

Development of Integrated Laboratory Management Information System

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Abstract— In 2021 PGRI Semarang University have at least 64 laboratories. This makes it a challenge for a private university to obtain funding independently in managing and maintaining assets of that size. It is necessary to develop an information system that could provide information input and information output facilities managed by the faculty and laboratory managers at the unit level of study programs and faculties, to be further reported as information to institutions and stakeholders. The researcher wants to make it a research goal, by designing and developing a Laboratory Information System (SILab) at the University of PGRI Semarang, which is validly tested according to the design results and is reliable or proven to be used well by users through user response tests.

Keywords— laboratory management; information systems; research methods research and development; unified modeling language; system development design.

I. INTRODUCTION

IKIP PGRI Semarang, which in 2014 transformed into Universitas PGRI Semarang, has made extraordinarily significant development. Starting from the addition of the number of faculties, study programs, educational staff, and supporting facilities such as laboratories. According to the results of the latest survey summarized in the matrix of the distribution of laboratory facilities owned by this university, it was recorded that there were approximately 64 laboratories, spread over

8 faculties including the Postgraduate Faculty (Post) 1 Laboratory, the Faculty of Social Sciences and Sports Education (FIPSKR) 16 Laboratory, Faculty of Mathematics Education, Natural Sciences and Information Technology (FPMIPATI) 18 Laboratories, Faculty of Language and Literature Education (FPBS) 3 Laboratories, Faculty of Engineering and Informatics (FTI) 19 Laboratories, Faculty of Law (FH) 1 Laboratory, Faculty of Economics (FE) 1 Laboratory, Professional Development Institute (LPP) 3 Laboratory and SMA Laboratory, PGRI University Semarang 4 Laboratory. This is a challenge in itself, considering that if it is not managed properly, then the facilities which were originally an asset of the institution become a burden in itself. Considering that PGRI Semarang University is a private institution, which obtains its funding independently. From this, a thought emerged that it was deemed necessary to manage such a large asset, it was highly recommended or an effective system for providing information reporting was needed, so that the potential of the laboratory could be well organized and well-structured for its management and development plan. This developed system will later be able to provide informed input and information output facilities which are managed by the faculty and laboratory managers at the unit level of study programs and faculties, to be subsequently reported as information to institutions and stakeholders (both students and lecturers as users, or the general public who requires cooperation in special laboratory tests in universities according to their needs).

Literature Review

Several research journal libraries and relevant sourcebooks were used to support this research, including;

1. The research of Hisyam Wahid Lutfi and Berliana Kusuma Riasti (Luthfi & Riasti, 2013) entitled "Information Systems for Maintenance and Laboratory Inventory at SMK Negeri 1 Rembang is Web-Based" which uses the Unified Modeling Language (UML) design, PHP and SQL programming languages, resulted in an information system that can be implemented in good laboratory management.
2. Research by Mahendra Pratama, Muhammad Komarudin, and Helmy Fitriawan (Pratama et al., 2014) entitled "Design of an Integrated Electrical Engineering Laboratory Information System, University of Lampung Web-Based" which uses a modified waterfall research method, system design using the ER-Diagram model, PHP programming language and PostgreSQL database and system functional testing, with test results valid or following system design.
3. Research by Lasmedi Afuan and Ipung Permadi (Afuan & Permadi, 2013) entitled "Design of a Web-Based Laboratory Information System (SILAB) in Informatics Engineering Universitas Jenderal Soedirman" which uses the waterfall research method (Pressman, 1997), DF-Diagram system design and Conceptual Data Model (CDM), the programming language PHP and MySQL. A laboratory information system is produced that can be implemented and assist activities in the Universitas Jenderal Soedirman study program.
4. Novendra Adisaputra Sinaga's research (Sinaga, 2018) entitled "Development of a Web-Based Computer Laboratory Information System (Case Study of the Indonesian

Business Polytechnic)" uses a DF-Diagram system design based on business process analysis, PHP and MySQL programming languages, the resulting system valid information can be used according to the design.

5. Al Antoni Akhmad's research (Akhmad, 2010) entitled "Creating a Web-Based Energy Conversion Laboratory Information System Using Open Sources PHP and AuraCMS Programs" uses an evolutionary research method that starts directly from field studies to determine system requirements and continues directly with interface creation. and writing PHP scripts. Direct testing based on system requirements analysis. As a result, the system runs, but it is not perfect and improvements still need to be made according to user input.

