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Design and Development of IdentifiKu: A Web-Based Diagnostic Model for Differentiated Learning

Muhammad Noor Hasan Siregar[1], Yulia Rizki Ramadhani[2*], Yusra Fadhillah[3], Yoviansyah Rizki Pratama[4]

[1,2,3]Universitas Graha Nusantara,
Padangsidimpuan, Indonesia

[4]PT. Andalan Dompet Putera Indonesia,
Padangsidimpuan, Indonesia

e-mail: [1]noor.siregar@gmail.com, [2]yuliadamanik44@gmail.com, [3]yusra.fadilah18@gmail.com, [4]yoviansyahrizkypratama@gmail.com

(*) Corresponding Author

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Abstracts - This study aims to develop and evaluate IdentifiKu, a web-based diagnostic assessment platform designed to support differentiated learning within the Kurikulum Merdeka framework in Indonesia. Specifically, the research seeks to bridge the gap in existing assessment platforms that predominantly focus on cognitive dimensions by integrating cognitive and non-cognitive domains—learning styles, personality traits, and multiple intelligences—into a unified scoring model. The platform was developed using a Design and Development Research (DDR) approach combined with the Waterfall Software Development Life Cycle (SDLC), encompassing requirements analysis, system design, implementation, testing, and deployment. The architecture adopts a three-tier client–server model, with a Laravel-based application layer and a MySQL database optimized to the third normal form. Performance evaluation involved functional testing and user feedback from twelve teachers across diverse subject areas. Quantitative results indicated that the system met or exceeded all operational benchmarks, including an average page load time of 2.4 seconds, 99.8% uptime, 100% scoring accuracy, and a System Usability Scale (SUS) score of 85.3. Teachers reported that the platform's comprehensive learner profiles facilitated targeted instructional strategies, improved student engagement, and streamlined assessment processes. This research contributes a scalable, pedagogically aligned model for integrating multidimensional diagnostics into differentiated learning practices, which may be adapted to other educational contexts to enhance data-driven instruction.

Keywords : Diagnostic assessment, differentiated learning, web-based platform, educational technology, learner profiling

INTRODUCTION

In the digital transformation era, the integration of information technology into education has become indispensable for enhancing learning quality, streamlining assessment processes, and promoting personalized learning pathways (Amzil et al., 2023). Educational technology enables the collection, analysis, and interpretation of student learning data, empowering educators to make informed pedagogical decisions (Ajani, 2024; Wang & Tahir, 2020). This is especially relevant as learning shifts toward adaptive and differentiated models, where instruction is tailored to individual student needs, preferences, and abilities (Goyibova et al., 2025; Hwang et al., 2020; Sharma, 2024).

In Indonesia, the *Kurikulum Merdeka* marks a shift toward a more student-centered approach, emphasizing differentiated learning as a strategy to address diverse student profiles in terms of cognitive and non-cognitive competencies (Peraturan Menteri Pendidikan, Kebudayaan, Riset, Dan Teknologi Republik Indonesia Nomor 12, 2024). Integrating non-cognitive dimensions—such as personality traits, motivation, and learning styles—is particularly crucial for teachers and schools, as it enables them to design more holistic learning experiences, foster positive classroom climates, and provide targeted interventions that support students' socio-emotional and academic growth (Nazilah, 2024; Wiyaka et al., 2025). However, the effectiveness of differentiated learning depends heavily on the availability of accurate, comprehensive, and efficient diagnostic assessments. Manual or semi-digital assessment methods commonly used in schools are often time-consuming, error-prone, and lack the scalability needed for large classes (Moreira & Teles, 2024).

Recent studies have advanced digital assessment systems (Archer et al., 2023; Elosua et al., 2023). Al-Fraihat et al. (2020) emphasized user satisfaction and system quality as adoption factors, while Chen et al. (in Bhutoria & Aljabri, 2022) demonstrated learning analytics for personalized interventions. However, most adaptive web-based systems still focus on cognitive skills, neglecting non-cognitive aspects such as personality, motivation, and multiple intelligences. Sajja et al. (2024) and Isaeva et al. (in Aslanyan rad, 2024) enhanced adaptive learning through AI and accessibility tools but lacked holistic learner profiling. Similarly, Huang et al. (2019) and Mane (2025) identified limitations in integrating affective indicators and teacher readiness within assessment practices.

