IJDSEA
International Journal of Data Science Engineering, and Analytics

e-ISSN : 2807-1689
p-ISSN : 2798-9208

Strategic Insights into Educational Assessment: The Implementation and Constraints of SIMCPM in Monitoring Student Outcomes

Seftin Fitri Ana Wati [1*], Anindo Saka Fitri [2] and Anik Vega Vitianingsih[3], Abdul Rezha Efrat Najaf[4]

[1*] Information System Department, Universitas Pembangunan Nasional Veteran Jawa Timur 1; Seftin.fitri.si@upnjatim.ac.id
[2] Information System Department, Universitas Pembangunan Nasional Veteran Jawa Timur 2; anindo.saka.si@upnjatim.ac.id
[3] Informatic Engineering Department, Universitas Dr. Soetomo Surabaya 3; vega@unitomo.ac.id
[4] Information System Department, Universitas Pembangunan Nasional Veteran Jawa Timur 4; rezha.efrat.sifo@upnjatim.ac.id
* Correspondence: Seftin.fitri.si@upnjatim.ac.id

Vol. 3, No 2, Page 11-21.
Received: 16 November 2023
Accepted: 20 November 2023
Published: 24 November 2023

Abstract: In response to the evolving challenges in educational institutions, the Ministry of Education and Culture emphasizes the crucial role of effective information systems in achieving optimal educational objectives. This study introduces the Student Learning Achievement Information System (SIMCPM) as a strategic solution for systematically monitoring and evaluating student performance. The research explores the implementation of SIMCPM, focusing on its role in functional testing within educational environments. With a user-centric approach, the study investigates how SIMCPM can be integrated as an innovative tool for monitoring student learning achievements, specifically in displaying grade and attendance data. The methodology outlines the comprehensive approach to SIMCPM's development, emphasizing the use of Laravel 8 for backend infrastructure and HTML, CSS, and JavaScript for UI/UX development. Data visualization development is highlighted, showcasing the integration of ApexCharts.JS for effective communication of educational metrics. Functionality testing ensures the reliability of the system, encompassing testing scenarios, integration testing, load and performance testing, and mobile and tablet functional testing. Results and discussion present the outcomes of SIMCPM's implementation, including data simulation, dashboard rendering, and functionality testing. The study introduces dashboard features for students, lecturers, and the Head of Study Program, emphasizing speed, efficiency, and data visualization quality. Functionality testing results confirm the robustness of the system. The subsequent section interprets the results, addressing implications, strengths, limitations, and potential improvements in the SIMCPM system. The conclusion recommends continuous testing with real-time data, user feedback integration, and potential enhancements such as predictive analytics and personalized learning recommendations to ensure sustained effectiveness in supporting academic processes. Overall, SIMCPM emerges as a promising tool for efficient academic management, subject to continuous refinement and innovation.

Keywords: Student Learning Outcome; Information System; Functional Testing; Education Asesement; Laravel, PHP

1. Introduction

In the dynamic landscape of educational institutions, the development of an effective and efficient information system emerges as a critical response to the unique challenges faced in monitoring and evaluating student learning outcomes. Recognizing the pivotal role of education in societal advancement, the Ministry of Education and Culture (2019, Article 16 paragraph 1) underscores the importance of ensuring that educational objectives are optimally achieved. To meet this imperative, the Student Learning Achievement Information System (SIMCPM) has been conceived as a strategic solution[1]. Functioning as an effective and efficient tool, SIMCPM is meticulously designed to systematically and integratively monitor and evaluate student performance[2].

The research questions guiding this investigation delve into the extent of SIMCPM's implementation in providing additional insights into the literature on the functional testing of information systems in educational environments[3]. With a user-centric approach, the study aims to explore how SIMCPM can be seamlessly integrated as an innovative tool for monitoring student learning achievements, particularly in the nuanced contexts of displaying grade and attendance data[4]. This exploration extends beyond the immediate academic environment, probing into the potential for SIMCPM to pave the way for the development or enhancement of similar information systems in diverse educational institutions. While the research seeks to unravel the possibilities and benefits inherent in SIMCPM, it acknowledges certain constraints that delineate its scope. The study is intentionally confined to three primary user applications—students, faculty members, and program coordinators—to ensure a nuanced understanding of their specific needs within the educational realm. Furthermore, recognizing the symbiotic relationship with the existing academic system, SIMCPM is positioned as an additional or supportive component. This deliberate approach aims to augment the functionalities of the established academic infrastructure without imposing a complete overhaul[5].

