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Development of a Web-Based Academic Legalization System (E-Legalization) to Enhance Inclusive Academic Services in Support of SDGs 9 and 10

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E-Legalization,
Inclusive Services,
Digital Accessibility,
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ABSTRACT

Diploma and academic transcript legalization in higher education institutions remains largely manual, obliging alumni to visit campus on multiple occasions to submit requests and retrieve certified documents. Such conventional procedures generate considerable inefficiencies in time and expenditure, poor process transparency, and unequal access to academic administrative services, with the burden falling disproportionately on alumni who live far from campus, hold full-time jobs, or have mobility limitations. A web-based academic legalization system (E-Legalization) was developed to address these shortcomings by enabling online legalization requests, real-time process monitoring, and flexible document collection or delivery options. Development followed the Waterfall methodology, progressing through requirements analysis, system design, implementation, testing, and maintenance. System reliability was verified through Black Box Testing, which assessed whether each function produced outputs consistent with user requirements. The E-Legalization system proved capable of delivering a more efficient, transparent, and accessible legalization process: physical campus visits were substantially reduced, and applicants could track their requests independently through an online interface. The incorporation of UserWay accessibility features extended usability to individuals with diverse backgrounds and special needs, including those with disabilities and mobility constraints. What distinguishes this research from prior work is its integration of accessibility-oriented digital services within an academic legalization platform, rather than treating accessibility as an afterthought to process automation. The system contributes to strengthening digital educational infrastructure in alignment with SDGs 9 and to reducing inequalities in access to academic administrative services in alignment with SDGs 10.

INTRODUCTION

Digital transformation has become a strategic priority for higher education institutions, reaching well beyond teaching and learning to reshape how administrative services are delivered. Electronic services (e-services) have proven effective at cutting operational overheads, simplifying bureaucratic procedures, and extending access to academic services across geographical distances (Kalua et al., 2024). As universities deepen their engagement with digital tools, expectations for accessible, transparent, and user-centered administrative systems have grown correspondingly. Diploma and academic transcript legalization stands out among these services: graduates routinely need certified copies for employment applications, professional licensing bodies, postgraduate admission, and academic exchange programs.

Despite the pace of digital adoption in higher education more broadly, diploma and academic transcript legalization in many institutions remains tied to physical procedures that require applicants to visit campus in person for both submission and retrieval

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(Rofiah & Hermin Indiyah, n.d.). These procedures typically add cost and time, reduce service accessibility, and place the greatest burden on alumni who reside far from campus, hold full-time jobs, or experience mobility constraints (Permadi et al., 2025). These conditions expose a persistent gap between the efficiency gains that digital transformation promises and what academic administrative offices actually deliver to their alumni.

Existing scholarship on web-based academic legalization systems covers several dimensions of service improvement. Online document submission paired with electronic data management has been shown to lessen reliance on manual workflows that are prone to delays and clerical errors (Mohammad Mushfiqul Haque Mukit et al., 2025). Real-time tracking has been reported to strengthen service transparency by giving applicants reliable visibility into the status of their requests throughout the process (James, 2025). On the security side, digital verification mechanisms are increasingly applied to guarantee the authenticity and integrity of academic documents (Lebopa et al., 2025). Blockchain technology has been proposed as a particularly robust method of preventing document manipulation through tamper-resistant record management (Raghuvanshi, 2025). Distributed data architectures can further reduce the vulnerabilities inherent in centralized storage systems (Nanda Sari & Gelar, 2025). Decentralized identity approaches have also attracted interest for their potential to improve interoperability and protect user privacy across institutions (Berrios Moya & Ayoade, 2024).

Technical solutions alone do not determine whether online legalization services succeed; regulatory conditions and user perceptions play equally important roles. The governance framework for electronic academic document legalization still calls for more comprehensive compliance mechanisms to ensure legitimacy and accountability (Nowira & Mochamad Zairul Alam, 2023). User willingness to engage with digital legalization systems depends heavily on perceived transparency, service accessibility, ease of use, and overall reliability (Mahatara & Bhandari, 2025). Well-organized service information and intuitive interfaces have also been identified as factors that shape user trust and satisfaction (Yi et al., 2025).

