PIECES framework to an online job-training registration system and reported more efficient registration services [8]. Ansyari et al. [9] developed a web-based training registration system that gives participants access to training information at any time and helps managers recapitulate registration data. Panyili et al. developed a web-based learning management system to improve learning effectiveness and efficiency [10]. However, these systems handle only one stage of training, namely registration [8,9] or learning delivery [10].

The RAD method has also been widely applied to web-based information systems. Setyati et al. developed a web-based learning course system through prototyping and user involvement, and all of its functions passed black-box testing [11]. Gunadi applied RAD to a previously manual organizational information system and improved the efficiency of data management and information services [12]. Salsabilla et al. [13] used RAD to integrate the management of student, tutor, schedule, and payment data for tutoring administration. In education, RAD was applied by Fitriani et al. [14] to an academic information system, by Sofiati [15] to a school counseling information system, and by Yudahana et al. [16] to a new student admission system that sped up registration and improved data accuracy.

RAD emphasizes a fast, iterative development cycle in which prototypes are evaluated directly by users [17]. Its stages consist of requirements planning, system design through a prototype–test–refine cycle, development, and implementation [17,18]. Systems developed in this way are usually

evaluated through black-box testing and UAT. Black-box testing checks whether each function produces the expected output for valid and invalid inputs without examining the source code [19]. UAT involves end users in assessing whether the system meets their needs and expectations [20]. Table 1 summarizes the RAD-based studies reviewed above.

Table 1. Summary of previous studies.

Title	Method	Results	References
Development of the web-based "Kurteyki" learning course system application using the RAD method	Rapid Application Development (RAD)	The web-based training system was successfully developed and supports online learning effectively.	[11]
Implementation of the rapid application development method in the design and development of a web-based information system using the W3.CSS framework (Case study: POUK Lenteng Agung)	Rapid Application Development (RAD)	The web-based information system improves the efficiency of organizational data management.	[12]
Penerapan metode rapid application development pada pengembangan sistem informasi administrasi Bimbel MEC	Rapid Application Development (RAD)	Tutoring administration becomes more integrated and efficient.	[13]
Application of the rapid application development method in the development of an administrative information system for MEC Tutoring Center	Rapid Application Development (RAD)	The web-based academic system improves the effectiveness of academic information delivery.	[14]
Implementation of the rapid application development (RAD) method in the design of a guidance and counseling information system at SMKN 1 Sijunjung	Rapid Application Development (RAD)	The web-based counseling system improves the efficiency of counseling data management.	[15]
Design of a web-based new student enrollment (PPDB) information system using the rapid application development (RAD) method	Rapid Application Development (RAD)	The PPDB system speeds up registration and improves data accuracy.	[16]
Development of a web-based training information system for halal product process assistants using rapid application development	Rapid Application Development (RAD)	An integrated PPPH training system from registration to certificate issuance, evaluated with black-box, basis path, and UAT.	This study

Two research gaps emerge from this review. First, the training systems in [8-10] support only one stage of training, whereas PPPH training requires a continuous workflow in which the output of one stage becomes the input of the next. Second, the RAD-based systems in [11-16] serve general educational or organizational processes; none of them implements the business rules of PPPH training or verifies the modules that enforce these rules at the level of program paths. This study therefore integrates the entire PPPH training workflow and its business rules into one system and evaluates it at the functional, structural, and user acceptance levels.

3. RESEARCH METHODOLOGY

This study used a research and development approach with the RAD method. RAD was chosen because PPPH training consists of interrelated stages, from participant registration to the issuance of certificates, so the system design had to be validated gradually by the Halal Center through prototypes [17]. The research stages are shown in Figure 1.

In the requirements planning stage, the authors interviewed the training managers of the Halal Center and observed PPPH training sessions to map the workflow from registration to certificate issuance. The findings were formulated as functional and non-functional requirements [17]. In the system

design stage, these requirements were modeled using use case, activity, and class diagrams and an Entity Relationship Diagram (ERD), followed by user interface design. Each prototype was presented to the same training managers, who reviewed every feature against the operational training workflow and the administrative requirements of BPJPH. Their feedback was recorded as revision items. The first iteration implemented all core functional requirements, and the second implemented the revision items from the first; the managers reviewed and approved it before the development stage was completed.

