Design of a Web-Based Learning Management System for Physics Education FKIP University of Riau

Salsabilla Azahra Putri[1], Feri Candra[2]
[1, 2] Universitas Riau, Kampus Bina Widya KM. 12,5, Simpang Baru, Kec. Tampan, Kota Pekanbaru, Riau 28293, Indonesia
Email: salsabilla.azahra4059@student.unri.ac.id [1], feri@eng.unri.ac.id [2]

Abstract – 21st-century technology requires everyone to see and continue to advance in learning in various forms. Technology is a reference in the success of the learning process supported by the quality of teaching, teaching staff, and curriculum. The Physics Education Study Program at the University of Riau in its learning still uses conventional methods. Learning is only carried out by students and lecturers in class in a short time so students often do not understand the material provided. Based on these problems, we need a learning management system. The goal is to add a limited amount and short meeting time. The system was built using the PHP and MySQL programming languages with the CodeIgniter framework. This study uses the Research and Development (R&D) method and software development uses the System Development Life Circle (SDLC) method with a variation of the v-model. Based on software testing using a black box, all features run 100% well and the User Experience Questionnaire (UEQ) test found that the Learning Management System has good appeal, clarity, and certainty. While efficiency is categorized as very good, stimulation and novelty are included as above average.

Keywords - Learning Management System, Web-Based, System Development Life Cycle, Research, and Development

I. INTRODUCTION

The development of information and communication technology demands learning innovation in various forms. Specific knowledge in optimizing ICT to support student learning in certain subjects/classes is called Technological Pedagogical Content Knowledge (TPACK) [1]. In implementing TPACK, lecturers and students must learn not to be IT literate.

The National Education System Law about Academic Qualification Standards and Teacher Competency of the Republic of Indonesia Minister of National Education Number 16 of 2007 requires teachers to be competent in applying TPACK. In this law, it has been stated that one of the components of teacher professional competence is the teacher's ability to use ICT to carry out educational development activities. This is so that teachers can access learning resources and prevent students from getting bored in class more easily if they have a firm grasp of information technology.

Learning in the Riau University Physics Education Study Program generally still uses conventional methods. Learning activities were only carried out in class for a short time. This of course can reduce the effectiveness of students in learning, and make the material by the lecturer take longer. Based on these problems, we need a web-based learning management system to solve problems arising in the learning process. A learning management system that supports learning that is not only done in the classroom so that learning can be done anytime and online so that time constraints can be overcome.

With the Learning Management System, students gain insight and knowledge face-to-face on campus and can access material using Internet services. This Learning Management System allows the computerized learning process to be carried out remotely in online learning and is

useful if students or lecturers do not have time to attend class. In addition, this system is expected to increase the limited number and short time of meetings so that students do not miss information and materials from lecturers

The Learning Management System is used to interact with lecturers or their colleagues on the Internet network. All documentation is neatly arranged to facilitate the learning process. Another advantage of the system is that the activities of students or lecturers can still be monitored by the study program. The Learning Management System can assist in an effective teaching and learning process as a way to improve learning using IT according to Minister of Education Regulation No. 16 of 2007.

II. STUDY SIGNIFICANCE

A. Literature Study

Related research conducted by Laras Sulistyorini, et al with the title "Literary Study of Analysis of Strengths and Weaknesses of LMS Against Project-Based Learning for Web Programming Subjects in Vocational High Schools", revealed that Moodle is a simple LMS, which has very complete features in accessing learning. Moodle has drawbacks, namely using Moodle requires more understanding when configured, must have experts in building the system, requires a very large fee, and must install paid software to support Moodle [2]. Another study entitled "User Experience Evaluation on Edmodo and Google Classroom using the Technique for User Experience Evaluation E-Learning" by Nurhayati, et al revealed that Edmodo has features that allow teachers to expand learning strategies. The weakness of Edmodo is that Edmodo is only available in English, and does not yet provide a chat forum feature, where this feature is very important for carrying out online teaching and learning activities [3]. Another related research conducted by Pradana with the title "The Influence of Google Classroom Implementation on PBL Learning Models on Student Outcomes", revealed that Google Classroom is the most frequently used LMS, has easy and fast application settings, and has been integrated with all other Google services [4]. According to Nurhayati, the user experience on Google Classroom has problems related to General Assignments, Learnability, and Usability where there are no Help and Documentation features [3].

Based on the explanation of several existing LMS, the novelty of this LMS is that the system has user-friendly, flexible features and can be used by users unfamiliar with the technology. Some important features are, study program admins can monitor classes, LMS has analytical and graphical features that can monitor students in carrying out exams, there are online/offline features for students that can be seen by lecturers, document headers that can be adjusted to study program headers, can manage schedules in setting exams, and designing an easy-to-use interface so that it is responsive on various devices.