What is striking about the existing body of work is how narrowly most systems are conceived. Prior developments concentrate predominantly on process automation, operational efficiency, and document security (Arif, 2023). Another strand of work addresses system integration and digital service delivery mechanisms (Candra et al., 2025). Yet another thread concentrates specifically on technological approaches to document verification and authenticity assurance (Rustemi et al., 2023). Notably absent from these developments is any sustained attention to inclusive service principles that guarantee equal access regardless of a user's academic background, geographical location, employment status, mobility condition, or disability. This omission matters: digital transformation in academic administration should widen access, not simply speed up existing workflows.

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Responding to this gap, the present work develops a web-based academic legalization system (E-Legalization) that combines digital service efficiency with inclusive accessibility principles. UserWay accessibility features are embedded within the system to support users with diverse needs, including those with disabilities. The distinctive contribution of this work lies in treating accessibility not as a supplementary feature but as a core design requirement, extending the scope of digital academic services beyond process automation toward genuinely inclusive delivery. The primary objectives are to develop and evaluate E-Legalization in terms of efficiency, transparency, and inclusiveness in academic administrative services while advancing SDG 9 through digital infrastructure development and SDG 10 by reducing inequalities in access to academic administrative services.

RESEARCH METHOD

A Research and Development (R&D) approach was used to build the web-based academic legalization system (E-Legalization). The intended outcome was a platform capable of supporting efficient, transparent, and inclusive academic administrative services through online legalization requests, real-time process monitoring, and flexible document retrieval or delivery. Development followed the Waterfall software development model, which provides a sequential, phase-gated framework encompassing requirements analysis, system design, implementation, testing, and maintenance (Rao et al., 2025). This model suits information system development projects where requirements are relatively stable, as it imposes clear documentation standards and controlled procedures at each stage (Olabiyi, 2023).

Requirements Analysis.

Data collection drew on direct observation of current legalization workflows, interviews with alumni as end users and administrative staff as system operators, and review of the literature on web-based academic service systems (Simanullang et al., 2024). The phase sought to identify functional requirements, covering online legalization submission, document upload, status tracking, and administrative management, alongside non-functional requirements for security, usability, and accessibility.

System Design.

The identified requirements were converted into technical models comprising use case diagrams, database structures, process flow designs, and user interface prototypes. Accessibility was a primary concern throughout this stage: UserWay features including text adjustment, contrast enhancement, keyboard navigation, and screen-reader support were built into the design to enable equal access for users with varying backgrounds and abilities.

System Implementation.

where designed modules were converted into executable program code. Core functionalities built at this stage included user authentication, legalization submission, document verification, process monitoring, and administrative management. The

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accessibility features established during system design were also integrated into the interface at this point.

System Testing.

System testing used the Black Box Testing method, which evaluates functionality by examining input-output behavior without inspecting the internal source code structure (Salih & Saefullah, 2024). Tests covered all major system functions, including document submission, document upload, status tracking, and administrative operations. Black Box Testing has been shown to be effective at identifying functional errors and improving the quality of web-based applications prior to deployment (Farhani et al., 2025). Accessibility testing was also carried out to confirm that each UserWay feature functioned correctly across a range of user scenarios involving different accessibility needs.

Deployment and Maintenance.

Once the system satisfied both functional and accessibility requirements, it was deployed for operational use. Ongoing maintenance addresses potential errors, accommodates technological changes, and preserves the effectiveness of the accessibility features over time. These activities are essential for sustaining the quality of digital academic services and ensuring continued inclusive access for all user groups.

The overall research methodology based on the Waterfall development model is illustrated in Figure 1.

