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Design and Implementation of Public Service web-based Information System Using RESTful API and Firebase: A Case Study in Takalar Education Office

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Abstract

Effective and transparent public service is a key indicator of good governance, especially in the education sector. Initial findings revealed that the administrative services at the Takalar District Education Office were still manual, unintegrated, and lacked accessible information. This study aims to develop a centralized, transparent, and easily accessible public service system available on web platforms. The research employed a Research and Development (R&D) approach with development stages synthesized from various instructional models, including ADDIE, 4D, Borg and Gall, Prototyping, and Dick & Carey. The stages included needs analysis, system design, prototype development, expert validation, user testing, and limited implementation. Data were gathered through observation, interviews, and questionnaires administered to administrative staff and teachers. The final product was administrative service system website. System evaluation based on ISO/IEC 25010 demonstrated validity across all standards aspects: functionality, efficiency, compatibility, usability, reliability, security, maintainability, and portability. Based on the development and testing software results confirm that the system is functional, user-friendly, and effective as a digital public service solution for improving administrative performance in the education sector.

Keywords: Good-governance, R&D, Synthesized model, Education Sector (3-5 keywords)

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INTRODUCTION

In the era of digital transformation and increasing demands for transparency, effectiveness, and efficiency in governance, public service delivery has become a fundamental indicator of good governance (Dhaoui, 2022). The government, as the primary actor in state administration, is obliged to provide accessible administrative services and information for all citizens (Law Number 25, 2009). This law emphasizes that public services are not only a fulfillment of citizens' rights but also a reflection of a nation's progress in managing administrative functions in a measurable and professional manner. In line with this, public information disclosure—as stipulated in Law No. 14 of 2008—serves as a crucial foundation for encouraging government agencies to develop fast, accurate, and technology-based service systems. One modern approach to achieving this is through the implementation of e-government, which leverages information and communication technology (ICT) to improve public service quality (Simonofski et al., 2019)(Milakovich, 2021)(Balaji, 2025). Research by (Špaček et al., 2020) affirms that e-government has become a key element of public sector reform in both developed and developing countries.

Nevertheless, the implementation of e-government at the local level still faces significant challenges. (Hartanti et al. (2021) stress that public trust is a critical factor in the success of digital services, and without a reliable system, citizen participation remains low. Similarly, Lean dkk. (2009) argue that successful digital services depend on the availability of multi-platform systems that can reach diverse user groups.

In the context of public service in the education sector, the presence of an integrated information system has become an urgent necessity. Fast and accurate administrative reporting is essential to support strategic decision-making processes within educational institutions. Unfortunately, the authors' preliminary observations at the Takalar District Education Office revealed that administrative services are still conducted conventionally, are not integrated, and lack interactive online service features. This condition contradicts the principles of good governance, which demand accessible, measurable, and timely services. A comparative analysis of various education department websites across regencies and cities in South Sulawesi further revealed that most regions do not yet offer fully functional online administrative services. Only a few, such as Jeneponto Regency, have actively developed online-based systems. The problem is exacerbated by the lack of access to service prerequisites for users and the absence of systems facilitating remote service delivery.

This study aims to design and develop a web-based administrative service system for the Takalar District Education Office. Employing a Research and Development (R&D) approach

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synthesized from ADDIE, 4D, Borg and Gall, Prototyping, and Dick & Carey models, this study seeks to produce an integrated and efficient service system that aligns with the principles of information transparency and quality public service. The contribution of this research lies not only in the technical development of the system but also in promoting transparent, responsive, and adaptive local government administration that addresses community needs.

LITERATURE REVIEW

Service System

Public service is an integral part of an organizational system, consisting of interconnected components that work together to achieve specific objectives (Ferlie & Ongaro, 2022) (Holland, 2023). A service system is defined as a set of functions within an organization aimed at providing support and convenience to stakeholders. In this context, human resources, infrastructure, and facilities play a crucial role in ensuring the delivery of effective services. The implementation of optimal service delivery requires good governance, particularly in the sustainable utilization of resources to ensure the well-being of both present and future generations (Castro & Lopes, 2022). Therefore, the success of public service delivery is largely determined by the synergy between institutions as service providers and the public as service recipients (Cepiku & Mastrodascio, 2021).