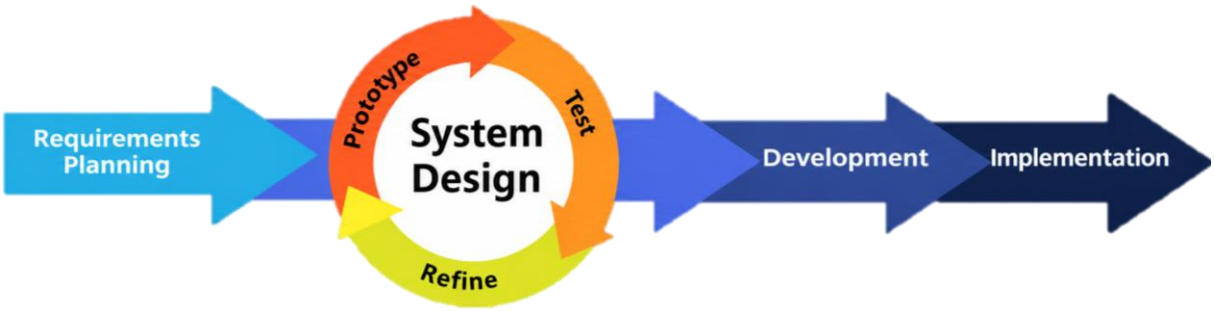


Figure 1. Flow diagram.

In the development stage, the approved design was implemented using Laravel with a Model–View–Controller architecture, Tailwind CSS for the interface, MySQL for the database, and Filament for the administrator panel. These ready-made components are in line with the RAD principle of accelerating system development [18]. The system follows the input–process–output concept shown in Figure 2: data from participants and administrators are processed by the web application according to the training rules and stored in the database, producing training information, scores, graduation status, certificates, and reports.

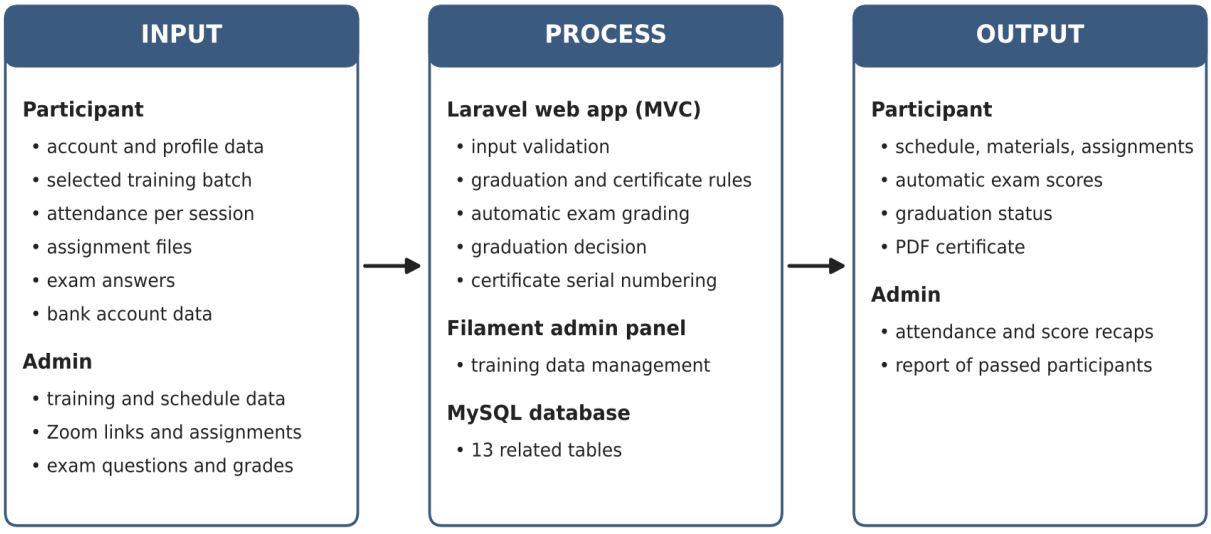


Figure 2. System architecture based on the input–process–output concept.