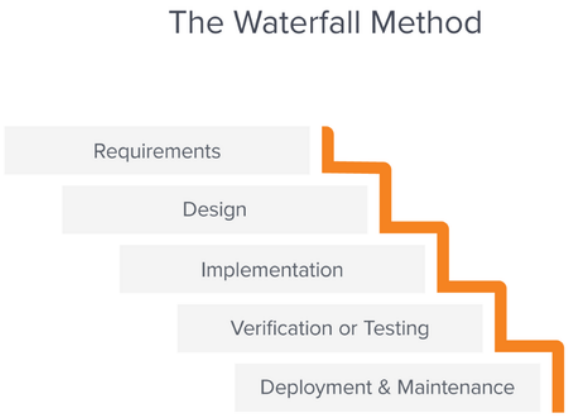


Figure 1. Waterfall Method

RESULTS AND DISCUSSION

A. Requirement Analysis

Requirement analysis revealed several shortcomings in the existing diploma and academic transcript legalization workflow. Under current arrangements, alumni must visit campus on multiple occasions for both document submission and collection, generating avoidable costs and delays. The impact is most pronounced among alumni living outside the immediate campus area, those working full-time, and those with

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mobility limitations. On the administrative side, manual processing creates higher workloads, complicates document tracking, and makes service data difficult to manage systematically.

Interviews and observations consistently pointed toward the same set of user expectations: a fully online legalization service covering document submission, real-time status monitoring, and flexible delivery options. Accessibility also emerged as an important non-functional requirement, reflecting the need to guarantee equal service access for users across a range of backgrounds and abilities. These findings collectively defined the development scope for the E-Legalization system. The detailed mapping of identified problems, user requirements, and corresponding system design implications is presented in Table 1.

Table 1. Analysis of Problems, User Requirements, and Implications for E-Legalization System Design

Problem Aspect	Main Problem (Existing Condition)	User Requirements	Implications for E-Legalization System Design
Service Accessibility	The legalization process requires alumni to physically visit the campus during both submission and document collection stages.	A legalization service that can be accessed anytime and anywhere without physical presence.	The system is designed as a web-based platform with a 100% online legalization mechanism (Zero Physical Contact) through digital document uploads.
Time and Cost Efficiency	Alumni must make repeated campus visits, resulting in increased time and financial costs.	A fast, simple, and efficient service process that minimizes face-to-face interactions.	Automation of the legalization workflow, covering submission, verification, and document completion in an integrated process.
Process Transparency	Alumni have limited information regarding the progress and completion status of their legalization requests.	Clear and accessible information regarding document status that can be monitored independently.	Provision of a real-time legalization tracking feature to improve service transparency.
Service Flexibility	Documents can only be collected directly from the campus.	Flexible document collection methods based on user needs and circumstances.	Integration of self-collection and courier delivery options to provide greater service flexibility.

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Administrative Workload	Legalization data are managed manually and separately.	A system that facilitates data management and document verification for administrative staff.	A centralized administrative dashboard for request management, document verification, and service reporting.
Service Accessibility for Users with Disabilities	Existing services are not fully accessible for users with mobility limitations or disabilities.	Equal access to services for all users.	Integration of web accessibility features (e.g., UserWay) to support inclusive digital services.
Document Security	Manual processes increase the risk of document loss or manipulation.	Assurance of document authenticity and security.	Implementation of validation mechanisms, access control, and digital record management to maintain document integrity.
Service Quality	User satisfaction is reduced due to uncertainty and service limitations.	Responsive, transparent, and user-friendly services.	Development of a user-centered interface to enhance service experience and satisfaction.

B. System Design

Drawing on the identified requirements, the E-Legalization system was designed as a web-based platform capable of handling the full legalization workflow from start to finish. The design covers online submission, document verification, status tracking, and delivery management. Functional requirements were modeled using use case diagrams, with alumni and administrators serving as the two primary actors.

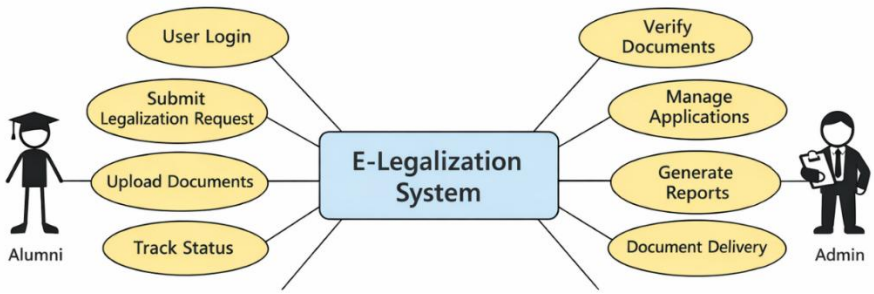


Figure 2. *Use Case Diagram*

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The database was structured to handle user information, legalization requests, academic documents, process status records, and service history. The user interface was developed according to responsive design principles to support access from both desktop and mobile devices. UserWay features, covering text resizing, contrast adjustment, keyboard navigation, and screen-reader support, were embedded to meet the accessibility requirements established during analysis.