Affecting Service factor

The quality of public service delivery is influenced by various interrelated factors, both structural and human-centered. In accordance with Law No. 23 of 2014 on Regional Government and Law No. 6 of 2014 on Villages, regional and local authorities are granted autonomy to manage public services to promote community welfare and good administrative governance (Song dkk., 2021). Effective public services are closely tied to the principles of good governance efficiency, transparency, accountability, and responsibility which serve as the foundation for strategic, goal-oriented service delivery (Ojogiwa, 2021), (Karunia, 2023).

Multiple determinants affect the public service process, including policy and regulatory clarity, the competence and motivation of human resources, infrastructure readiness, and the use of digital technology. Equally crucial is the participation of citizens in planning, monitoring, and evaluating public services, which fosters both accountability and responsiveness. Transparency and fairness are essential in ensuring equitable service delivery, while continuous evaluation and improvement mechanisms enhance service quality.

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Internal quality focuses on intra-organizational interactions, managerial patterns, and work environment dynamics. External service quality refers to customer interaction, service procedures, and delivery mechanisms. Additionally, customer perceptions of service quality can be measured using the SERVQUAL dimensions: tangibles, reliability, responsiveness, assurance, and empathy. These indicators reflect both the technical and interpersonal aspects of public service (Sibonde & Dassah, 2021).

Organizational structure also plays a pivotal role, particularly in terms of complexity, formalization, and centralization. A well-defined division of labor, clear standard operating procedures (SOPs), and decentralized decision-making processes contribute to more efficient and citizen-centered service delivery. Moreover, the capabilities of public service personnel are critical, as their expertise and conduct directly impact public trust and satisfaction.

Based on the literature review, it can be stated that the implementation of a structured public service system can reduce inefficiencies and corrupt practices. Transparent requirements, service timelines, and clearly communicated costs contribute to building institutional integrity and improving public confidence in government services.

Research Model Synthesis

The selection of an appropriate development model is a critical factor in ensuring the success of an educational product. Several well-established models have been widely adopted, including the Dick and Carey Model (Dick dkk., 2005), Borg and Gall (Borg & Gall, 1984), ADDIE (Morrison dkk., 2010), the 4D Model (Thiagarajan, 1974), and the Prototype Model (Pressman RS, 2010). Each of these models possesses distinct advantages and procedural stages, ranging from planning and development to evaluation and implementation. To address the need for a comprehensive yet efficient and practical development approach, a synthesis process was conducted by integrating elements from these existing models, resulting in a more relevant and contextually adaptive modified model.

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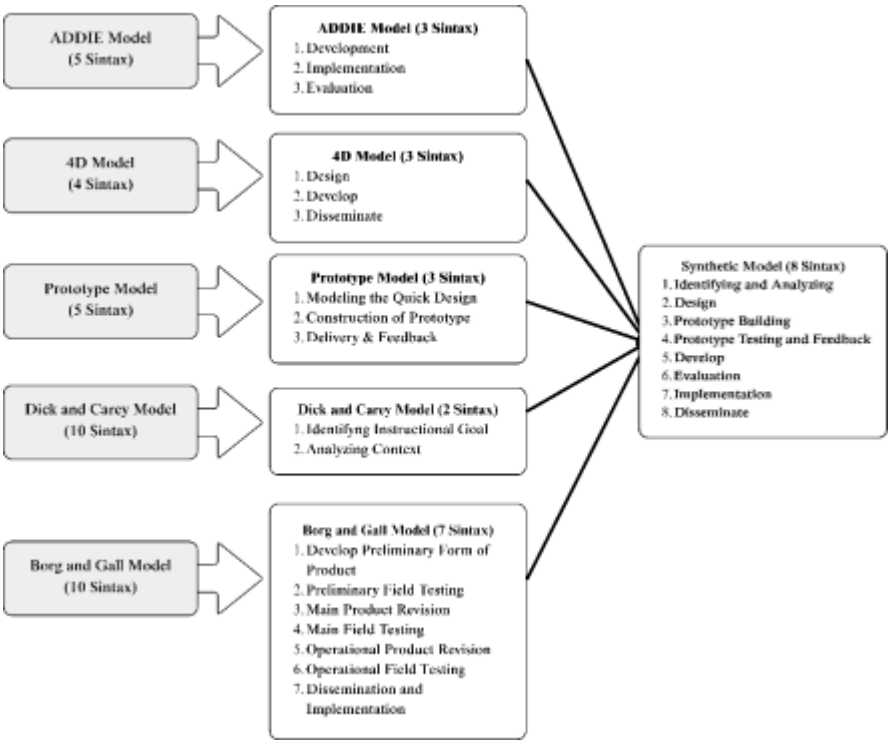