In the implementation and testing stage, the system was evaluated at three levels. Black-box testing verified that each function produced the expected output for valid and invalid inputs without examining the source code [19]. The 20 test cases were derived from the use case diagram: every participant and administrator use case was mapped to at least one test case covering its main flow, and negative and conditional cases were added for authentication because it receives free input from users. Basis path testing then verified the internal control flow of five critical modules: login, account registration, automatic exam grading, assignment submission, and certificate issuance. The source code of each module was converted into a flow graph, and its cyclomatic complexity was calculated using Equation

(1). In this equation, E is the number of edges and N is the number of nodes. The value of V(G) indicates the number of independent paths that must be executed at least once.

$$V(G) = E - N + 2 \quad (1)$$

UAT measured end-user acceptance [20]. The questionnaire consisted of 17 statements on ease of use, clarity of information, feature effectiveness, reliability, and satisfaction, rated on a Likert scale from 1 (strongly disagree) to 5 (strongly agree). The 44 respondents were prospective users of the system and PPPH assistants who had completed the training. All of them used the system in the participant role, from registration to certificate download, before completing the questionnaire; training managers, who use the administrator role, were not included. Item validity was tested using the Pearson product–moment correlation and reliability using Cronbach's alpha with a threshold of 0.70, both in SPSS. The mean score of each item and the overall mean were interpreted using the categories in Table 2.

Table 2. Interpretation categories of the mean score.

Category	Mean score interval
Very poor	1.00 – 1.79
Poor	1.80 – 2.59
Fair	2.60 – 3.39
Good	3.40 – 4.19
Very good	4.20 – 5.00

The test results at each level were analyzed descriptively, and the training administration workflow before and after implementation was compared qualitatively.