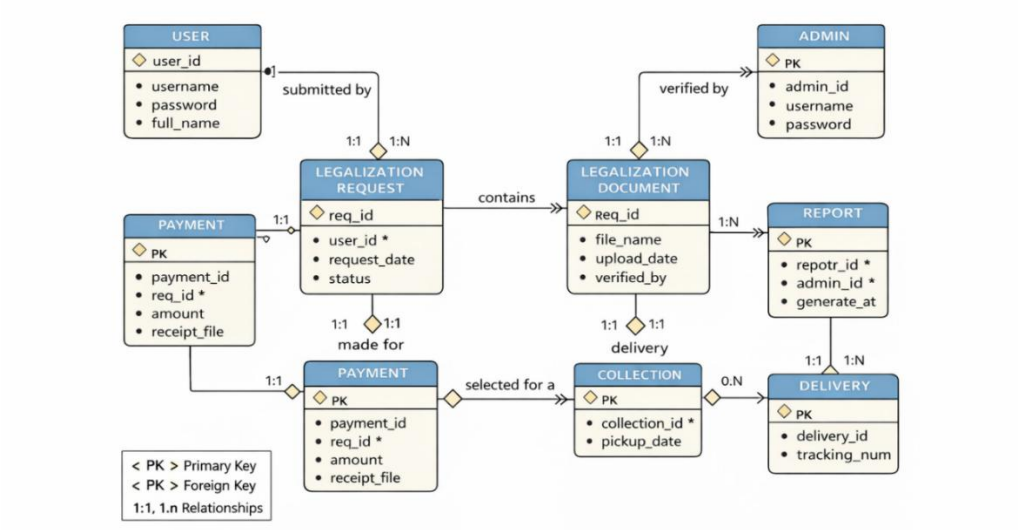


Figure 3. *Entity Relationship Diagram (ERD)*

C. System Implementation

Implementation produced a working E-Legalization application ready for digital academic legalization services. The system comprises modules for user authentication, online legalization requests, document upload, document verification, status monitoring, and administrative management.

A distinguishing feature of the implementation is the integration of UserWay accessibility tools. These tools allow users with varying accessibility requirements to engage with the system more independently and comfortably. The result is a platform that goes beyond administrative digitalization to actively support inclusive service delivery.

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Table 2. Implementation of E-Legalization System Modules and Their Contributions to the SDGs

System Module	Main Function	Technical Implementation	SDG Contribution
User Authentication	Validation of alumni and administrator identities	Login using registered user accounts	**SDG 9** – Reliable digital infrastructure
Online Legalization Request	Submission of legalization requests without physical presence	Online forms and document upload functionality	**SDGs 9 & 10** – Service digitalization and equitable access
Document Verification	Verification of document authenticity and validity	Centralized administrator dashboard	**SDG 9** – Improved administrative efficiency
Status Tracking	Transparency of the legalization process	Real-time status updates through the system	**SDG 10** – Reduction of information asymmetry
Service Data Management	Management and reporting of legalization records	Integrated cloud-based database system	**SDG 9** – Strengthening information technology infrastructure
Flexible Document Collection	Options for self-collection or document delivery	Integration with document delivery workflows	**SDG 10** – Service accessibility regardless of location
Accessibility Features (UserWay)	Support for users with disabilities	Text adjustment, contrast settings, keyboard navigation, and screen-reader support	**SDG 10** – Inclusive service provision
Cloud Infrastructure	System availability and scalability	Cloud hosting and server management	**SDG 9** – Sustainable digital infrastructure

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The implemented interfaces span login pages, legalization request forms, document upload modules, tracking dashboards, administrative management pages, and accessibility controls embedded directly within the system interface.