Fig. 1. Research model synthesis results

The synthesized model represents a comprehensive amalgamation of the core stages from the five theoretically and practically validated development models. The synthesis process extracted key elements such as needs analysis, instructional design, prototype construction, testing and feedback, and comprehensive evaluation followed by implementation. As a result, the proposed modified model comprises eight systematic and integrated phases: Identifying and Analyzing, Design, Prototype Building, Prototype Testing and Feedback, Develop, Evaluation, Implementation, and Dissemination.

METHOD

The system development in this study employed the Research and Development (R&D) methodology. Research and Development (R&D) is a type of research that involves a series of developmental stages aimed at producing a new product, improving an existing product, and testing the effectiveness of the developed product. The trial subjects in this study consisted of teachers and administrative staff within the scope of the Takalar District Education Office.

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Institutions under this office include early childhood education (kindergarten), elementary schools (SD), and junior high schools (SMP).

Table 1. Research Subjects

Trial Stage	Subject amount	Institutions
Individual Testing	30 – 45	1 Kindergarten, 1 Primary School, 1 Junior High School
Limited Testing	100 – 150	2 Kindergartens, 3 Primary Schools, 3 Junior High Schools
Extended Testing	>300	4 Kindergartens, 6 Primary Schools, 5 Junior High Schools

The research design implemented in this study followed a synthesized development model, tailored to meet the specific needs of the system being developed.

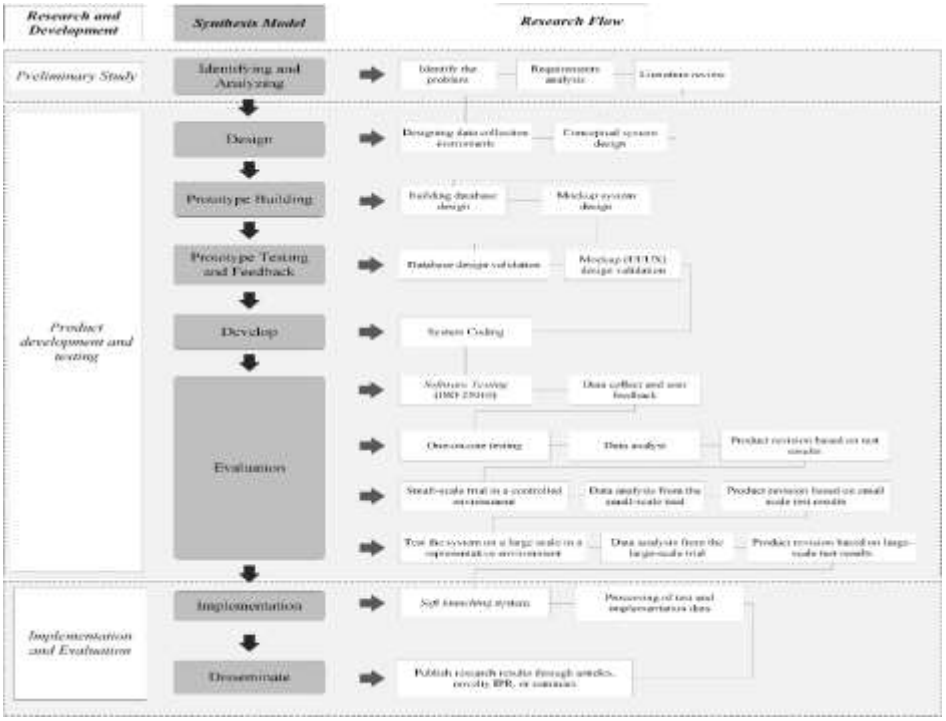


Fig. 2. Research flow

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RESULTS AND DISCUSSIONS

Identifying and Analyzing Result

The initial condition analysis and development needs assessment were conducted using a questionnaire consisting of nine statements related to flexibility, ease of access, administrative service speed, and the necessity for online, website-based, and Android-based systems. Respondents were given two answer choices—"Yes" and "No"—with a total of 120 participants involved in the survey.

