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Web-Based Student Learning Activities and Development Information System Using Pieces Analysis at OSI Tutoring Center

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ABSTRACT *– Tutoring (BIMBEL) is a form of non-formal education that plays a role in improving students' academic achievements. Oemah Sinau Indonesia (OSI) in Banjarnegara still uses Excel and physical reports to record learning activities and student development, making the process of searching and distributing data less efficient. This study aims to build a web-based information system for learning activities and student development using the PIECES analysis as a system evaluation method at OSI tutoring. The system development uses the Waterfall method with PHP programming language, Laravel framework, and data storage based on Firebase Realtime Database. System testing is conducted using Black-box testing to ensure the system functions according to user needs, and all 10 test scenarios were successfully executed with a "successful" status. System feasibility evaluation uses PIECES analysis (Performance, Information, Economy, Control, Efficiency, Service) was conducted through the distribution of questionnaires to 11 respondents consisting of admins, mentors, and student guardians. The evaluation results showed an average feasibility score of 95%, categorized as very feasible. Specifically, the Performance and Efficiency aspects received the highest scores of 97%, indicating an improvement in the speed and ease of administrative processes as well as real-time access to information. Based on the testing and analysis results, this system is considered effective in replacing manual record-keeping, improving data accuracy, strengthening access control, and facilitating communication between the tutoring center and student guardians. Thus, this information system is proven feasible to be used as a solution for digitalizing learning administration at OSI.*

Keywords - *Information System, Learning Activities, PIECES, Student Progress, Tutoring*

Sistem Informasi Aktivitas Belajar dan Perkembangan Siswa Berbasis Web Menggunakan Analisis Pieces pada Bimbel OSI

ABSTRAK *– Bimbingan belajar (BIMBEL) merupakan pendidikan non-formal yang berperan dalam meningkatkan prestasi akademik siswa. Oemah Sinau Indonesia (OSI) di Banjarnegara masih menggunakan Excel dan laporan fisik dalam pencatatan aktivitas belajar dan perkembangan siswa, sehingga proses pencarian serta pembagian data menjadi kurang efisien. Penelitian ini bertujuan untuk membangun sistem informasi aktivitas belajar dan perkembangan siswa berbasis web dengan menggunakan analisis* PIECES *sebagai metode evaluasi sistem pada bimbel OSI. Pengembangan sistem menggunakan metode* Waterfall *dengan bahasa pemrograman PHP,* framework *Laravel, serta penyimpanan data berbasis* Firebase Realtime Database. *Pengujian sistem dilakukan menggunakan metode* Black-box testing *untuk memastikan fungsi sistem berjalan sesuai kebutuhan pengguna, dan seluruh 10 skenario uji berhasil dijalankan dengan status "berhasil". Evaluasi kelayakan sistem menggunakan analisis* PIECES *(Performance, Information, Economy, Control, Efficiency, Service) dilakukan melalui penyebaran kuesioner kepada 11 responden yang terdiri dari admin, mentor, dan wali siswa. Hasil evaluasi menunjukkan skor rata-rata kelayakan sebesar 95% dengan kategori sangat layak. Secara khusus, aspek* Performance *dan* Efficiency *memperoleh nilai tertinggi sebesar 97%, menandakan peningkatan kecepatan dan kemudahan dalam proses administrasi serta akses informasi secara* real-time. *Berdasarkan hasil pengujian dan analisis, sistem ini dinilai efektif dalam menggantikan pencatatan manual, meningkatkan akurasi data, memperkuat kontrol akses, serta mempermudah komunikasi antara pihak bimbel dan wali siswa. Dengan demikian, sistem informasi ini terbukti layak digunakan sebagai solusi digitalisasi administrasi pembelajaran di OSI.*

Keywords *- Aktivitas Belajar, Bimbel, Perkembangan Siswa, PIECES, Sistem Informasi.*

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1. INTRODUCTION

Tirta et al. stated that tutoring, often referred to as BIMBEL, is a form of non-formal education that supports the improvement of academic performance. Tutoring provides support in developing students' abilities [1]. OSI, or Oemah Sinau Indonesia, located in Banjarnegara, is an institution in the field of non-formal education or tutoring that provides learning for children from toddlers to elementary school. OSI still uses Microsoft Excel for recording learning activities and physical reports for progress reporting. This sometimes makes it difficult to search for and distribute data to students' guardians.