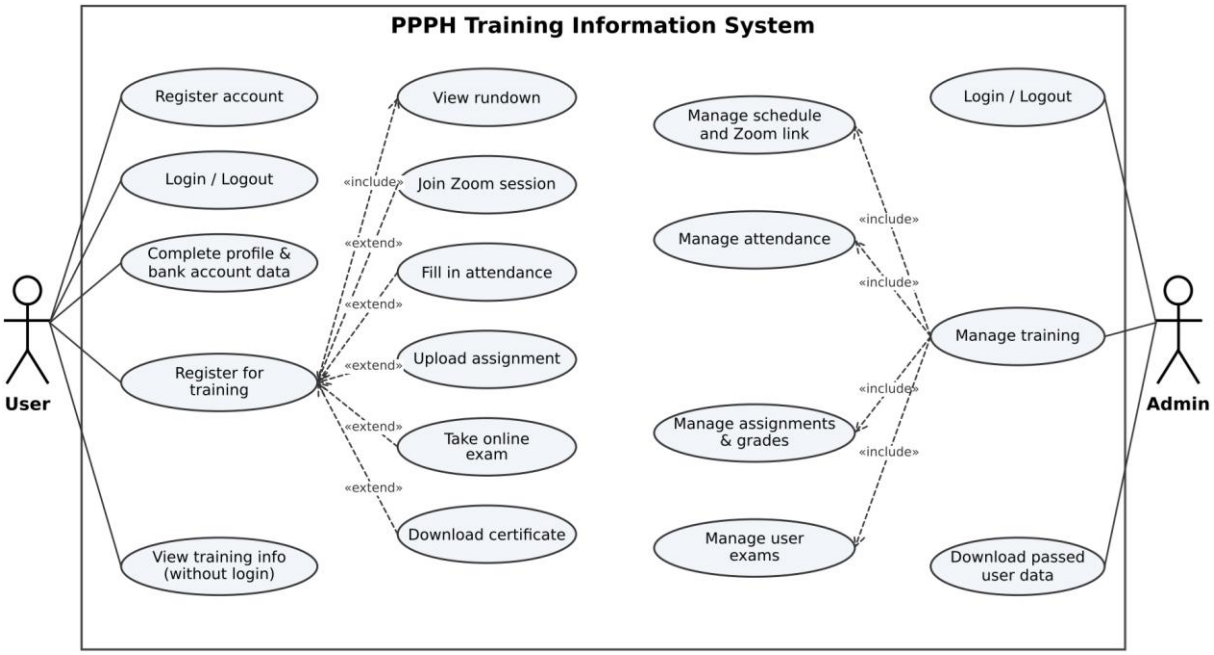


Figure 3. Use case diagram of the PPPH training information system.

4. RESULTS AND DISCUSSIONS

The requirements planning stage showed that registration, scheduling, material distribution, attendance, assignments, and evaluation were handled through different media, so the managers could not monitor participants or manage data centrally. Eleven functional and six non-functional requirements were therefore defined. The functional requirements cover online registration, training data management, attendance, assignments, online examinations, graduation monitoring, and certificate

information. The non-functional requirements cover accessibility, authentication, ease of use, performance, browser compatibility, and data availability. These requirements are modeled in the use case diagram in Figure 3. The User actor represents training participants, and the Admin actor represents the training managers who operate the administrator panel.

Table 3. Results of black-box testing ID Module Test scenario.

ID	Module	Test scenario	Expected result	Status
TC001	Registration	Register a new account with a valid name, email, and password	Account is created and the user is redirected to the login page	Pass
TC002	Registration	Register with an email that is already registered	Registration is rejected with a duplicate-email message	Pass
TC003	Login	Log in with valid credentials and an incomplete profile	User is logged in and redirected to complete the profile	Pass
TC004	Login	Log in with valid credentials and a complete profile	User is logged in and redirected to the training list	Pass
TC005	Login	Log in with a wrong password	An “incorrect email or password” message is displayed	Pass
TC006	Profile	Complete profile data (national ID number, WhatsApp number, address)	Data are saved and the profile is marked as complete	Pass
TC007	Profile	Upload a profile photo (.jpg/.png)	Photo is updated and displayed on the account page	Pass
TC008	Profile	Change the account password	Password is updated and can be used to log in	Pass
TC009	Enrollment	Enroll in an active training batch	Enrollment is recorded and a confirmation is shown	Pass
TC010	Attendance	Click the attendance button during an open session	Attendance is recorded and a notification is shown	Pass
TC011	Assignment	Download the assignment from the administrator	File is downloaded in the correct format	Pass
TC012	Assignment	Upload an assignment answer file	File is submitted and stored for grading	Pass
TC013	Exam	Answer and submit the exam questions	Answers are saved and the score is displayed automatically	Pass
TC014	Certificate	Download the graduation certificate	A PDF certificate with the participant’s name is generated	Pass
TC015	Admin panel	Log in with an administrator account	Administrator is redirected to the admin dashboard	Pass
TC016	Training	Add or edit training data	New training appears on the home page and can be selected	Pass
TC017	Schedule	Set the session date and Zoom link	Schedule is updated and visible to participants	Pass
TC018	Exam	Create multiple-choice exam questions	Questions are saved and displayed during the exam	Pass
TC019	Report	Export participant data	An Excel file of participants who passed is downloaded	Pass
TC020	Logout	Click the logout button	Session ends and the user returns to the home page	Pass

The managers' review of the first prototype produced three revision items, which were implemented in the second iteration. First, a bank account entity was linked to participant data; bank details must be complete before a certificate can be downloaded so that BPJPH can pay the assistants' honoraria directly. Second, the data export feature was restricted to participants who passed, so that it can serve directly as the final report. Third, public visitors can view training information without logging

in. None of these items emerged in the initial interviews, which shows that the RAD prototyping cycle can capture requirements that have not been formally documented.