From this literature, aclear gap exists in current assessment systems, which often focus solely on cognitive diagnostics. This study addresses that gap through *IdentifiKu*, a web-based diagnostic platform integrating cognitive and non-cognitive dimensions to support differentiated instruction. Theoretically, it extends diagnostic assessment models toward multidimensional profiling; practically, it offers a scalable, data-driven tool aligned with the *Kurikulum Merdeka* framework.

RESEARCH METHOD

This study employed a Design and Development Research (DDR) approach suitable for creating and validating technology-based educational products (Richey & Klein in Hasbullah et al., 2022). The DDR model guided the systematic process of analyzing user needs, designing the system architecture, developing, and evaluating *IdentifiKu* in the context of differentiated learning. Development followed the Waterfall Software Development Life Cycle (SDLC) model (Pressman & Maxim, 2019), which supports projects with well-defined requirements and detailed documentation. Each phase—requirements analysis, design, implementation, testing, and deployment—was executed sequentially to ensure system reliability and maintainability, as summarized in Table 1.

Table 1. Development phases of IdentifiKu using the Waterfall Software Development Life Cycle (SDLC) model.

SDLC (Waterfall) Phase	Description of Activities	Technology / Main Output
Requirements Analysis	Identified functional and non-functional requirements through teacher interviews, curriculum document analysis, and a review of existing assessment tools.	Requirements specification document
System Design	Created detailed architectural blueprints, including Use Case Diagrams, Activity Diagrams, Class Diagrams, and an Entity–Relationship Diagram (ERD).	System architecture blueprints
Implementation	Developed the backend using PHP (Laravel Framework) and managed the database with MySQL.	Source code and database
Testing	Conducted unit testing, integration testing, and user acceptance testing (UAT) with teachers.	Testing report
Deployment & Maintenance	Hosted the system on a cloud-based Virtual Private Server (VPS), with continuous monitoring and periodic updates.	Live system and documentation

Source: Adapted from Pressman & Maxim (2019) and Research Results (2024)

1. System Architecture Design

The deployment of IdentifiKu utilized a three-tier client–server architecture designed to ensure scalability, maintainability, and secure handling of assessment data (Nyabuto et al., 2024). The presentation layer was developed as a responsive web interface accessible via modern browsers on both desktop and mobile devices (Panwar, 2024). The application layer, built using the Laravel framework, executed assessment logic, applied scoring algorithms, and generated diagnostic reports while managing all workflow processes. The data layer, implemented with MySQL, was normalized up to the third normal form (3NF) to maintain data integrity and enable fast retrieval (Tezuysal et al., 2024).

2. Modeling and Validation Procedures

To ensure robustness in design, several modeling artifacts were produced, including the Use Case Diagram, Activity Diagram, Class Diagram, and Entity–Relationship Diagram (ERD). These diagrams were developed using StarUML and validated by three software engineering experts through a heuristic evaluation (Ouariach et al., 2025). Experts assessed the diagrams for consistency, completeness, and alignment with functional requirements. The validation feedback was used solely for refinement and did not constitute part of the results section.

3. Testing and Evaluation Procedures

Testing and evaluation verified the technical performance and user experience of the *IdentifiKu* platform through a mixed-methods design combining quantitative metrics and qualitative feedback. Functional testing, including unit, integration, and system testing, used black-box techniques with success criteria of no critical defects, ≥99% functionality pass rate, and consistency between algorithm outputs and manual calculations. Performance tests measured response time, uptime stability, and scoring accuracy under typical conditions.