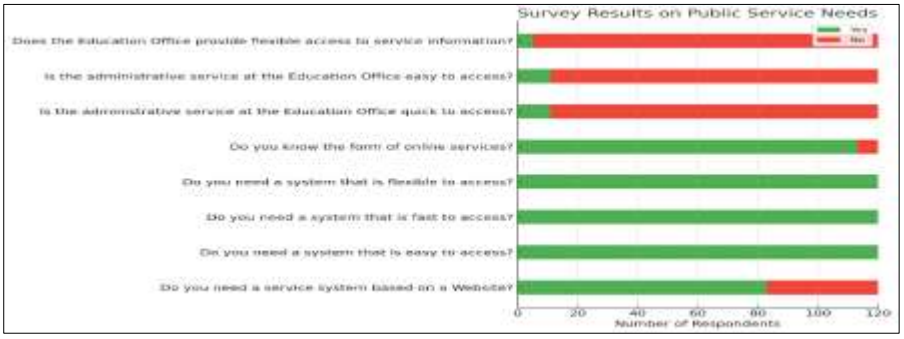


Fig. 2. Survey result on public service needs

Design Result

The results of the problem identification and needs analysis were formulated into a context diagram and data flow design.

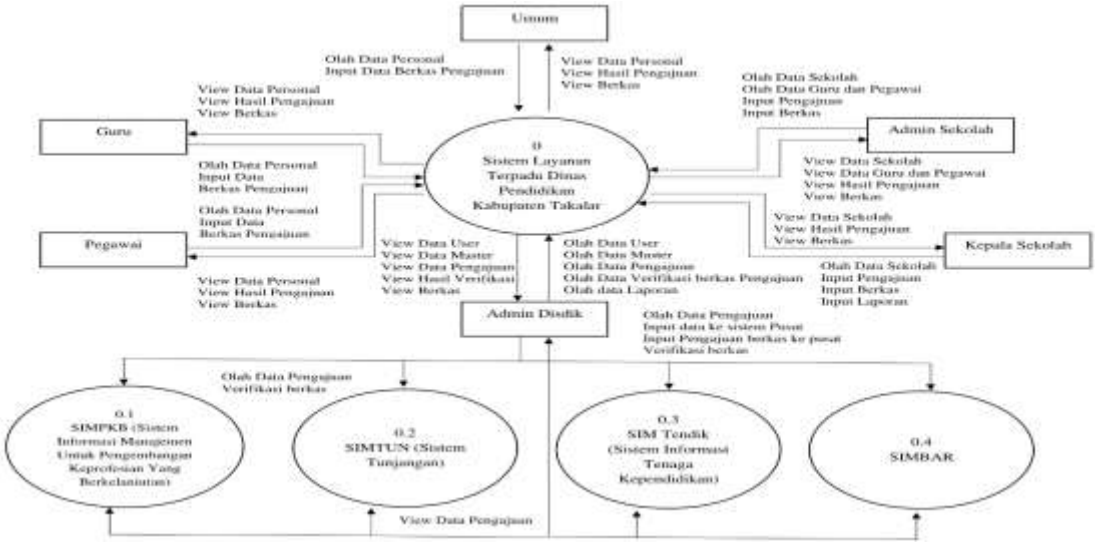


Fig. 3. Contex diagram

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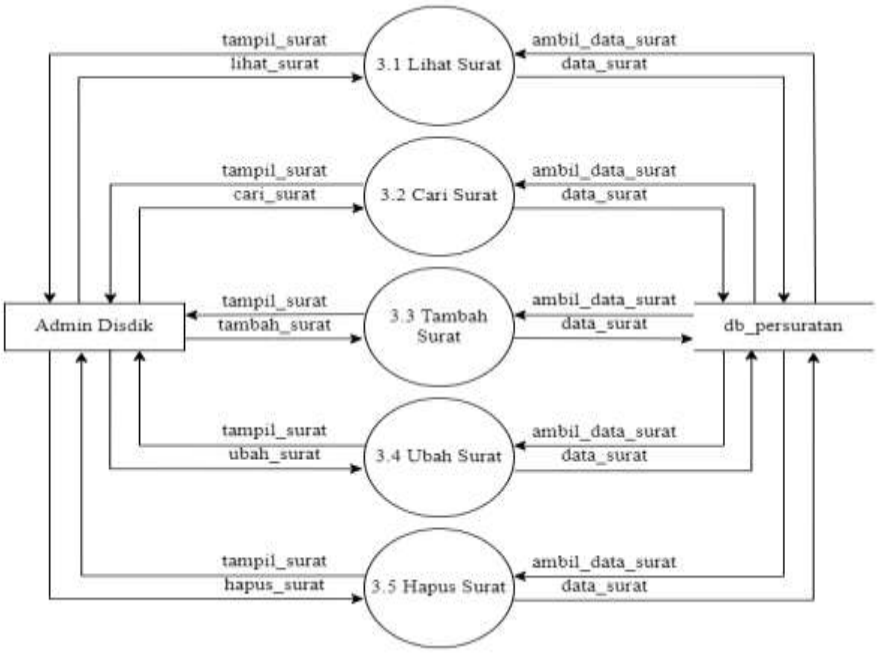


Fig. 4. DFD Sample: DFD 2.0

Prototype Building Result

The results of the database design were translated into user interface mockups, serving as an initial visual representation of the system interface. The mockups were designed using a user experience (UX)-based approach, taking into account navigation simplicity, clarity of information, and interface aesthetics.

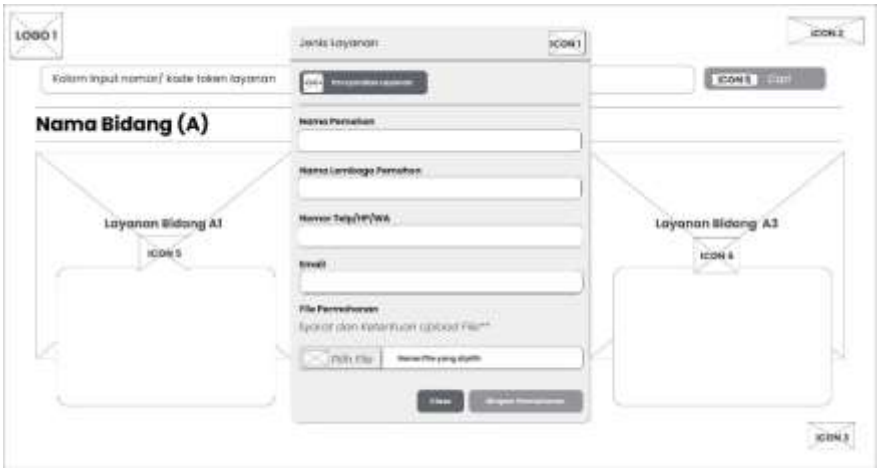


Fig. 5. wireframe: Service filling form

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Prototype testing and feedback result

At the system prototype evaluation stage, assessments were conducted on the workflow design, database schema, and system interface design in the form of a website. The conceptual design was validated by expert system validators using a validation instrument based on object-oriented software development principles. Meanwhile, the program flow design and user interface were evaluated through a Focus Group Discussion (FGD) involving the Takalar District Education Office and the School Principals Group. Based on the evaluation results, the system design was deemed satisfactory and suitable for progression to the coding and implementation phase.

Develop Result

The coded web-based system can be accessed via the website disdikbudtakalar.id through a standard web browser.