The PPPH training information system was successfully implemented as a web application with 13 related database tables. Participant data are entered once and reused in later stages. Examinations are graded automatically on submission. A certificate can only be generated when the participant has an exam score of at least 50 and has attended at least three sessions. Once these requirements are met, the system assigns a unique serial number and produces the certificate in PDF format.

The results of the 20 black-box test cases are presented in Table 3. Fourteen cases test participant functions (TC001–TC014), five test administrator functions (TC015–TC019), and one tests logout. All cases passed (100%). In the negative cases TC002 and TC005, the system rejected the input and displayed the appropriate message. In the conditional case TC003, the participant was redirected to complete the profile first.

These results show that the implemented functions behave as specified, although they do not measure the efficiency gained by the institution. The internal logic of the critical modules was then examined through basis path testing, as summarized in Table 4.

Table 4. Results of basis path testing.

Module	E	N	V(G)	Independent paths tested	Result
Login	9	8	3	(1) wrong email or password → error message; (2) valid credentials, incomplete profile → redirect to the account page; (3) valid credentials, complete profile → redirect to the training page	3/3 valid
Account registration	7	7	2	(1) email already used or password shorter than 8 characters → rejected with validation error; (2) valid data → password hashed, account stored, redirect to login	2/2 valid
Automatic exam grading	8	8	2	(1) submission without any answer → score 0 without error; (2) answers matched with the key in a loop → percentage score (0–100) stored	2/2 valid
Assignment submission	10	9	3	(1) file larger than 10 MB → rejected; (2) deadline has passed → rejected; (3) valid file before the deadline → stored with a unique name	3/3 valid
Certificate issuance	12	10	4	(1) certificate already issued → blocked; (2) graduation criteria not met → blocked; (3) incomplete identity form → validation error; (4) eligible participant → unique serial number and PDF generated	4/4 valid
Total			14		14/14 valid

The cyclomatic complexity of the five modules ranges from 2 to 4, and all 14 independent paths produced the expected output. The certificate issuance module has the highest complexity (V(G) = 4) because it contains the most decision points: the duplicate certificate check, the graduation check, and the identity data validation. All four paths are valid, so requests for duplicate certificates or from participants who have not passed are always rejected, even when the certificate URL is accessed directly.

For the UAT, the critical value of r for n = 44 at a 5% significance level is 0.297. Table 5 shows that the correlation coefficients of all items range from 0.487 to 0.842, so all 17 items are valid. A Cronbach's alpha of 0.931 indicates very high internal consistency.

Table 5. Validity and mean scores of the user acceptance testing.

Statement	r-value	Total score	Mean	Category
The website is easy to learn for new users	0.736	193	4.39	Very good
The interface is easy to understand and not confusing	0.742	196	4.45	Very good
Information and text on the website are easy to read and understand	0.740	199	4.52	Very good
Menus and features are clearly organized	0.739	192	4.36	Very good
I can use the website without help from others	0.487	196	4.45	Very good
Account registration and login run smoothly	0.800	199	4.52	Very good
I can easily enroll in the available training	0.748	199	4.52	Very good
The attendance feature works well	0.842	201	4.57	Very good
The assignment upload feature works without errors	0.773	197	4.48	Very good
Exam questions are displayed properly and the score is shown after the exam	0.728	199	4.52	Very good
The website helps me understand and follow the PPPH training stages	0.605	194	4.41	Very good
During testing, the website rarely experienced errors or disruptions	0.683	181	4.11	Good
The system responds every time I press a button or menu	0.742	194	4.41	Very good
The data I enter are stored securely and are not lost	0.720	206	4.68	Very good
I am satisfied with the PPPH training information system	0.734	195	4.43	Very good
The system improves my experience as a training participant	0.507	201	4.57	Very good
The system is feasible for use by training participants	0.543	199	4.52	Very good
Overall		3,341	4.47	Very good

Sixteen of the 17 items fall in the very good category, and the overall mean is 4.47 (Figure 4). The highest score was obtained by item 14 on the security of stored data (4.68), followed by item 8 on attendance and item 16 on the training experience (4.57 each).