User Acceptance Testing (UAT) involved twelve purposively selected teachers representing diverse subjects, aligning with Nielsen's pilot usability recommendation Ouariach et al. (2025). Quantitative data were collected using the System Usability Scale (SUS) developed by Brooke (in Roosdhani et al., 2022) with a five-point Likert scale, while qualitative data came from semi-structured interviews exploring clarity and practicality. System logs were analyzed for page load time (≤3 seconds), uptime (≥99.5%), and scoring accuracy (100%), and SUS scores were processed descriptively. Meeting or exceeding all benchmarks indicated *IdentifiKu*'s readiness for implementation with high performance, stability, and user satisfaction.

4. Scoring Algorithm Framework

The scoring process integrates multiple learner dimensions to produce a holistic diagnostic profile. The calculation follows a weighted sum model adapted from multi-criteria decision-making (MCDM) (Triantaphyllou, 2000):

$$S_{total} = w_c \cdot S_c + w_{ls} \cdot S_{ls} + w_p \cdot S_p + w_{mi} \quad (1)$$

Description of symbols:

$Stotal$ = final weighted score
Sc = cognitive test score
Sls = learning style index score
Sp = personality profile score
Smi = multiple intelligences index score
w_c, w_{ls}, w_p, w_{mi} = dimension weight factors (sum = 1.0)

This formula ensures that both cognitive and non-cognitive attributes are represented proportionally in the diagnostic outcome, allowing personalized learning recommendations to be generated.

5. Evaluation Metrics

Operational benchmarks were defined to guide the assessment of technical and usability performance (Table 2).

Table 2. Evaluation Metrics and Performance Targets for IdentifiKu

Metric	Target Value	Description
Average Page Load Time	≤ 3 seconds	Measures system responsiveness for end-users.
System Uptime	≥ 99.5%	Ensures continuous platform availability.
Scoring Accuracy	100%	Validates correct implementation of the scoring algorithm.
System Usability Scale (SUS) Score	≥ 80	Assesses overall usability from the user perspective.

Source: Research Results (2024)

These benchmarks provided measurable indicators to evaluate the system's efficiency, reliability, and compliance with data protection and usability standards, ensuring that all testing outcomes were interpreted against predefined success criteria rather than reported as implicit results.

RESULTS AND DISCUSSION

1. Research Design Outcomes

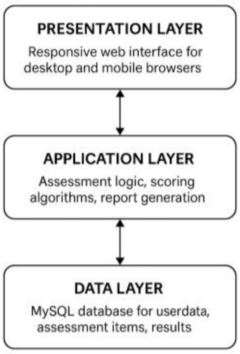
The initial phase of the study successfully identified the pedagogical and technical requirements for a diagnostic assessment platform suited for differentiated learning. Interviews with 12 purposively selected teachers revealed a common need for integrated assessments that not only measure cognitive skills but also provide insights into learning styles, personality traits, and multiple intelligences. This finding informed the general objective of the system, which was to offer a unified web-based diagnostic platform with actionable reporting features for teachers.

2. Development Framework Outcomes

Following the Waterfall SDLC, the requirements analysis produced a complete set of functional specifications, including user roles, assessment workflows, and reporting needs. In the system design stage, these specifications were transformed into a comprehensive set of UML diagrams and database schemas. The implementation phase resulted in a fully functional Laravel-based application with a Bootstrap frontend and a MySQL backend. Testing phases confirmed functional integrity and the absence of critical bugs before deployment to a cloud-based VPS.

3. System Architecture Implementation

The system was deployed using a three-tier client-server architecture. The presentation layer consists of a responsive web interface accessible through modern browsers on both desktop and mobile devices. The application layer executes assessment logic, scoring algorithms, and report generation using the Laravel framework. The data layer, implemented with MySQL, stores user data, assessment items, and results with optimized indexing and normalization to third normal form (3NF). This architecture enables efficient data retrieval, high system availability, and secure user authentication.