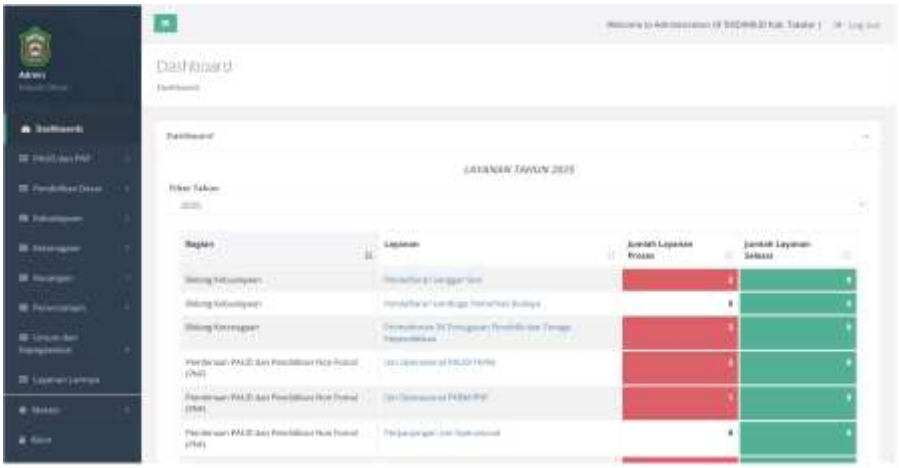


Fig. 6. Sample interface web: dashboard page

Implementation and Evaluation Result

The system evaluation was conducted using the ISO/IEC 25010 standard, which encompasses eight aspects of software quality. This software quality standard is also used in any public service web-based testing (Sivaji dkk., 2014), (Nurunnisa dkk., 2024). In the functional suitability aspect, all features were validated by two expert validators using the Guttman scale (1 and 0), indicating the system's alignment with user needs. The performance efficiency testing, conducted using GTMetrix, showed a website performance score of 87% and a structure score of

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86%. In terms of compatibility and portability, the system was proven to be compatible across various browsers and operating systems.

Functional Suitability

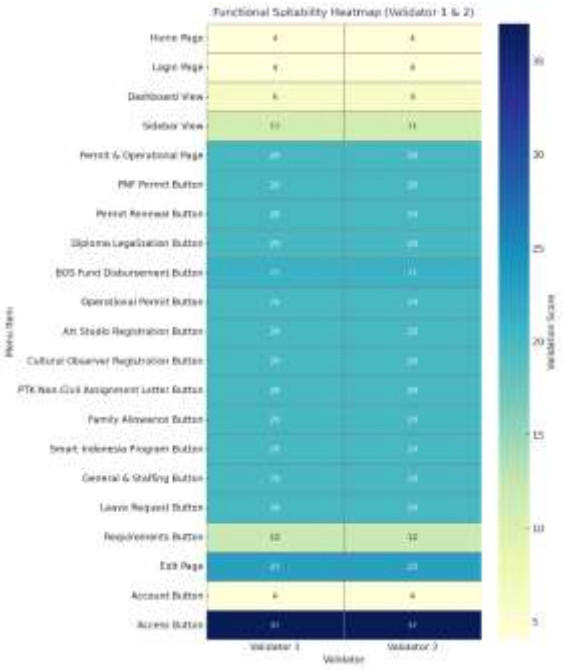


Fig. 7. Blackbox testing result (Functional Suitability)

Performance Efficiency



Fig. 8. Performance Efficiency Testing Results (GTMetrix)

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Compatibility

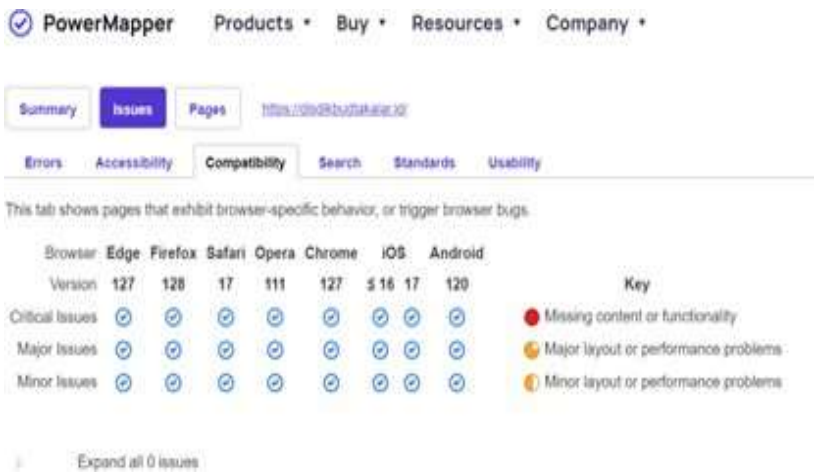


Fig. 9. Compatibility Testing Results (Powermapper)