The number of students is expected to continue to increase, and the need for guardians to monitor their children's progress in real time makes recording using Excel and physical progress reports seem inefficient. Based on these problems, it encourages the development of a client-server web-based information system that is sufficiently accessible through a browser [2] so that recording and reporting are more effective, easily accessible, and integrated. Research conducted by Widiyanti et al. [3] designed a tutoring payroll system using the Rapid Application Development method with PIECES analysis. However, that study only used three aspects of PIECES, namely performance, information, and economy, so the evaluation results were not comprehensive. Meanwhile, another study by Maliki et al. [4] designed a web-based information system at BNF Tutoring with features for registration, scheduling, monitoring, and payment.

The results improved tutoring management efficiency, but the study did not explain the technical use of the framework or the system evaluation method. In addition, research by Nasution dan maulana [5] developed an academic information system using the Laravel Framework with secure features for teacher and student data authentication and management, but it has not yet It emphasizes the aspect of evaluating system performance comprehensively.

Meanwhile, Maulidia. [6], who applied the PIECES analysis as an assessment of a web-based school information system, found that control and efficiency aspects are important indicators for improving system quality. However, that study did not integrate cloud database technology for real-time data management. Unlike those studies, there has not been any research that integrates the use of the Laravel framework and Firebase real-time database in developing a system and conducting system feasibility evaluation using all six aspects of the PIECES analysis.

This research aims to fill that gap by building a web-based student learning activity and development information system using the Laravel framework, with security features such as authentication, encryption, and hashing already available [7], and data stored in a database with the purpose of Integrating data in the [8] form of a Firebase database, which is a cloud and backend-as-a-service developed by Google [9], and conducting feasibility evaluation using six main aspects of the PIECES analysis (performance, information, economy, control, efficiency, and service) so that the results are more comprehensive in the context of informatics.

This study aims to build a web-based information system for learning activities and student progress reports, which can facilitate the process of recording, report preparation, and assist guardians who are fully responsible for their children[10] in monitoring the child's development in real time. The scope of this study is limited to the system covering only the recording of learning activities and preparation of progress reports, without including features for payment or student registration.

2. RESEARCH METHOD

The system development method in this research focuses on the construction and design of information systems based on the data that has been obtained, and uses data collection methods that are analyzed using qualitative analysis and quantitative analysis.

System development methods

Method waterfall used as a system development method. This method was chosen to meet the needs of a system with a clear scope and a structured development flow. The following are the stages of the method waterfall[11].

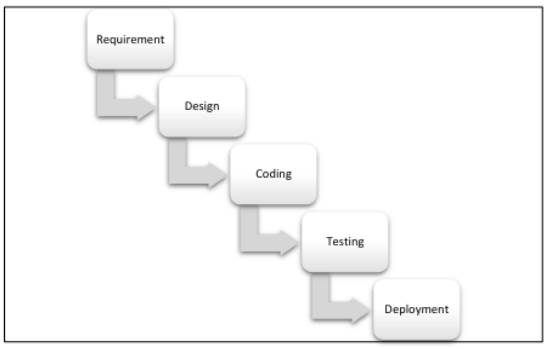

Figure 1. Method Stages Waterfall

The following is an explanation of the stageswaterfall:

Requirements, The researcher conducted direct observations as a mentor and interviews with the owner of the tutoring center, the aim of which was to collect information related to the process of recording student learning activities and creating student progress reports, which were previously done using Excel and paper.

Design, stages design, researchers designed a user interface/UI for three types of users, namely admin, mentor, and student guardian. In addition, the design of the structure was also carried out database use firebaseas well as a system flow diagram that describes the process that the system will carry out.

Coding, researchers built an information system using the PHP programming language andlaravel framework. Researchers built key features such as recording of learning activities by mentors, input of student progress reports that can be downloaded in PDF format, and a page for student guardians to view student learning activities periodically.

Testing, testingis a system testing process to find errors in the system[12]To ensure that every function in the system runs according to expectations, testing is carried out using the methodblack box testing. Such as data input processes, downloading PDF reports, and accessing activity displays by student guardians.

Deployment, deploymentinvolves fixing errors[13] During the deployment phase, the system is first tested locally and shown to the tutoring team to gain initial feedback. The system is then planned for hosting for use.

Method of collecting data

A qualitative approach with a descriptive type was used in this study to obtain data. Developing an understanding of one or more of the phenomena encountered is the goal of qualitative research.[14] This approach was chosen because it aligns with the description and in-depth understanding of conditions occurring in the field, particularly in the design and evaluation process of the information system being developed. This study employed four data collection methods:

Observation, systematic recording of the symptoms being studied, namely observation or observation[14]The observation process was carried out to determine the process of recording learning activities and reporting student progress currently being used at the OSI Tutoring Center.