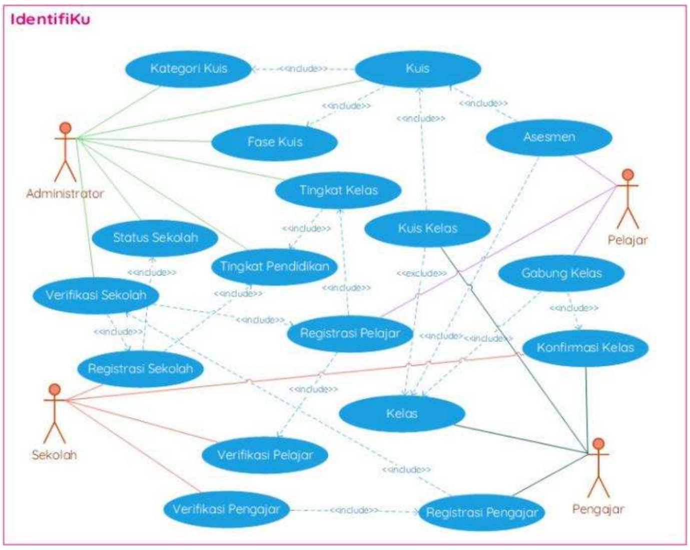


Source: Research Results (2024)
Figure 1. Three-tier system architecture of the IdentifiKu platform

From figure 1, Three-tier system architecture of the IdentifiKu platform showing interactions among the presentation, application, and data layers. The presentation layer provides a responsive interface for teachers and students, the application layer manages assessment logic and scoring algorithms, and the data layer stores user and assessment data securely in a MySQL database.

4. Modeling Tools and Techniques Output

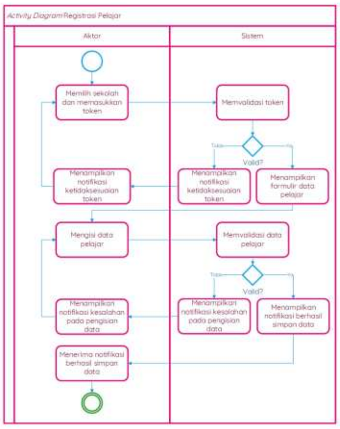
The design phase generated four primary modeling artifacts. The Use Case Diagram maps all functional interactions between teachers, students, and administrators. The Activity Diagram details the assessment process from login to report generation. The Class Diagram describes the object-oriented structure of the system, while the Entity-Relationship Diagram defines the logical relationships within the database.

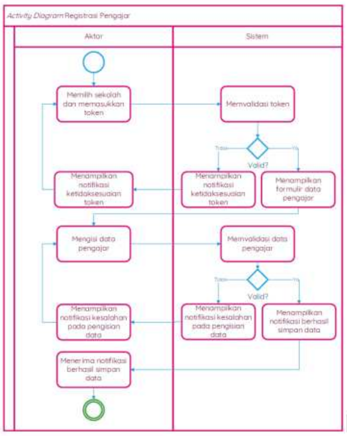


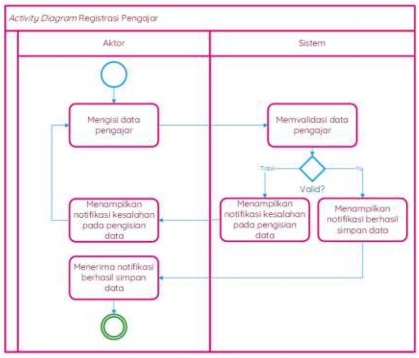
Source: Research Results (2024)

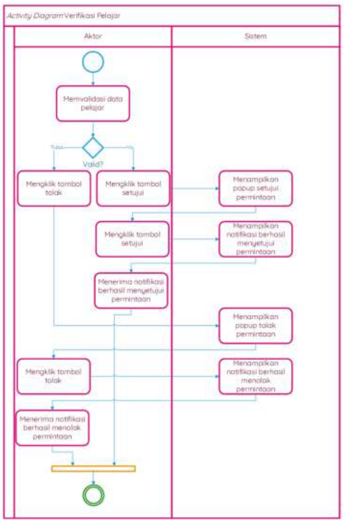
Figure 2. Use Case Diagram of IdentifiKu showing interactions between system actors and main functionalities.