Portability

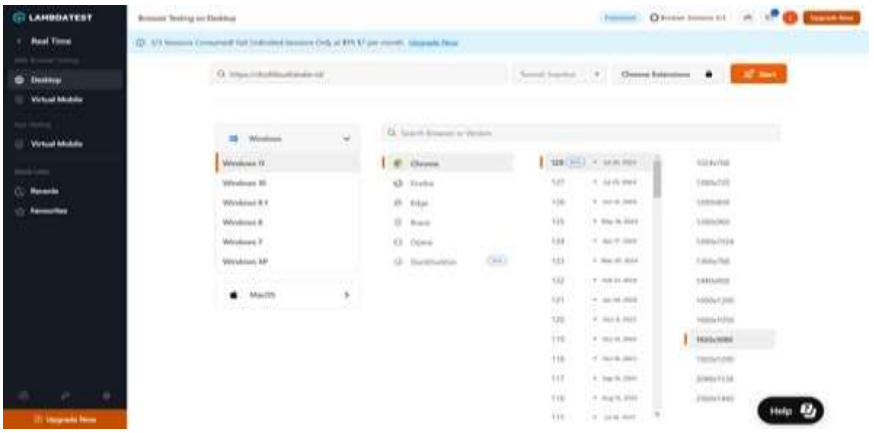


Fig. 10. Portability Testing Results (LambdaTest))

The usability aspect was evaluated through one-on-one, small group, and large group testing schemes. The results indicated a high level of user satisfaction, with an average score of 87.44%. Reliability testing using WAPT showed that all features operated stably without errors. Security testing using Sucuri reported no vulnerabilities or malware threats. For the maintainability aspect, analysis using PHP Metrics revealed low code complexity with an average bug rate of 0.11, indicating that the system is maintainable and scalable for future development.

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Reliability

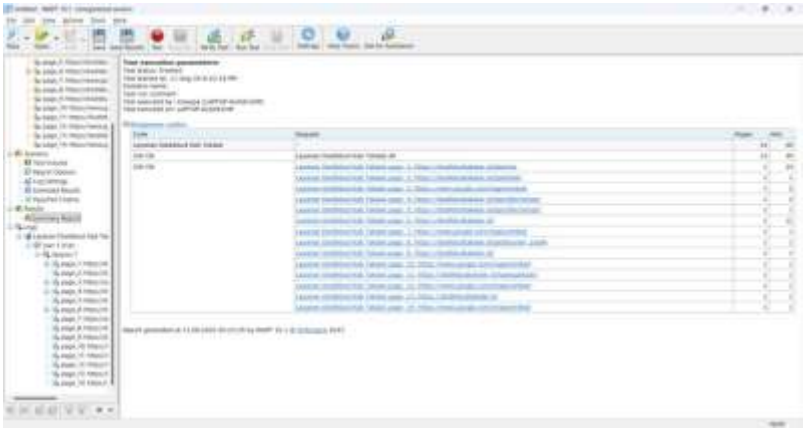


Fig. 11. Reliability Testing Results (WAPT)

Security

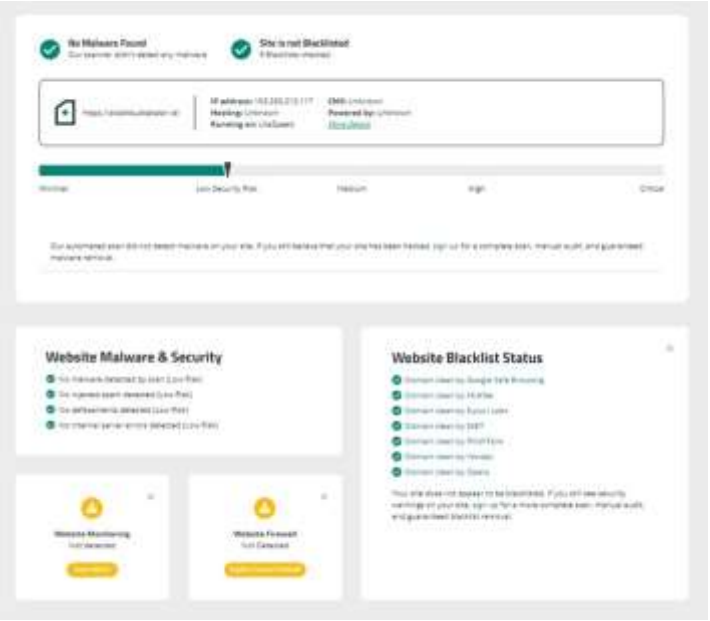


Fig. 12. Security Testing Results (Security Site Hack)