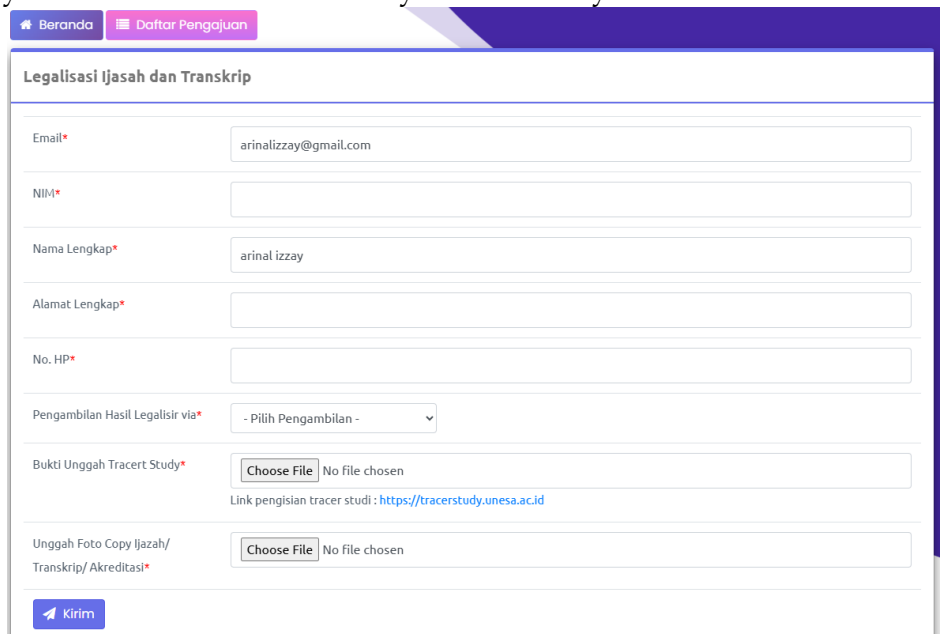


Figure 4. E-Legalization Application Form

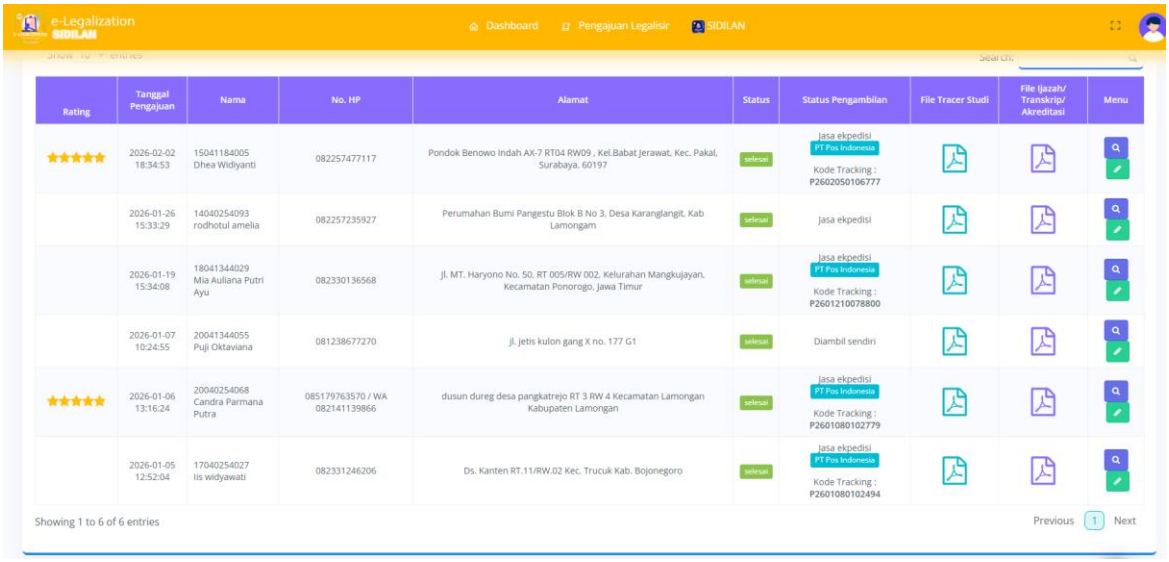


Figure 5. E-Legalization Application Data

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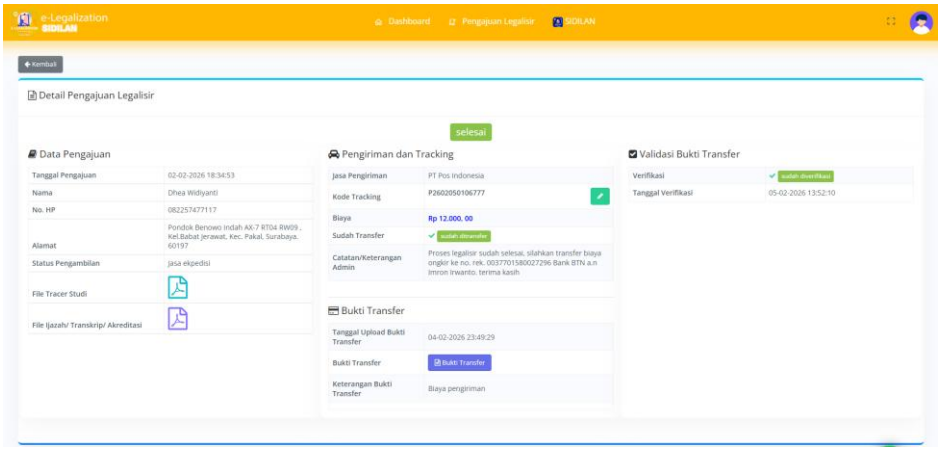