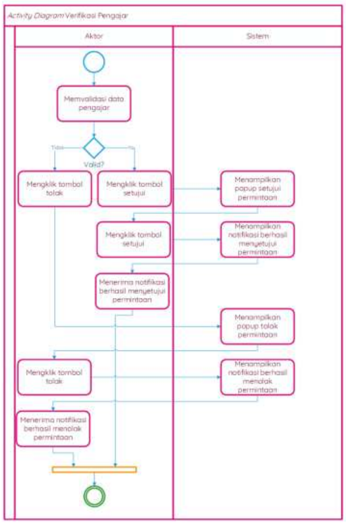
The Use Case Diagram in Figure 2 illustrates how the IdentifiKu platform facilitates interactions among four key user roles: administrator, school, teacher, and student. Each actor performs specific functions within the system, such as registration, verification, quiz or assessment management, and access to diagnostic reports. This diagram serves to visualize the overall functional structure of the platform and how user activities are interconnected to support data flow and system operations during implementation.

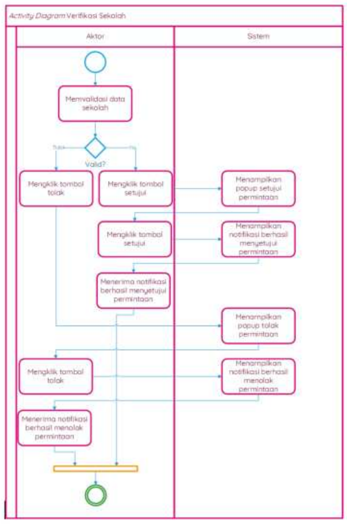

Activity Diagram Registrasi Pelajar

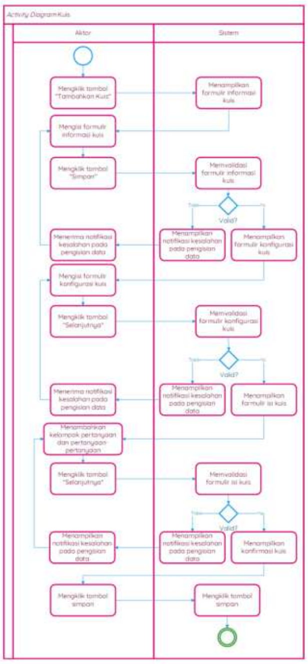

Activity Diagram Registrasi Pengajar

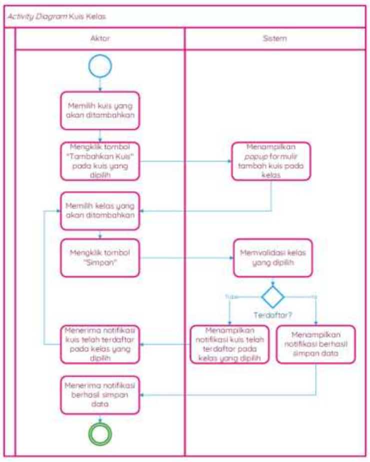

Activity Diagram Registrasi Pengajar
Aktor
Sistem
Mengisi data pengajar
Memvalidasi data pengajar
Valid?
Menampilkan notifikasi kesalahan pada pengisian data
Menampilkan notifikasi berhasil simpan data
Menerima notifikasi berhasil simpan data