Maintainability

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Fig. 13. Maintainability Testing Results (PHP Metrics)

Usability

Tabel 2. Individual testing result

∑	
Mean	96
Median	96
Mode	94
Standard Deviation	2
Range	8
Minimum	91
Maximum	99
Sum	4496
Count	47

Source: Data analysis, 2025

Tabel *3.* Frequency distribution

Category	Interval Class	FA	FR (%)	FK (%)
SP	98	11	23,40	23,40
P	96-97	24	51,06	74,47
TP	94-95	8	17,02	91,49
STP	93	4	8,51	100,00
Total		47	100,00	

Source: Data analysis, 2025

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Tabel 4. Limited testing result

∑	
Mean	106
Median	106
Mode	106
Standard Deviation	28
Range	8
Minimum	100
Maximum	108
Sum	15878
Count	150

Source: Data analysis, 2025

Tabel 5. Frequency distribution

Category	Interval Class	FA	FR (%)	FK (%)
SP	108	27	18,00	18,00
P	106-107	92	61,33	79,33
TP	104-105	17	11,33	90,67
STP	103	14	9,33	100,00
Total		150	100,00	

Source: Data analysis, 2025

Tabel 6. Extended testing result

∑	
Mean	129
Median	129
Mode	129
Standard Deviation	2
Range	12
Minimum	123
Maximum	135
Sum	45437
Count	351

Sumber: Olah data, 2025

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Tabel 7. Frequency distribution

Category	Interval Class	FA	FR (%)	FK (%)
SP	131	109	31,05	31,05
P	129-130	178	50,71	81,77
TP	127-128	34	9,69	91,45
STP	126	30	8,55	100,00
Total		351	100,00	

Source: Data analysis, 2025

Public service is a key indicator in evaluating the performance of a government administration that is transparent, accountable, and responsive to the needs of its citizens. The implementation of good governance principles requires public institutions to deliver services that are not only fast and accurate but also easily accessible to all segments of society. The development of an integrated web-based service system serves as a strategic solution to meet the growing demand for services that are more integrated, flexible, and adaptive to technological advancements.

The findings of this study provide empirical evidence that a web-based digital system can significantly enhance the effectiveness, efficiency, and transparency of public services in government institutions, particularly in the education sector. Based on system testing and high levels of user satisfaction, it can be concluded that the system is not only feasible for use but also capable of meeting user needs holistically. These findings further reinforce the assumption that digital transformation of public services is highly achievable even in regions with limited technological infrastructure, provided that the system design is grounded in local needs and supported by institutional commitment.

CONCLUSION

The results of this study confirm that the development of a web-based integrated public service system provides a responsive, efficient, and effective solution to the administrative challenges faced by the Education Office of Takalar Regency. Through a structured process involving needs analysis, interface and workflow design, prototyping, testing, and evaluation, the system achieved full feature completeness (score = 1.0) and high user satisfaction. It also fulfilled all quality criteria of the ISO/IEC 25010 standard, particularly in the aspects of functional suitability (100% validation), usability (87.44% average score), performance efficiency (GTMetrix score of

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87%), reliability score 100%, portability and compatibility 100%, low security risk, maintainability (bug rate of 0.11). These results indicate the system's potential to deliver scalable, accessible, and user-centered services that align with the principles of good governance.

This study is strengthened by the use of a user-centered design approach, a rigorous evaluation process, and validation based on international software quality standards. However, a notable limitation is the absence of a long-term impact assessment, particularly in measuring sustained system usage and user behavior over time. Future research is recommended to perform longitudinal studies that examine the long-term effectiveness and scalability of the system in real-world use. Additional enhancements may include integration with national educational databases, application of user analytics, and adoption of AI-based decision support features to improve adaptability and personalization in public services.

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