The limitations of the research are intricately tied to the focus on specific features within SIMCPM, specifically the visualization of student data related to grades and attendance[6]. By delving deeply into these components, the study intends to provide an in-depth examination of their impact on the holistic monitoring of student learning achievements[7]. In essence, this introduction sets the stage for a comprehensive exploration of SIMCPM, balancing the promises it holds for educational advancement with the pragmatic considerations that guide its.

2. Methodology

The methodological anchor of this study, providing a comprehensive overview of the approaches, techniques, and processes employed in the implementation and evaluation of the SIMCPM system.

2.1. Application Development

The application development process involves a comprehensive approach to ensure the creation of a functional and efficient educational assessment system[8]. Laravel 8, chosen as the development framework, facilitates the systematic organization of the project by providing a set of

tools and conventions. The development team will leverage Laravel's capabilities for routing, database management, and templating to create a robust back-end infrastructure[9]. The PHP programming language, known for its versatility, will be employed to implement the business logic, ensuring seamless interactions within the application. The choice of MySQL as the database management system further supports data storage and retrieval requirements. This integrated approach aims to establish a cohesive and scalable foundation for the educational assessment system, emphasizing the importance of a well-structured application development process in achieving the research goals[10].

The user interface (UI/UX) development phase is pivotal in shaping the overall user experience and visual appeal of the educational assessment system. HTML and CSS are employed to craft an intuitive and visually engaging front-end interface. Leveraging the capabilities of JavaScript, particularly with the integration of ApexChars.JS for charting, enhances the interactivity and data visualization aspects of the user interface. The combination of these technologies ensures a seamless and responsive user experience across various devices. By implementing a user-centric design philosophy, the UI/UX development focuses not only on aesthetic aspects but also on creating an interface that promotes user efficiency and comprehension. The incorporation of ApexCharts.JS for dynamic charting contributes to effective data communication, aligning with the research objective of emphasizing visualized educational data. This subchapter underscores the significance of thoughtful UI/UX design in enhancing the overall usability and accessibility of the educational assessment system.

2.2. Data Visualization Development

The subchapter on Data Visualization Development [11] constitutes a critical phase in the implementation of the educational assessment system. Beginning with the identification of relevant data sets, this phase aims to translate raw information into meaningful insights through the application of visual elements. ApexCharts.JS is instrumental in this process, providing a powerful toolset for creating dynamic charts and diagrams. The selected visualizations are strategically designed to communicate educational data effectively, catering to diverse audiences. The integration of these visual components not only enhances the aesthetic appeal of the system but also facilitates a more intuitive understanding of complex educational metrics. By combining the identified data with visually impactful representations, this subchapter emphasizes the pivotal role of data visualization in making the educational assessment system accessible and comprehensible for users, thereby contributing to the overarching objectives of the research.

2.3. Functionality Testing

Functionality Testing is a crucial stage in ensuring the reliability and effectiveness of the educational assessment system. This subchapter encompasses a series of rigorous tests designed to evaluate the application's various functionalities. Beginning with Testing Scenarios, key use cases are systematically examined to validate that the system behaves as expected under different conditions. Integration Testing follows, verifying the seamless interaction between different components to ensure a cohesive and well-integrated system. Load and Performance Testing are integral to assessing the application's responsiveness and stability under varying levels of user activity. Mobile and Tablet Functional Testing ensures that the system's interface remains responsive and functional across diverse devices. By employing a comprehensive set of testing methodologies, this subchapter aims to validate the robustness and reliability of the educational assessment system, emphasizing its capability to meet the intended objectives and user expectations.

3. Result and Discussion

This chapter delves into the heart of the study, presenting the results obtained from the comprehensive implementation and evaluation of the SIMCPM system. This chapter serves as a detailed exposition of the outcomes derived from various phases, including data simulation, dashboard rendering, and functionality testing.