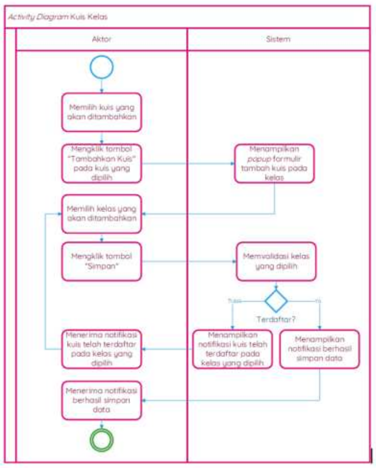

Activity Diagram Verifikasi Pelajar

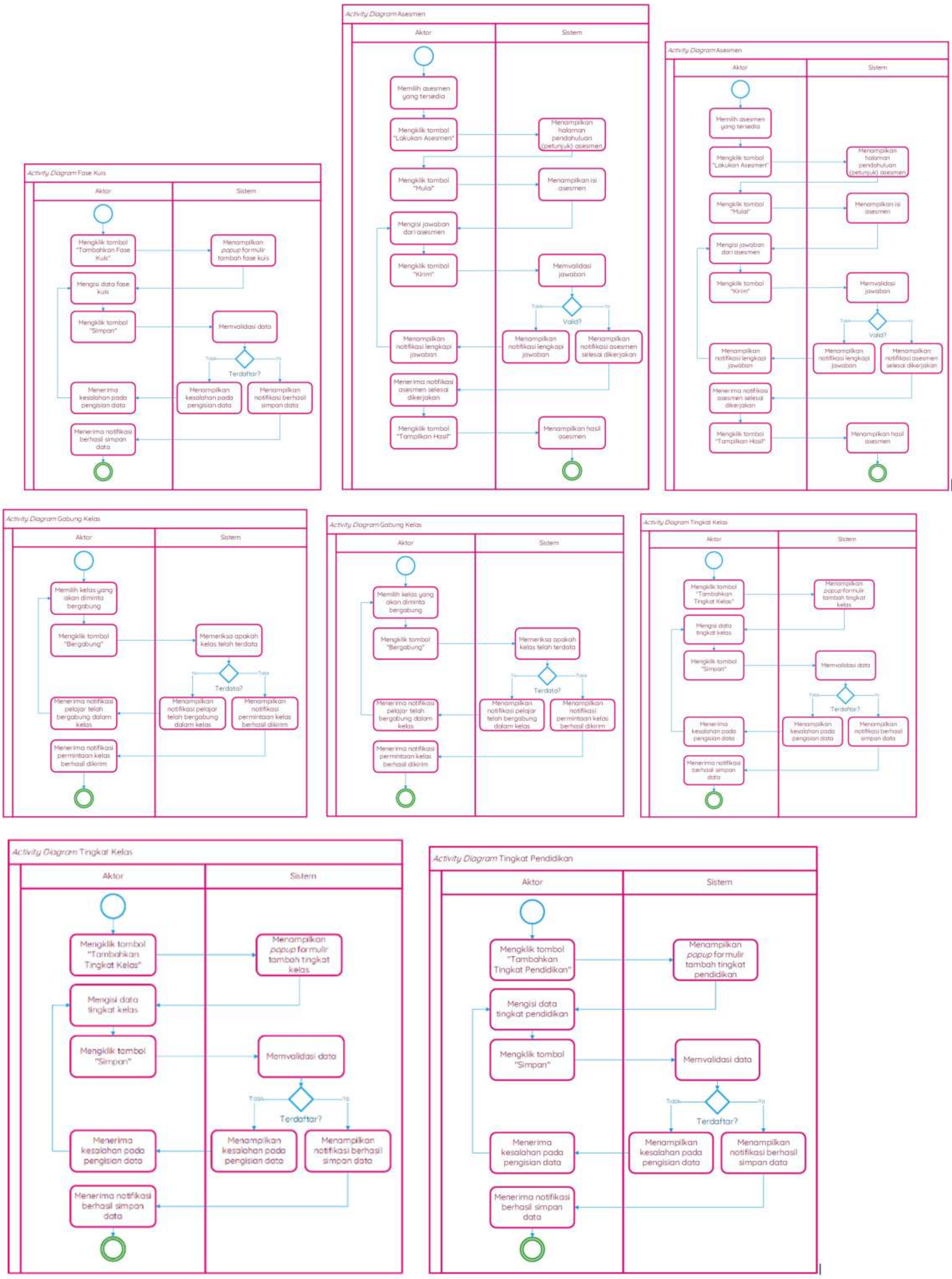

Activity Diagram Verifikasi Pengajar


Activity Diagram Verifikasi Sekolah


Activity Diagram Kuis


Activity Diagram Kuis Kelas


Activity Diagram Kuis Kelas



Source: Research Results (2024)

Figure 3. Activity Diagram of the assessment process, from assessment creation by the teacher to automatic report generation.