Interview, data collection by interviews for the design or development of information systems has been recognized as an important and widely used technique.[15]In this study, interviews were conducted with the owner of the tutoring center, who also serves as the administrator, to obtain data and the desired system requirements.

Questionnaire, the questionnaire is conducted by giving several written questions or statements to respondents to answer.[16]The questionnaire uses a five-point Likert scale to assess the feasibility of the system based on the PIECES analysis aspects (performance, information, economy, control, efficiency and service).[17].

Literature study, collecting library data, reading and recording and managing research materials are a series of activities in literature studies.[18]. The literature study in this research was conducted by searching for sources related to the research being conducted.

The data analysis in this study used two types of analysis: qualitative data analysis to analyze the results obtained from observations, interviews, and literature studies. Quantitative data analysis was also used to analyze the results of the questionnaire based on the PIECES model. The questionnaire data from the Likert scale were calculated using the following formula [16].

$$\text{total percentage} = \frac{\text{Overall score}}{\text{Maximum overall score}} \times 100\%$$

The next stage is to interpret the results of the Likert scale calculations which is obtained by the following representation according to Table 1[19].

Table 1. Validity Index Range

No	Percentage (%)	Information
1.	81%-100%	Very Worthy
2.	61%-80%	Worthy
3.	41%-60%	Enough
4.	21%-40%	Not feasible
5.	0%-20%	Totally Unworthy

3. RESULTS AND DISCUSSION

Oemah Sinau Indonesia (OSI) is a tutoring institution in Banjarnegara Regency with one administrator, 80 active students, and 20 mentors. Previously, mentors at OSI Tutoring used Excel to record learning activities, while student progress reports were created physically. This created challenges in data retrieval and delayed distribution of reports to guardians. The information system developed for OSI Tutoring is web-based, with three types of users: administrators, mentors, and guardians. Figure 2 is a use case diagram that helps visualize the relationships between actors and activities within the system.[20].

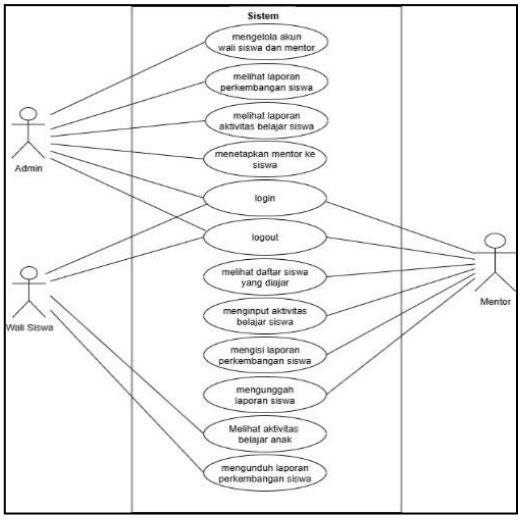

Figure 2. Use Case Diagram of Learning Activity Information System

Use case diagram Figure 2 illustrates the interaction of three main actors: the admin, mentor, and student guardian, with various features available in the system. The admin plays a crucial role in system management: he can log in and log out, and he has access to manage student, guardian, and mentor accounts. He can also view student progress and learning activity reports and assign mentors to students. Guardians can log in to the system to monitor their children's progress. Guardians can access features such as viewing student progress reports, viewing student learning activities, and downloading student progress reports as documentation. Finally, the mentor acts as the student's guide.[21]Mentors can log in and out, view a list of their students, and upload student reports to the system, which can then be accessed by parents and administrators.

The information system interface is designed to be web-based, with a simple interface that adapts to user roles. Figure 3 shows the login page for all users. On this page, users are required to enter the appropriate email address and password to access the dashboard for their respective roles.

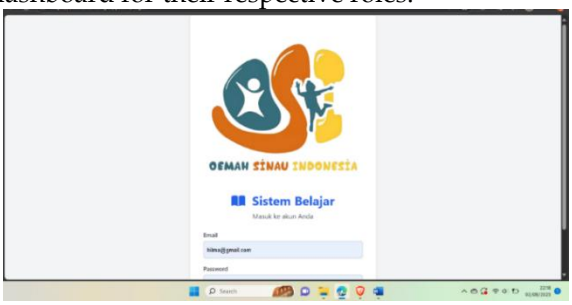

Figure 3. Page Implementation All Users Login

Based on Figure 3 is an implementation of the dashboard page for the admin. This view displays the main menu which has the function of managing system data comprehensively by the admin, such as mentor data, students and learning activity reports.