3.1. Result Presentation

The comprehensive implementation of the SIMCPM system is presented, enriched by a diverse set of dummy data generated using FakerPHP v1.23.0. The simulation spans across six academic semesters, resulting in a dataset comprising 12,192 rows of information. The dataset encompasses key elements, including student IDs, course details, assigned faculty, academic years, semesters, attendance, examination status, and performance metrics such as pre-test scores (Pre Test 1-4), midterm (UTS), and final (UAS) exam grades, overall course grades, and corresponding letter grades. It is noteworthy that all values in the dataset are customized within the range of 40 to 100. Further details and a visual representation of the dataset can be found in Fig 1.

The dummy data, meticulously crafted to emulate the intricacies of a dynamic educational environment, enables a thorough exploration of the system's functionality and its impact on diverse user experiences. The utilization of FakerPHP ensures a realistic and diverse representation of student and course interactions within the simulated academic context.

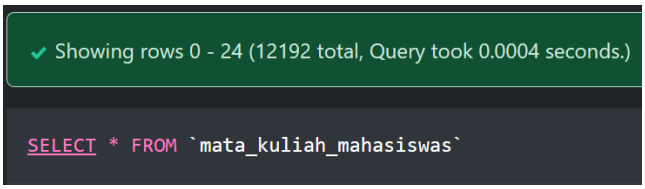

Figure 1 Data

In the development of SIMCPM, we introduce a dashboard feature specifically designed for students, providing contextual visualization based on the current academic year, semester, and the student's ID. The algorithm's success in rendering the visual dashboard in a short time, averaging 0.3 seconds, ensures fast and efficient access to student data. Comprehensive details regarding this data can be found in Table 1.

Table 1 Average Page Load Speed

Page	Average Page Load Speed
Student Dashboard	0,3
Student Course	0,3
Lecturer Dashboard	0,4
Head of Study Program Dashboard	0,4
Head of Study Program Course	0,6

This feature not only offers speed but also delivers relevant information. The student dashboard display includes crucial elements such as the course name, assigned faculty, semester, and academic year. The data generated from this feature is clearly documented in Fig. 2, illustrating a concrete

visualization of the student dashboard view. Thus, students can easily track their academic progress and plan their studies more effectively. The data visualization in the table and image provides a profound understanding of the excellence and added value of this dashboard feature.

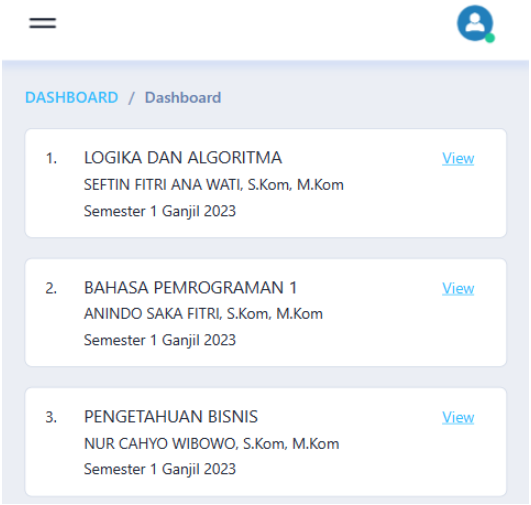

Figure 2 Student Dashboard

A student course dashboard feature specifically tailored for students, displaying visualizations based on the current academic year, semester, and the selected course, along with the student's ID. The implemented algorithm successfully renders the visual dashboard with an average time of 0.5 seconds, ensuring quick and efficient access to student data. All detailed information regarding this data can be referenced in Table 1.

This feature goes beyond providing a general overview; it delves into more comprehensive details concerning students' grades, attendance, and the course materials covered. The selection of this feature aims to offer a more profound understanding of students' academic progress within a specific course. The data visualization is presented distinctly in Fig. 3, providing a concrete representation of the course dashboard feature. With this feature, it is anticipated that students can easily monitor their academic development, make informed decisions, and enhance their overall learning experience.

Moreover, the tracking of grades and attendance serves as a reminder for students to remain focused on their coursework, ensuring that final grades and attendance records remain favorable. This feature acts as a valuable tool, prompting students to prioritize their academic commitments and contributing to a more successful and engaged learning journey.