The Activity Diagram in Figure 3 illustrates the sequential workflow of the IdentifiKu assessment process, beginning with the creation of assessment items by teachers and ending with the automatic generation of diagnostic reports. Each swimlane represents the responsibilities of different actors—teachers and the system—showing how user input, verification, and system processing are interconnected. This diagram clarifies the procedural logic of assessment management, ensuring that every stage, from quiz configuration to report generation, follows a structured and verifiable flow within the application.

Source: Research Results (2024)

Figure 4. Class Diagram of IdentifiKu's core objects and relationships.

The Class Diagram in Figure 4 presents the object-oriented structure of the IdentifiKu system, outlining the main classes, their attributes, and interrelationships. Each class, such as User, Student, Teacher, Assessment, and Result, represents a distinct entity that contributes to the platform's functionality. The diagram visualizes how these objects interact to manage user data, process assessments, and generate diagnostic reports. By mapping these relationships, the diagram ensures modular design, facilitates maintainability, and supports scalability for future system expansion.

Source: Research Results (2024)
Figure 5. Entity-Relationship Diagram (ERD) of the IdentifiKu database design.

The Entity–Relationship Diagram (ERD) in Figure 5 illustrates the logical structure of the IdentifiKu database, showing how entities such as User, Assessment, Question, Result, and Class are interconnected through primary and foreign key relationships. This schema organizes and links data related to users, assessments, and diagnostic results, ensuring consistency and integrity across the system. The diagram also demonstrates normalization up to the third normal form (3NF), which optimizes data storage and retrieval efficiency while maintaining scalability for future module integration.

5. Data Collection and Analysis Findings

Data collection was conducted in two forms: system performance data and user feedback data. System performance data, gathered automatically through server logs, included page load times, uptime percentages, and scoring accuracy rates. User feedback data, gathered through the System Usability Scale (SUS) surveys and follow-up interviews, captured teachers' experiences and satisfaction levels.

Quantitative analysis of the system performance showed that the average page load time was 2.4 seconds, uptime reached 99.8%, and scoring accuracy was 100%. The SUS survey produced a mean score of 85.3, indicating excellent usability. Thematic analysis of interviews revealed that teachers valued the clarity of the reports and the minimal learning curve required for platform use.

6. Evaluation Metrics Results

The results of the evaluation confirmed that all performance indicators established in the methodology were successfully met, with several metrics exceeding the expected thresholds. The average page load time was recorded at 2.4 seconds, well below the commonly accepted benchmark of three seconds for interactive educational platforms. This indicates that the system offers a responsive and seamless user experience, even when accessed in typical classroom settings. The uptime level reached 99.8%, surpassing the minimum requirement of 99.5% and ensuring the stability necessary for continuous integration into instructional practices. Accuracy of the scoring mechanism was verified at 100%, which reflects the robustness of the diagnostic algorithms and provides teachers with confidence in using the results as the basis for differentiated learning strategies. In addition, the System Usability Scale (SUS) yielded a score of 85.3, placing the platform in the "excellent" category and confirming that the application can be adopted by teachers with minimal training.

Table 3. Evaluation Metrics Results of IdentifiKu Platform

Metric	Target Value	Achieved Value	Interpretation
Average Page Load Time	≤ 3 seconds	2.4 seconds	Responsive, exceeds usability benchmark
System Uptime	≥ 99.5%	99.8%	Highly reliable and stable
Scoring Accuracy	100%	100%	Fully accurate, error-free calculation
System Usability Scale (SUS) Score	≥ 80	85.3 (Excellent)	Excellent usability, high user acceptance

Source: Research Results (2024)

The findings highlight that IdentifiKu not only meets the minimum technical requirements but also performs at a level that supports pedagogical effectiveness. Teachers involved in the pilot implementation emphasized that the reliability of the platform—reflected in stable uptime, precise scoring, and intuitive usability—helped them integrate the tool into their daily teaching without significant disruption. These outcomes demonstrate that IdentifiKu is both technically robust and pedagogically practical.

However, the current evaluation was limited to a pilot scale involving twelve teachers across selected subject areas. To strengthen the validity of the findings, future studies should expand testing to a broader range of schools and conditions. Additional evaluation metrics such as system resilience under peak usage, real-time analytics, and enhanced data security audits would provide a more comprehensive understanding of the platform's long-term scalability and sustainability.