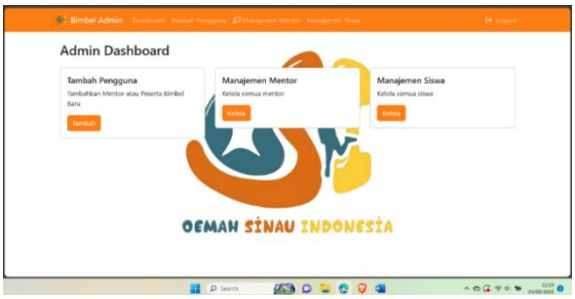

Figure 4. Page Implementation Admin Dashboard

Figure 5 below shows the mentor's main page. This is the initial page when the mentor successfully logs into the system.

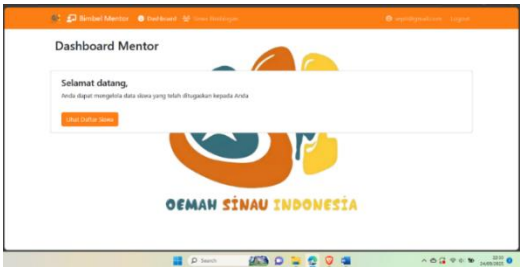

Figure 5. Page Implementation Mentor Dashboard

Figure 6 below shows the mentor's add activity page. This is a crucial part of the system. Mentors can add student learning activities on this page. Mentors must enter the activity's added data, including the date, subject, topic, duration, and description. Then, select the save option to save the created activity and display it on the learning activities page for all users.

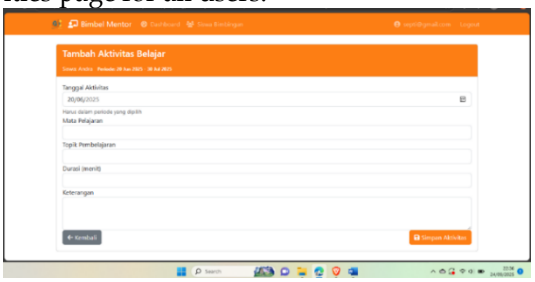

Figure 6. Implementation of the Add Learning Activity Page

Based on Figure 7 below shows the student progress Mentors can create student progress reports on this page. Mentors must enter data to create the report, such as grade level, program, learning category, overall grade, and so on, throughout the learning period.

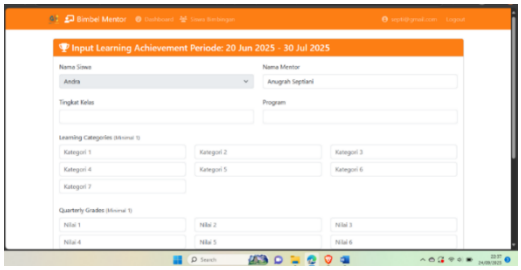

Figure 7. Student Progress Report Input Page View (Mentor)

Based on Figure 8 below is the main page or dashboard for guardians. After logging in, guardians are taken to the main page. On this page, guardians can view the learning periods their child has completed while working with a mentor. There are two main menus for guardians on this page: "View Activities" to view learning activities and "View Achievements" to view reports on their child's progress.

Figure 8. Page Implementation Guardian Dashboard

This research conducted testing of systems built using the blackbox testing method, which focuses on system functions without knowing the internal structure of the code. Testing with blackbox testing is done by executing the program and filling in data on each available form [22]. The system was tested to ensure that every feature and function worked as expected. Testing was conducted by several system users, each with their respective roles: administrator, mentor, and student guardian. Each user was given access to try out the system's available features. The test results can be seen in table 2 below.

Table 2. InstrumentBlack Box Testing

No	Features tested	Test description	Expected results	Status (success/ failure)
1.	Login	The user enters a username and password.	The system displays a dashboard according to each role (admin, mentor, student guardian).	Succeed
2.	Learning activity input	Mentors fill in activity data per meeting.	Data is saved and appears in history.	Succeed
3.	Input progress report	Mentors fill out student progress reports	Data is saved and appears in history.	Succeed
4.	View learning activities by guardian	Student guardians log in to view student learning activities	Learning activities appear according to the students concerned.	Succeed
5.	Downloading student progress reports by guardians	The student's guardian selects the print button.	The report is downloaded and saved on the device.	Succeed
6.	Add mentor and guardian accounts by admin	Add username and password for mentor and guardian accounts.	The system stores data in the database and the system displays the latest mentor and guardian data.	Succeed
7.	Delete guardian and mentor account data	Admin deletes guardian and mentor accounts by selecting the delete menu	Account successfully deleted and displays the latest account data	Succeed
8.	Assignment of mentors to students by admin	Select a mentor when filling in student data	Displays student data form and mentor selection dropdown	Succeed
9.	View student	Admin monitors	Displaying the	Succeed