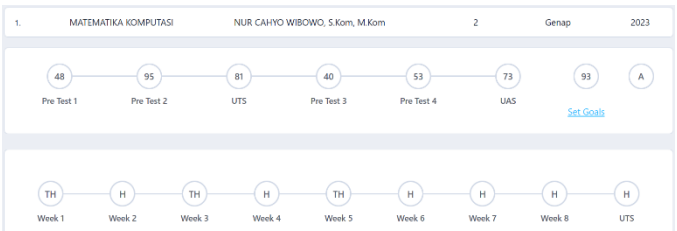

Figure 3 Student Course Dashboard

A dashboard feature specifically designed for Lecturer, displaying visualizations based on the courses they teach, considering the current academic year, semester, and the instructor's ID. The algorithm's success in rendering the visual dashboard with an average time of around 0.3 seconds ensures quick and efficient access to instructor-related data. All detailed information regarding this data can be accessed in Table 1.

Figure 4 Lecturer Dashboard

This feature goes beyond providing a general overview; it also presents key information that facilitates instructors' analysis of student performance. The feature includes a list of the five highest and lowest grades obtained by students in the respective course. Additionally, there is a pie chart summarizing the percentage of student grades with customized colors for each grade: green for Grade A, blue for Grade B, cyan for Grade C, orange for Grade D, and red for Grade F. As a complement, a stacked column chart for student attendance is displayed, using purple for present students and gray for absent ones. All these features are clearly depicted in Figure 4, providing a more comprehensive representation of the course dashboard feature for instructors. With this feature, it is expected that instructors can easily analyze and understand student performance, make informed decisions, and manage classes more efficiently.

A dashboard feature specifically designed for the Head of Study Program displaying visualizations based on the current semester within the current year. The algorithm successfully renders the visual dashboard with an average time of around 0.4 seconds, ensuring quick and efficient access to Head of Study Program related data. Detailed information regarding this data can be accessed in Table 1.

This feature goes beyond providing a general overview; it also includes links to a list of courses that allow the Head of Study Program to explore further details. The dashboard view also incorporates information on the lowest, average, and highest grades for each course. These links are designed to facilitate the Head of Study Program in gaining more insights into each course, while the grade distribution provides a comprehensive overview of the progression of each course. With this feature, it is anticipated that the Head of Study Program can easily manage and monitor the educational progress at the program level. The associated data can be viewed in Figure 5. Additionally, for the bar chart, the color representation is as follows: orange represents the lowest grades, blue represents the average grades, and green represents the highest grades.

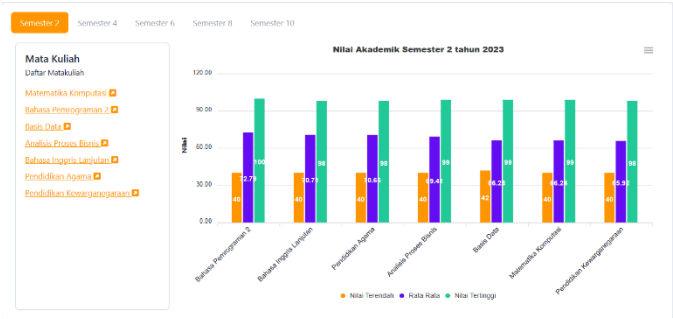

Figure 5 Head of Study Program Dashboard

A dedicated dashboard feature for the Head of Study Program displaying visualizations based on the selected courses. The algorithm successfully renders the visual dashboard with an average time of around 0.6 seconds, ensuring quick and efficient access to Head of Study Program Course-related data. All detailed information regarding this data can be accessed in Table 1.

This feature goes beyond providing a general overview; it also offers specific details related to the courses being supervised. The dashboard view includes information on the name of the instructing faculty, a line chart depicting the progression of grades (highest, average, lowest) for each course per academic year. The color representation in this chart distinguishes the highest grades with green, average grades with blue, and lowest grades with orange. Additionally, there is a pie chart summarizing the percentage distribution of grades in that particular course. The feature also presents a tabulated list of grades and attendance for all enrolled students in that course.