Figure 6. Legalization Application Details

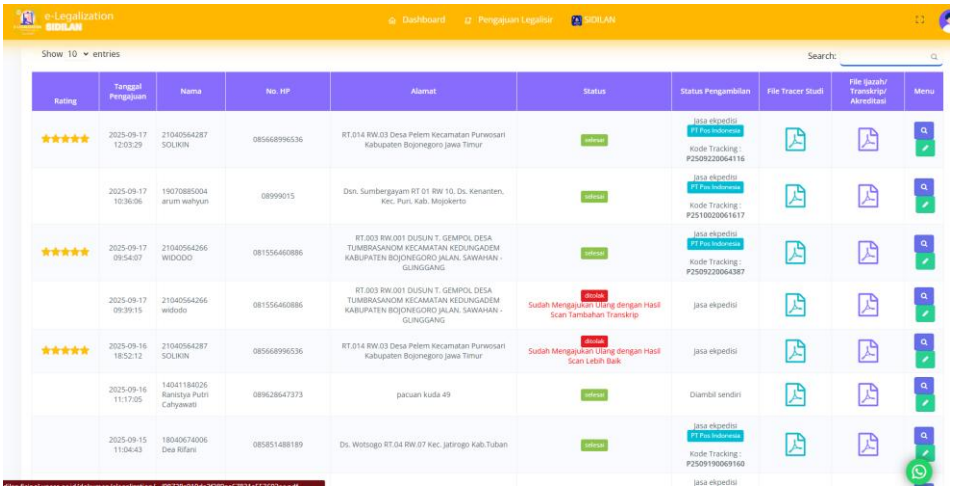


Figure 7. Verification of E-Legalization Application

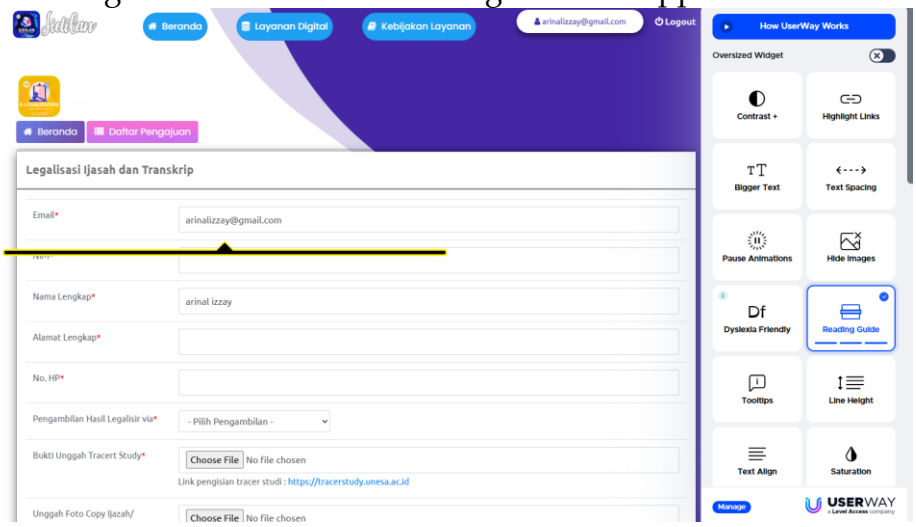


Figure 8. Reading Guide Feature for Disabilities

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D. System Testing

Black Box Testing was applied to verify that each function performed in accordance with its intended specifications. The testing scope encompassed user authentication, legalization submission, document upload, payment verification, status tracking, delivery selection, administrative verification, and accessibility functions.

All tested functions performed successfully. Valid inputs were processed correctly, invalid data were rejected, records were stored accurately, and process status updates were applied automatically. Accessibility testing confirmed that the UserWay features operated as intended across the range of tested user scenarios. Full testing results are presented in Table 3.

Table 3. Black Box Testing Results of the E-Legalization System

No.	Test Scenario	Input Provided	Expected Output	Status
1	Alumni Login	Valid username and password	System displays the alumni dashboard	Successful
2	Alumni Login	Invalid username or password	System displays an error message	Successful
3	Legalization Request Submission	Complete request data	Data are saved and the status is updated to "Submitted"	Successful
4	Legalization Request Submission	Incomplete request data	System displays a validation warning	Successful
5	Document Upload	Diploma and transcript files in the correct format	Documents are uploaded successfully	Successful
6	Document Upload	Unsupported file format	System rejects the uploaded file	Successful
7	Payment Proof Upload	Valid payment proof file	Payment proof is stored successfully	Successful
8	Status Tracking	Submitted legalization request	Real-time process status is displayed	Successful
9	Document Collection Method Selection	"Collect at Faculty" option selected	Collection method is recorded successfully	Successful
10	Document Collection Method Selection	"Courier Delivery" option selected with delivery address	Delivery information is stored successfully	Successful
11	Administrator Verification	Valid document	Status changes to "Approved"	Successful
12	Accessibility User Interface Testing	UserWay accessibility feature activated	Interface display and navigation are adjusted accordingly	Successful

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E. System Evaluation and Discussion