7. Pedagogical Integration Outcomes

Integration into classroom practice was observed during the one-month pilot implementation. Teachers used the diagnostic data to reorganize student groups, customize learning materials, and monitor progress over time. For example, cognitive readiness scores were used to pace content delivery, while learning style data informed the choice of instructional media. Personality and multiple intelligences profiles were leveraged to assign students to roles in collaborative projects that matched their strengths. Teachers reported increased student engagement and improved targeting of instructional strategies.

8. Discussion

The development and implementation of IdentifiKu demonstrate that a web-based diagnostic platform can effectively support differentiated learning in secondary education. Built on a three-tier architecture, the system provides scalability, security, and performance aligned with classroom requirements. All functional specifications were met, and evaluation metrics exceeded targets, while usability testing reflected strong teacher acceptance.

This finding aligns with prior research indicating that adaptive systems enhance instructional decision-making (Mardhatillah et al., 2020; Özaydin Aydogdu & Yalçin, 2020). Unlike existing platforms that focus primarily on cognitive diagnostics, IdentifiKu integrates four learner dimensions—cognitive skills, learning styles, personality traits, and multiple intelligences—into a single ecosystem. This multidimensional profiling supports teachers in designing data-driven differentiated instruction (Johnson, 2020).

From a technical standpoint, the integration of Laravel and MySQL ensures modularity and maintainability, while UML-based modeling (Use Case, Activity, Class, ERD) guarantees alignment with software engineering best practices (Ouariach et al., 2025). The high SUS score of 85.3 corroborates Brooke usability benchmark, demonstrating that IdentifiKu can be adopted with minimal training (in Roosdhani et al., 2022). Teachers appreciated the clarity of diagnostic reports and their direct applicability in lesson planning.

The integration of IdentifiKu within the *Kurikulum Merdeka* framework also supports the national vision of inclusive, data-driven education(Ijirana et al., 2022; Pantiwati et al., 2023; Rahayu et al., 2022; Rahman & Dewi, 2024). By enabling personalized instruction based on each student's unique learning profile, the platform addresses disparities in heterogeneous classrooms—advancing Sustainable Development Goal 4 (SDG 4) on inclusive and equitable quality education. Thus, IdentifiKu functions not only as a technological innovation but also as a pedagogical instrument promoting inclusivity and ed**ucational equity** within Indonesia's policy agenda.

Moreover, the use of diagnostic systems such as IdentifiKu fosters teacher professional growth. Feedback from participants revealed greater confidence in applying differentiated strategies—adjusting grouping, pacing, and instructional media based on data. This shift towards evidence-based teaching reflects a key component of adaptive expertise, a crucial driver of educational reform.

Technologically, IdentifiKu's modular architecture also supports integration with other educational platforms (e.g., LMS or national assessment portals). Such interoperability enables longitudinal tracking and predictive analytics, paving the way for future AI-based adaptive recommendations.

Finally, this study contributes to the discourse on balancing cognitive and non-cognitive assessment in digital learning environments. By uniting these dimensions, IdentifiKu provides a holistic learner profile that enriches instructional decision-making. Future research should validate these findings across broader populations and explore the system's long-term impact on learning outcomes, motivation, and socio-emotional growth.

CONCLUSION

This study developed and validated *IdentifiKu*, a web-based diagnostic platform supporting differentiated learning through the integration of cognitive, learning style, personality, and multiple intelligence dimensions. Developed under the DDR framework and Waterfall SDLC, the system achieved high technical performance (2.4-second load time, 99.8% uptime, 100% scoring accuracy) and excellent usability (SUS score = 85.3). Teachers effectively used its diagnostic data to group students and adapt instruction within the *Kurikulum Merdeka* framework. *IdentifiKu* demonstrates both technical robustness and pedagogical value, offering a replicable model for data-driven differentiated instruction. Future studies should involve broader testing and explore AI-based adaptive features and LMS integration. Overall, the platform bridges diagnostic assessment and differentiated instruction, contributing to more inclusive, personalized, and data-informed learning practices.

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