With this feature, it is anticipated that the Head of Study Program Course can easily analyze and monitor student performance in each supervised course. The information provided, ranging from grade progression to grade percentage summaries, is designed to offer a deeper understanding and facilitate the management of the curriculum and academic progress of the study program. The associated data can be viewed in Figure 6.

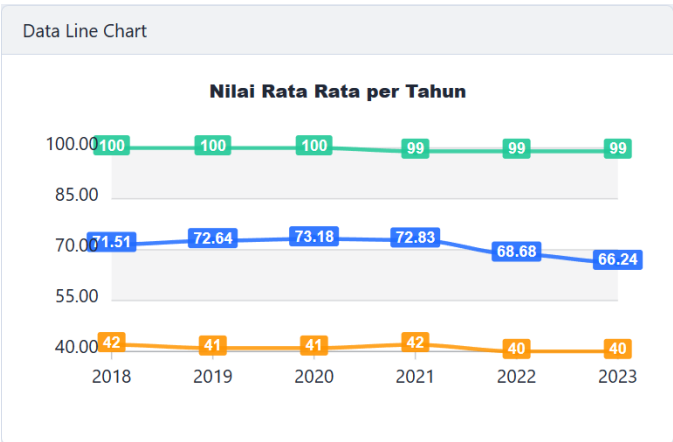

Figure 6 Head of Study Program Course Dashboard

3.2. Functionality Testing Results

- Data Simulation Process

We employed the FakerPHP v1.23.0 software to generate dummy data, incorporating diverse scenarios that mimic a range of academic situations. The simulation process involved selecting appropriate parameters for each data element and adjusting value ranges to align with the academic

context. Throughout this section, we provide a detailed account of the data simulation process, outlining the steps taken to produce a dataset that authentically reflects various academic scenarios. The utilization of the FakerPHP v1.23.0 software allowed us to simulate scenarios involving value variations, attendance situations, and exam scenarios, ensuring a comprehensive representation of academic contexts. This involved selecting suitable parameters for each data element and adjusting value ranges to accurately capture the intricacies of diverse academic situations.

- Dataset Details and Performance Metrics

In this subchapter, we present comprehensive details of the dataset generated during the simulation, including key parameters such as student IDs, course details, faculties, academic years, semesters, as well as performance metrics like pre-test scores, midterm grades, and final exam grades. Additionally, we describe how all values in the dataset were customized within a specific range to provide realistic variation.

- Dashboard Rendering Speed

We evaluate the performance of the algorithm that renders visual dashboards for students, lecturers, and the head of the study program. The average rendering speed, measured in seconds, is recorded for each user type. This evaluation ensures fast and efficient access to student data and understanding the system's response to dashboard rendering demands.

- Data Visualization Quality

Focusing on data visualization aspects, this subchapter discusses the quality of the dashboards produced by the system. We evaluate how well visualizations provide clear and useful information to users. Aspects such as graph clarity, data presentation, and interpretability are the focus of evaluation in this subchapter.

- Functionality Testing

This subchapter covers the overall functionality testing of the system. We test various features, ranging from the student dashboard to the head of the study program dashboard, to ensure that each function operates as expected. The results of functionality testing serve as the basis for assessing the success of the SIMCPM implementation in providing useful and responsive features.

3.3. Results and Discussion

This section serves as an extensive exploration of the data simulation process, encompassing key parameters and scenarios. Utilizing FakerPHP v1.23.0, diverse dummy data is generated, mirroring a spectrum of academic situations. The detailed process involves parameter selection, value range customization, and a focus on aligning simulated data with real-world academic contexts. The comprehensive overview extends to the presentation of the generated dataset, highlighting key performance metrics such as student IDs, course details, academic years, semesters, and exam scores. It also delves into assessing the rendering speed of dashboards for various user types, gauging system responsiveness. With a specific focus on data visualization, the section evaluates dashboards' quality in terms of clarity, interpretability, and overall effectiveness in conveying information. Furthermore, user responses regarding implemented dashboards are analyzed to measure effectiveness and user satisfaction. A crucial aspect covered is the functionality testing results, ensuring each system feature operates as intended. These outcomes contribute to the overall assessment of the system's success in providing useful and responsive features. The section culminates in interpreting the presented results, offering insights into their implications, strengths, limitations, and potential areas for improvement in the SIMCPM system.