Overall, the evaluation confirms that the E-Legalization system meets the functional and non-functional requirements identified during the analysis stage. Online legalization requests and digital document management minimize physical visits, support zero-physical-contact services, and improve operational efficiency.

Real-time tracking enhances transparency by allowing applicants to monitor request progress independently, reducing uncertainty and the need to contact administrative staff. Meanwhile, the centralized management interface enables administrators to oversee and monitor service operations more effectively.

A key achievement is the integration of accessibility features into the academic legalization platform. These features support users with different levels of digital literacy and physical abilities, demonstrating that digital transformation in academic administration must ensure inclusive access for all users.

Overall, E-Legalization delivers efficient, transparent, and inclusive academic legalization services. It supports SDG 9 through improved digital infrastructure and SDG 10 by reducing barriers to academic services. Future development may include digital payment gateways, electronic signatures, QR-code verification, and integration with institutional academic information systems.

CONCLUSION

A web-based academic legalization system (E-Legalization) was successfully developed to improve the efficiency, transparency, flexibility, and inclusiveness of diploma and academic transcript legalization services in higher education. The research is distinguished by its integration of UserWay-based accessibility features, which extend equal access to academic administrative services to users with diverse backgrounds, including those with disabilities and mobility limitations. Implementation and testing confirm that the system supports a fully online legalization process, raises service quality, and removes several barriers that previously restricted access. The broader implication is that digital transformation in academic administration must go beyond process automation: inclusive, user-centered design is not optional but necessary. By strengthening digital educational infrastructure, the system contributes to SDG 9; by reducing inequalities in access to academic services, it advances SDG 10. Future research could examine the integration of digital signatures, QR-code-based verification, payment gateway services, and interoperability with institutional academic information systems, each of which would further improve system effectiveness, security, and long-term sustainability.

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