Sources of literature in the form of books, which are used to support research, include;

1. Books written or adapted by M. Firman Arif, S.Kom., M.Kom. (M. FIRMAN ARIF, 2019) entitled "Information System Analysis and Design" Delivered that a good information system must implement a system life cycle (system life circle), this is important so that after the system is implemented or implemented it still can be redeveloped according to system requirements or business requirements. As for the design development tool or information system design, using the DF-Diagram model
2. The book written or adapted by Muhamad Muslihudin and Oktafianto (Muslihudin et al., nd) entitled "Analysis and Design of Information Systems Using Structured Models and UML" Conveys that the quality of the information displayed in an information system is very dependent on the analysis and design of the information system can be a decision

support system (decision support system) in a business process while the analysis of structured information systems mainly has several models including the DF-Diagram model, Object-Oriented Analysis and Design (OOAD), Unified Modeling Language (UML) and Use Case Diagrams, all of which have their advantages and disadvantages.

3. Books written or adapted by Adyatanata Lubism, S.Kom., M.Kom. (Lubis, 2016) entitled "Basic Database" Explain how the database design process uses ER-Diagram according to the needs of the data/information transaction process.
4. Indra Kharisma Raharjana's book or adaptation (Raharjana, 2017) entitled "Information System Development Using the AGILE Methodology" Explains how to develop an information system or software using the evolutionary method or the latest AGILE which is based or focused on the work process that is usually carried out iterative, where rules and solutions are agreed upon by collaboration between teams in an organized and structured manner. This means that the information system developed is adaptive, or developed and can be redeveloped as needed.
5. The book or adaptation of Mei Prabowo, M.Com (Prabowo, nd) entitled "Information System Development Methodology" Says that in addition to the method of developing information systems using the AGILE development model, there is also another method of developing information systems or software, namely the Rapid Method. Application Development and Spiral method. As for testing, the three of them can use several methods, namely using performance testing, system testing, unit testing, or integration testing

II. METHOD

To achieve the research objectives, software development research methods or information systems development methods are used, namely the AGILE evolutionary method, as for the information system design model using Use Case Diagrams which are then interpreted more clearly using Context Diagrams and database design using Entity-Relationship Diagrams (ER). -Diagram). For testing using performance testing based on the design and user response. The research method that the researcher applies is Agile, this method was chosen because the Agile method is faster in making changes or system development

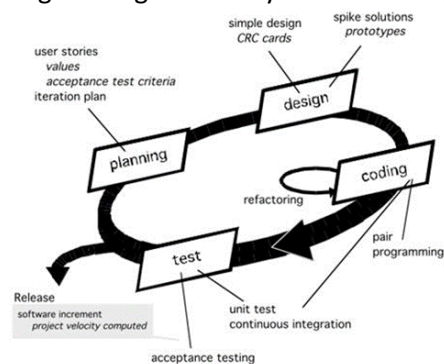


Figure 1. Agile Method

1. Planning
The next stage is the stage of gathering requirements by focusing on: hardware, software, and Brainware, Brainware itself includes making systems by translating designs or drawings into programming languages, validating and testing the system when the system is ready to use, and performing maintenance on the system so that the system can run. run as needed.
2. Design
This stage consists of how the system will be built in other words planning software solutions.
3. Coding
This stage is the stage of code generation, namely translating the image or design into an algorithm that can be implemented into a programming language.
4. Test

Next is the final stage in making software or system. After doing the analysis, design, and coding, the finished system will be used by the user. Then the software that has been made must be maintained regularly.

In performance testing which is based on the design, the researcher focuses on two main modules of the designed system, namely;

1. Front End Module
This is the part that is directly visible to the user. Users can directly interact in this section
2. Back End Module
Is the back of the layer that can only be accessed by the admin

While in testing user responses, researchers use a questionnaire which can be in the form of closed/open questions/statements, and each respondent's answer has a score as follows:

Category	Score
Yes	1
No	2

With this type of measurement scale, a firm answer will be obtained, namely "yes - no"; "True False"; ever – never"; positive - negative and so on. The answer "yes" will be given a score of 1 (one) and for the answer "no" will be given a score of 0 (zero). (Sugiyono, 2016:169).