4. Conclusions

The development and implementation of the SIMCPM system have been thoroughly examined and presented in this study. The utilization of FakerPHP v1.23.0 for data simulation has provided a robust foundation for testing the system's functionality under various academic scenarios. The comprehensive dashboard features for students, lecturers, and Head of Study Program demonstrate the system's versatility in catering to diverse user roles and needs.

The speed and efficiency of the dashboard features, as indicated by the average page load speeds, showcase the system's responsiveness and user-friendly design. The incorporation of detailed data visualizations, such as charts and graphs, enhances the interpretability of academic information for both students and instructors.

Based on the findings, several recommendations can be made for further improvements. Firstly, continuous testing and validation with real-time data are essential to ensure the system's reliability and accuracy in a live academic environment. User feedback should be actively sought and integrated into the system's updates to enhance user experience and address any emerging needs.

Additionally, expanding the system's features to include predictive analytics and personalized learning recommendations could contribute to a more proactive and adaptive educational environment. Integrating machine learning algorithms to analyze patterns in student performance and engagement could assist in identifying early indicators for academic challenges.

In summary, the SIMCPM system, with its simulated data and functional dashboard features, lays a solid foundation for an efficient academic management tool. Continuous refinement and innovation, guided by user feedback and emerging technological advancements, will be crucial in ensuring the system's sustained effectiveness in supporting academic processes.

References

[1] N. S. Adilah, L. Hadjaratie, and R. Yusuf, "Pengembangan Sistem Informasi Rencana Pembelajaran Semester dan Evaluasi Capaian Pembelajaran Lulusan Berbasis Progressive Web App," vol. 2, no. 1, pp. 84–96, 2022.

[2] E. N. Ogor, "Student Academic Performance Monitoring and Evaluation Using Data Mining Techniques," in *Electronics, Robotics and Automotive Mechanics Conference (CERMA 2007)*, 2007, pp. 354–359. doi: 10.1109/CERMA.2007.4367712.

[3] M. Shi, "Software Functional Testing from the Perspective of Business Practice," vol. 3, no. 4, pp. 49–52, 2010.

[4] A. Černezel and M. Heričko, "A User-Centric Approach for Developing Mobile Applications," in *7th International Conference on Knowledge Management in Organizations: Service and Cloud Computing*, 2013, pp. 455–465.

[5] T. T. Mayabee *et al.*, "Student Performance Monitor: A Big Data Analytical Application," in *Proceedings of International Conference on Data Science and Applications*, 2022, pp. 759–771.

[6] G.-J. Hwang, S.-Y. Wang, and C.-L. Lai, "Effects of a social regulation-based online learning framework on students' learning achievements and behaviors in mathematics," *Comput. Educ.*, vol. 160, p. 104031, 2021, doi: https://doi.org/10.1016/j.compedu.2020.104031.

[7] X. L. Lanqin Zheng and F. Chen, "Effects of a mobile self-regulated learning approach on students' learning achievements and self-regulated learning skills," *Innov. Educ. Teach. Int.*, vol. 55, no. 6, pp. 616–624, 2018, doi: 10.1080/14703297.2016.1259080.

[8] Y.-M. Huang, Y.-T. Lin, and S.-C. Cheng, "An adaptive testing system for supporting versatile educational assessment," *Comput. Educ.*, vol. 52, no. 1, pp. 53–67, 2009, doi: https://doi.org/10.1016/j.compedu.2008.06.007.

[9] R. Y. He, "design and implementation of web based on laravel framework," in *Proceedings of the 2014 International Conference on Computer Science and Electronic Technology*, pp. 301–304. doi: 10.2991/iccset-14.2015.66.

[10] X. Chen and J. Zhang, "The Applications PHP, HTML and MYSQL in Development of Website – Query Function," in *ICMLCA 2021; 2nd International Conference on Machine Learning and Computer Application*, 2021, pp. 1–4.

[11] C. Song, W. Ma, J. Li, B. Qi, and B. Liu, "Development Trends in Precision Agriculture and Its Management in China Based on Data Visualization," *Agronomy*, vol. 12, no. 11, 2022, doi: 10.3390/agronomy12112905.