No	Features tested	Test description	Expected results	Status (success/ failure)
	learning activities by admin	learning activities	learning activity table	
10.	View student progress reports by admin	Monitoring student progress reports	Displaying progress reports	Succeed

A system feasibility evaluation using the PIECES model was conducted on three user groups: administrators, mentors, and guardians. The results showed that all three user groups rated the system as highly feasible. Figure 9 below shows a diagram of the questionnaire with three types of respondents.

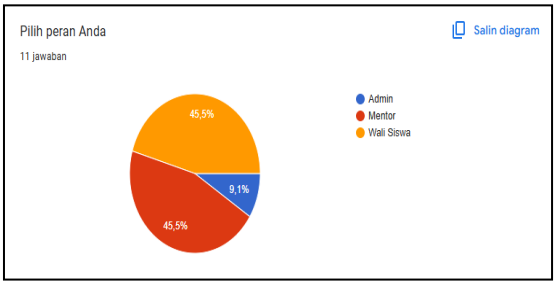

Figure 9. Questionnaire Diagram

Based on Table 3 below shows the questionnaire results table based on the PIECES aspects.

Table 3. Recapitulation of Aspect Questionnaire Results PIECES

No	Aspect	Likert Scale Results			Average	Category
		Admin	Mentor	Student Guardian		
1.	Performance	100%	92%	98%	96%	Very Worthy
2.	Information	90%	88%	98%	92%	Very Worthy
3.	Economy	100%	92%	100%	97%	Very Worthy
4.	Control	90%	92%	98%	93%	Very Worthy
5.	Efficiency	100%	90%	100%	97%	Very Worthy
6.	Service	100%	90%	100%	97%	Very Worthy

Based on the analysis results in Table 3, the information system developed meets the needs for recording learning activities and reporting student progress at the OSI tutoring center. The test results indicate that all functions functioned well, and the PIECES evaluation provided an average score of 95%, categorized as very adequate.

In terms of performance, the web-based system has been proven to accelerate record-keeping compared to the manual method using Excel. In terms of information, it was rated very good because the resulting reports were more accurate, easily accessible, and available in real time. In terms of economy, this web-based information system reduces paper usage and report printing costs. However, some mentors still gave it lower scores because they required additional devices for data input. This indicates the consequences of new operational costs, although generally more economical than the manual method. In terms of control, the implementation of different access rights for admins, mentors, and guardians demonstrated improved security. The role-based access control principle used is in accordance with information system control theory, which emphasizes data protection through limiting user rights. Efficiency and service aspects were also rated very high. This is understandable because admins find it easy to manage data, while guardians receive transparent service in the form of progress reports that can be accessed at any time.

When compared to the devotion by[3]This study produced a more comprehensive evaluation because it involved six PIECES aspects, not just three. Both findings indicate that PIECES is effective in assessing the feasibility of information systems. Meanwhile, the dedication by[4],demonstrated that a web-based tutoring information system can improve management efficiency, but it did not include quantitative evaluation. This study addresses this gap with a PIECES analysis that produces a comprehensive measure of feasibility.

Thus, this research aims to produce an information system that not only solves administrative problems but also proves highly feasible based on an evaluation of the six PIECES aspects. Its limitation is that the system's scope is still limited to recording learning activities and reporting student progress, without integration of automatic attendance, payments, or real-time notifications. This presents an opportunity for further development.

4. CONCLUSION

The results of this research in the form of the development of a web-based student learning activity and development information system at Oemah Sinau Indonesia (OSI) were successfully implemented. This system is able to replace manual recording that previously used Excel, so that the administrative process becomes faster, more efficient, and transparent. Evaluation using PIECES

analysis showed an average value of 95% with a very feasible category, which means the system is effective in improving administrative performance, providing accurate information, saving resources, providing better control, and improving the quality of service to student guardians. Thus, the goal of the service to provide a more efficient and beneficial information system for all parties at OSI can be achieved. Suggestions for further development are to add a special notification feature for student guardians so that parents can receive automatic reminders when there is a new study schedule or when a student progress report has been added by a mentor. In addition, the system is also recommended to add a feature to upload documentation in the form of photos or videos in the learning activity report, so that the information conveyed is not only in text form, but also supported by clearer and more accurate visual evidence regarding student learning activities.

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