The formula used in measuring the Guttman scale is still according to the same reference:

$$P = \frac{f}{n} \times 100\% \dots \dots \dots [1]$$

Description :

P = Percentage

f = Frequency of "yes" answers

n = Number of questions

Furthermore, the percentage obtained is changed in the form of a table as follows:

Percentage	Category
0% - 20%	Not feasible
21% - 40%	Less worthy
41% - 60%	Decent enough
61% - 80%	Worthy
81% - 100%	Very Worthy

III. RESULTS AND DISCUSSION

Implementation Design

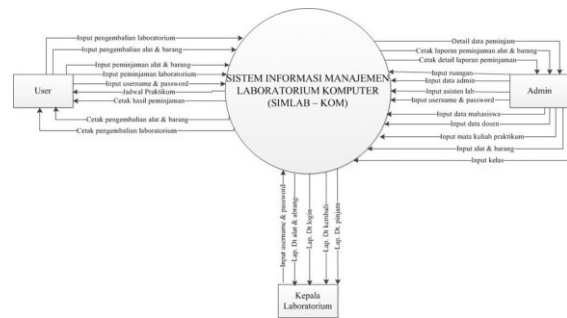


Figure 2. Context Diagram

In this study using a design model of information system design Use Case Diagram which is then interpreted in more detail using Context while the database design uses Entity Relationship Diagram (ER-Diagram). Shown in the context of the diagram above there are 3 entities, and some of the data flows include:

1. User Entity

The user entity has 9 data streams. The user will perform the login process by entering the username and password. Furthermore, the user can input (choose) a loan, either laboratory loan or equipment and goods. In addition, the user can also make a return. The system will process according to what is selected by the user, after that the system will provide feedback in the form of a print out of borrowing or returning. Users can also view loan and return reports.

2. Admin Entity

The admin entity has 12 data streams. Admin will perform the login process by entering the username and

password. Admins can access the data on the menus in the dashboard, namely class menus, rooms, courses, lab assistants, goods and tools, laboratory heads, admins, lecturers, students, and practicum schedules. Admin also has search, edit, add, and delete actions on class menus, rooms, courses, lab assistants, goods and tools, laboratory heads, admins, lecturers, students, and practicum schedules. Admin can also print and save loan and return reports.

3. Entity Head of Laboratory

The head laboratory entity has 5 data streams. The Head of the Laboratory will carry out the login process by entering a username and password. The Head of the Laboratory can print and save reports on the results of borrowing and returning. The head of the laboratory can view login data, as well as data on goods and tools.

Next, an Entity Relationship Diagram (ER-Diagram) is shown which shows the relationship between entities and the transactional data that occurs in them.

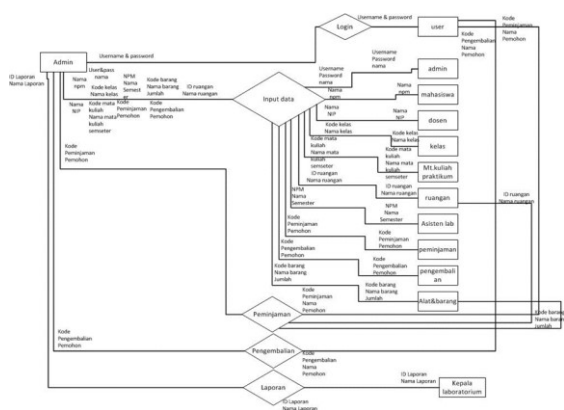


Figure 3. Entity Relationship Diagram

Furthermore, it is still in relation to database design which is literally a collection of tables in which there are entities, so the following table design and the entities in it are shown.