Figure 4 also shows that item 12, which states that the website rarely experienced errors or interruptions, has the largest share of neutral and negative responses and the lowest score of 4.11 (good). Some respondents therefore experienced interruptions during the trial, even though all functions passed black-box and basis path testing. Their cause was not investigated because this study did not include performance or load testing. In addition, all respondents used the participant role, so these results represent participant-side acceptance only.

Table 6 qualitatively compares PPPH training administration before and after the system was implemented; processing time and error rates were not measured.

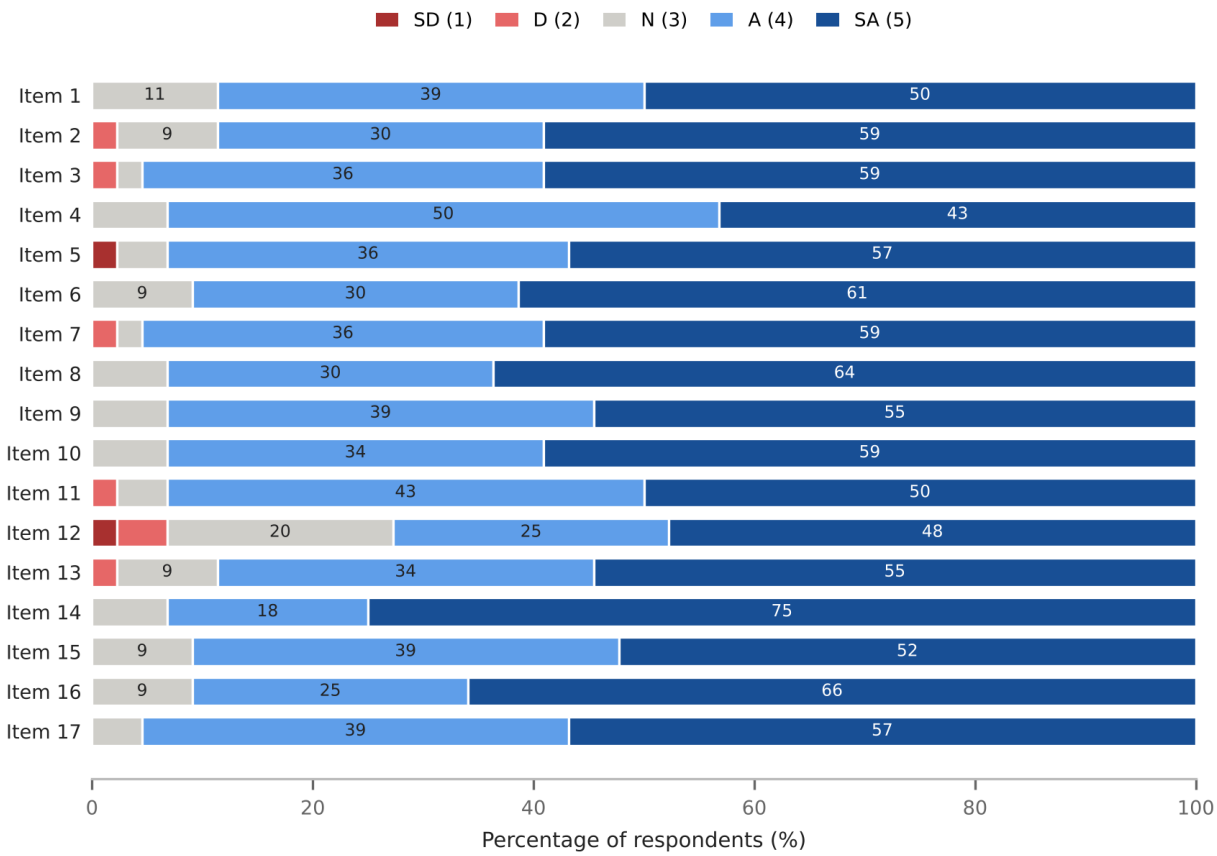


Figure 4. Distribution of UAT responses for each item (%).

Table 6. Comparison of training administration before and after system implementation.

Aspect	Previous process (manual)	Developed system
Registration	Participants fill in a Google Form; data are often duplicated	Participants register directly in the system and data are stored in the database
Schedule and materials	PDF schedules and materials are shared in WhatsApp groups and are hard to trace	Schedules and materials are organized per module on the participant dashboard
Attendance	A different form link is used in each session, prone to duplication and missed recaps	Attendance is integrated with the schedule and recapitulated automatically
Examination	A third-party platform is used and scores are copied manually	A built-in CBT grades automatically and stores the scores in the database
Certificate	Participants fill in another form to claim the certificate	Certificates are generated automatically for eligible participants after they enter their bank details
Data storage	Data are spread across several local Excel files with a high risk of loss	All data are stored in a centralized relational database (MySQL)

Centralized data management changes the governance of PPPH training in three ways. First, all records of a participant, from registration to the certificate, are linked in one database, so the managers work from a single data source instead of reconciling several forms and spreadsheets. Second, graduation decisions follow the same rules for every participant, and each certificate carries a unique serial number that can be traced to its attendance and examination records. Third, the list of partici-

pants who passed can be exported directly as the final report for BPJPH. Because training data are organized per batch, a new batch can be opened without changing the system, and other LP3H institutions with a similar workflow could adopt the same data model and rules.

Despite these results, this study has four limitations. First, the efficiency improvement is based on a qualitative comparison of workflows, not on measured processing time or error rates. Second, no performance or load testing was conducted, so the behavior of the system under many simultaneous users is unknown and the interruptions reported in item 12 have not been diagnosed. Third, administrator-side acceptance was not measured because the UAT respondents used only the participant role. Fourth, the system was developed and evaluated at only one institution, so its scalability to larger cohorts and other LP3H institutions has not been tested.

Overall, the main advantage of the system lies in making graduation decisions and issuing certificates automatically from the data recorded during the training, rather than by manually reconciling separate forms and spreadsheets.

5. CONCLUSION

This study developed a web-based PPPH training information system for the Halal Center of UIN Sunan Kalijaga using the RAD method in two prototype iterations. Its contribution is the integration of the entire PPPH training workflow with graduation and certification rules that run automatically in one centralized database, evaluated at three complementary levels.

All 20 black-box test cases and all 14 independent paths in the five critical modules passed. UAT with 44 participant-side respondents produced an overall mean of 4.47 (very good) using a valid and reliable instrument, with the lowest score (4.11) on system interruptions. The system therefore works correctly, the logic of its critical modules is valid, and it is accepted by participant-side users within the evaluated scope. However, the results do not yet demonstrate measured efficiency gains, performance under heavy load, administrator acceptance, or suitability for other institutions.

Future work should include performance and load testing, UAT with administrators, and quantitative measurement of processing time and error rates before and after implementation. Planned feature developments include integration with BPJPH's SIHALAL system, automatic notifications via WhatsApp or email, resubmission of assignment files before the deadline, question randomization with a question bank, and an in-panel preview of submitted documents.

AUTHOR CONTRIBUTIONS

Yusrina Mastura: Investigation, requirements analysis, software development, system testing, data curation, visualization, and writing—original draft. Dwi Otik Kurniawati: Methodology, supervision, validation, and writing—review and editing. Esti Wahyu Widowati: Training workflow clarification, user requirements identification, and prototype review. Agung Fatwanto: Conceptualization, methodological review, and evaluation of system design. Nia Maharani Raharja: Testing methodology review, interpretation of user acceptance results, and writing—review and editing. All authors contributed to manuscript revision and approved the final version.

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This research received no external funding.

DECLARATION OF AI USE

The authors declare that no AI tools were used in preparing this manuscript.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

All data supporting this study are included in the article. No separate datasets are available.

ETHICAL APPROVAL

Ethical approval was unnecessary, as no humans or animals were involved.

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