1. Class table

The class table contains information about the existing classes in the system. Which in

it consists of class code and class name which is described as follows:

Table 3. Class Table

Field	Type	Panjang/Nilai	Keterangan
Kode_kel	varchar	16	Primary Key
Nama_kel	varchar	30	

2. Table room/laboratory

The room table contains information about the laboratory rooms in the information technology education study program. Which in it consists of LAB ID and Laboratory Name which is described as follows:

Table 4. Table Room

Field	Type	Panjang/Nilai	Keterangan
ID_LAB	varchar	16	Primary Key
Nama_Laboratorium	varchar	30	

3. Table of practicum courses

The table of practicum courses contains information about practical courses in the information technology education study program. It consists of course code, course name, semester and credits which are described as follows:

Table 5. Table of Practicum Courses

Field	Type	Panjang/Nilai	Keterangan
Kode_Mata_Kuliah	varchar	16	Primary Key
Nama_mata_kuliah	varchar	30	
Semester	varchar	16	
SKS	varchar	16	

4. Lab assistant table

The lab assistant table contains information about laboratory assistants in the information technology education study program. Which consists of NPM, assistant name and semester which is described as follows:

Table 6. Lab Assistant Table

Field	Type	Panjang/Nilai	Keterangan
NPM	varchar	10	
Nama_asis	varchar	30	
Semester	varchar	10	

5. Table of tools and goods

The tools and goods table contains information about tools and goods in the laboratory of the information technology education study program. Which in it consists of the code of goods, the name of the goods and the number of goods described as follows:

Table 7. Table of Tools and Items

Field	Type	Panjang/Nilai	Keterangan
Kode_barang	varchar	16	Primary Key
Nama_barang	varchar	30	
Jumlah_barang	varchar	30	

Implementing Input Output Design (DIDO) Interface

1. Home View

Here is the implementation of the home menu. In the computer laboratory management information system there are two dashboards, namely the admin dashboard and the user dashboard. The admin dashboard has a dashboard menu, master, account, practicum schedule, loans, loan reports and logout. While on the dashboard the user only has a home menu, and logout. However, the admin and user dashboard display designs remain the same, only the menu access makes the difference. Here is the implementation of the home menu for admin:

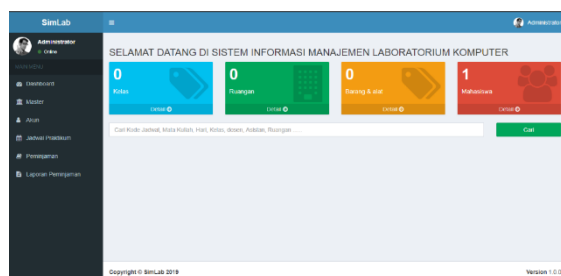


Figure 4. Implementation of Home Menu

2. Display course menu

The following is the implementation of the course menu. In the course menu there is a table containing the number, course_code, course_name, semester, credits and actions. And there is a table for adding data in the form of data for the course code, subject_name, semester, credits. Here is the implementation of the course menu:

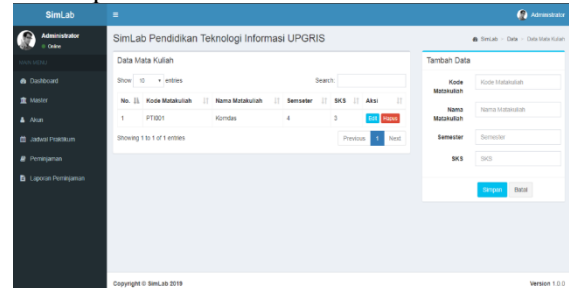


Figure 5. Implementation of the Course Menu

3. Display menu items and tools

Here is the implementation of the menu of items and tools. In the goods and tools menu there is a table containing the number, item_code, item_name, quantity, status and action. And there is a table added data in the form of data code_barang, nama_barang, amount, status. Here's an implementation of the tools and items menu:

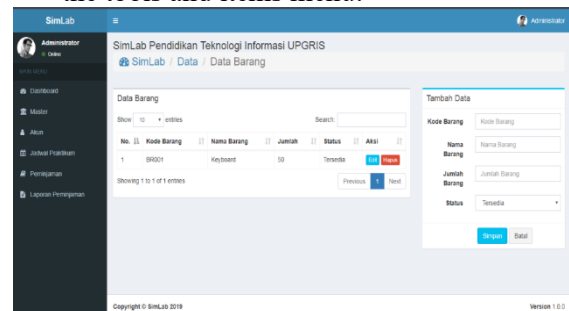


Figure 6. Implementation of Tools and Material Menu

4. Loan report menu display

The following is the implementation of the loan report menu. In the loan report menu there is a table containing the number, borrowing_code, requester, destination, start date, finish date, status, and action. The following is the implementation of the loan report menu:

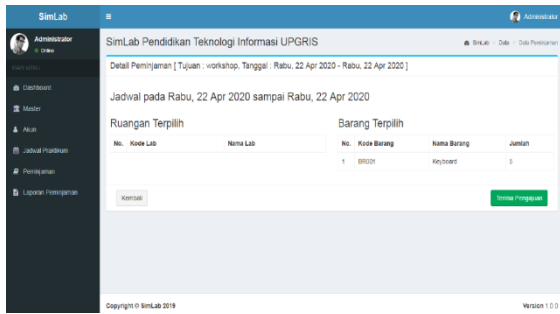


Figure 7. Implementation of the Loan Report Menu

5. Display the borrowing print menu to the user. The following is the implementation of the borrowing print menu for the user:



Figure 8. Implementation of User Loan Print Menu

Test

Using performance testing that focuses on 2 main modules of the system which includes front end and back-end modules

Table 8. Table of Performance Testing on the Front End (User) Module

Modul	Sub Modul	Keterangan
Account User	▪ Login	[√] Valid
	Account	[√] Valid
	▪ Register	[√] Valid
Dashboard	Account	
	▪ Logout	
	▪ Informasi	[√] Valid
	jadwal praktikum	[√] Valid
Product	▪ Menu	[√] Valid
	peminjaman	
	▪ Menu	[√] Valid
	pengembalian	
	▪ Menu	[√] Valid
	formulir	
	peminjaman	[√] Valid
	▪ Dokumen	
	peminjaman	[√] Valid

Modul	Sub Modul	Keterangan
	▪ Cetak	
	formulir	

Table 9. Table of Performance Testing on Back End Module (Administrator)

Modul	Sub Modul	Keterangan
Account User	▪ Login	[√] Valid
	Account	[√] Valid
Dashboard	▪ Logout	
	Account	
	▪ Manage mahasiswa	[√] Valid
	atau dosen	[√] Valid
	▪ Manage	[√] Valid
	jadwal praktikum	[√] Valid
	▪ Manage alat dan bahan	[√] Valid
	▪ Manage	
	peminjaman dan pengembalian	
	▪ Manage	
validasi		

User Response Test Results

Following are the results of testing user responses to the developed Integrated Laboratory Information System

Calculations are carried out using the following formula:

$$P = \frac{f}{n} \times 100\% \dots \dots \dots [1]$$

Description :

P = Percentage

f = Frequency of “yes” answers

n= Number of questions and obtained the following results:

Table 10. User Response Table

No	Responden	Presentase
1	Responden 1	70 %
2	Responden 2	100 %
3	Responden 3	90 %
4	Responden 4	90 %
5	Responden 5	100 %
6	Responden 6	100 %
7	Responden 7	100 %
8	Responden 8	90 %
9	Responden 9	70 %

No	Responden	Presentase
10	Responden 10	80 %
11	Responden 11	90 %
12	Responden 12	70 %
13	Responden 13	100 %
14	Responden 14	100 %
15	Responden 15	90 %
16	Responden 16	70 %
17	Responden 17	80 %
18	Responden 18	90 %
19	Responden 19	80 %
20	Responden 20	100 %
21	Responden 21	70 %
22	Responden 22	80 %
23	Responden 23	80 %
24	Responden 24	100 %
25	Responden 25	90 %

This user response questionnaire was obtained from laboratory managers at PGRI Semarang University who were specifically invited to provide assessments and input on the information system developed.



Figure 9. Audience Activities Assessment and Feedback by Users

A. RESULT

Then proceed to the calculation of the average results of all respondents using the following calculation formula:

$$\text{average} = \frac{\text{total percentage of respondents}}{\text{number of respondents}}$$

B. DISCUSSION

And based on the results of the calculation of the average percentage of answers from

all respondents said to be very feasible with a percentage of 87.2%

IV. CONCLUSION

The conclusions that can be drawn from the research activities that have been carried out are as follows:

1. A Laboratory Management Information System has been successfully developed that can be used in the PGRI Semarang University environment
2. Based on the results of testing the system performance is declared valid in accordance with the design of the developed system design
3. Based on the average percentage of the questionnaire or user response, the percentage obtained is 87.2% or the system is declared very feasible to use

ACKNOWLEDGMENT

Thank you very much to the Institute for Research and Community Service, Universitas PGRI Semarang

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