Based on the literature review, several previous studies have designed a learning management system that has its advantages and disadvantages. In this study, the authors combine features in previous studies and add other features into one system. This system features discussion forums, video management, student score recapitulation, exam and quiz retreat timeframe features, visualization in the form of graphs and tables, print and export data features, and user blocking features.

This software research and development use the System Development Life Circle (SDLC) waterfall development method with a v-model variation. The systematic of writing in this study are the introduction, study significance, results and discussion, and conclusions.

Codeigniter is a PHP framework that can develop web applications and help speed up PHP-based developers when compared to writing programs from scratch [5]. Codeigniter has a complete package for running operations on the web. For example, accessing databases sending

emails, and so on. The Codeigniter framework has advantages in a fairly complete package. This makes the website easier because it uses a framework.

The programming language Hypertext Preprocessor (PHP) uses scripts to process data and send the code back to HTML. PHP can be used to access databases so that they can run on all types of platforms. In the development of PHP, it is supported by many communities so PHP is very easy to learn on all types of platforms on the internet. Learning PHP will require a web server so that PHP can run well on the internet. PHP is the most widely used programming language by software developers [6].

Structured Query Language is the language used to access databases in relational databases. SQL or Structured Query Language is a standard language used in relational database management. Almost all database servers support this language to interrupt their current data management. By using SQL, it is possible to communicate with the database, write, read, and get useful information in the database [7].

B. Research Method

This research method uses research and development (R&D) methods. The method in question is a research and development approach which is a way to produce new products or improve existing products [8]. The following are the stages of research & development research:

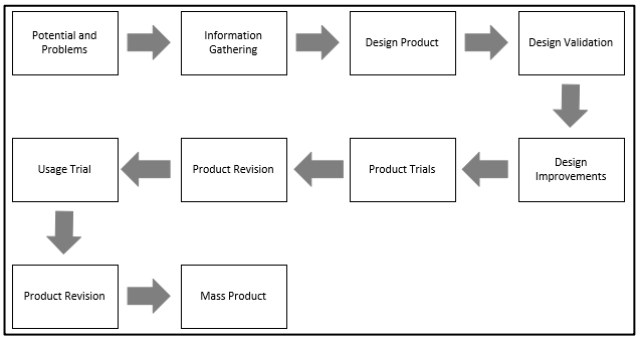


Figure 1. Research and Development Method

1. System Development Method

The System Development Life Cycle (SDLC) paradigm is used in the system developed for this project. One of the SDLC models, known as the V-model, is created from the waterfall approach, completed in phases, and then described using a V shape. The verification phase is known as the left side, while the validation phase is known as the right side. The development of the v-model has the advantage that each phase is always tested so that it has clear results [9], with the stages of testing as shown in the image below.

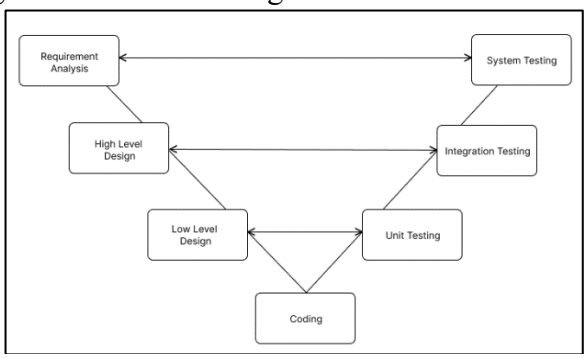


Figure 2. V-Model Method

The following is an explanation of the SDLC v-model stages:

a. Requirement Analysis
This stage is a process carried out after data collection. This analysis stage is carried out to analyze user requirements derived from interviews so that the right system is obtained. Learning in Physics Education FKIP UNRI shows that it is less effective in the process of teaching and learning activities, so it is necessary to develop a system to overcome these problems by building a website-based learning management system.

b. System Analysis
1. Old System Analysis
Old needs are analyzed using interviews and observations with lecturers, study programs, and students. The old system analysis flowchart can be seen in the image below:

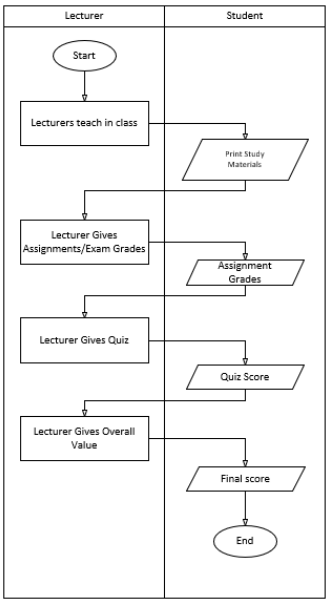


Figure 3. Old System Analysis

2. *New System Analysis*
The analysis of the new system is built by combining student data, lecturer data, course data, and other data. The processed data will then be included in a report so that the study program participants can view the data in the form of visualizations and tables. The new system analysis flowchart can be seen in the following figure:

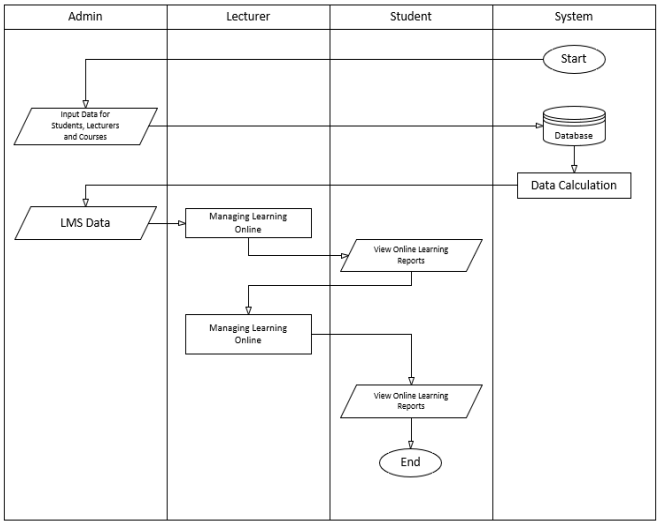


Figure 4. New System Analysis

C. System Design

1. Use a Case Diagram

2. Use case diagrams to illustrate how one or more actors in the future system will interact [10]. A use case diagram for the learning management system can be seen in the image below:

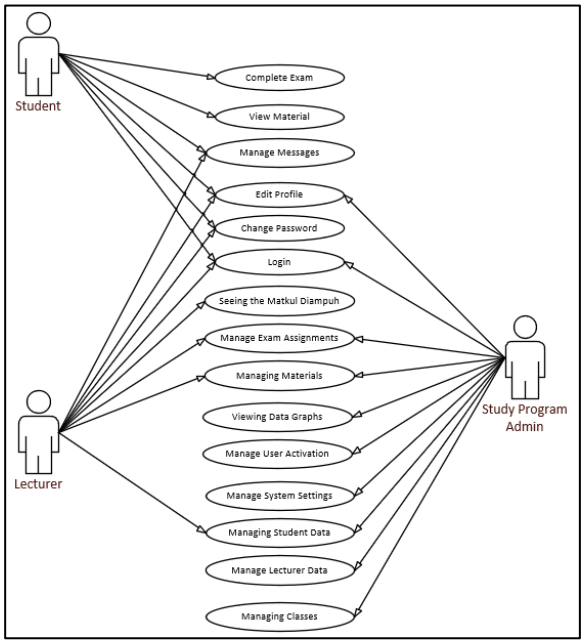


Figure 5. Use Case Diagram

3. Activity Diagram

Activity diagrams serve to model the behavior of use cases and objects in the system. This diagram illustrates the activation flow of the designed system and can describe the activation flow of the designed system so that it can describe parallel processes that may occur in several executions, as can be seen in the following figure :

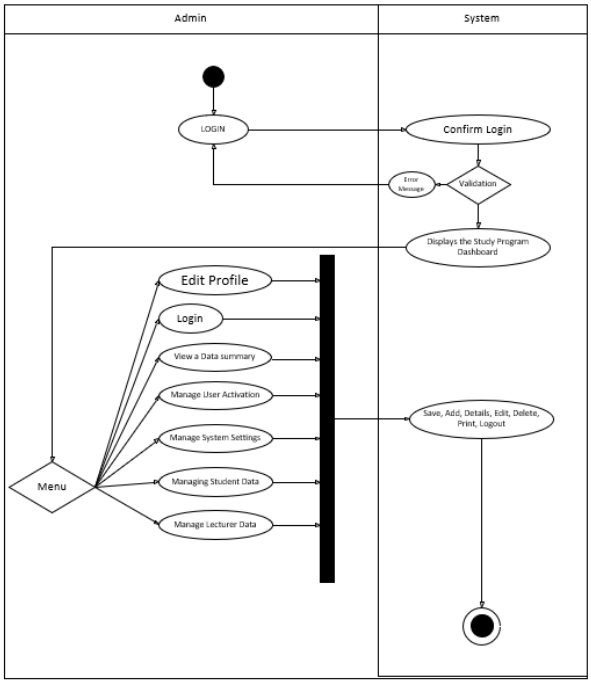


Figure 6. Activity Diagram

4. *Class Diagram*

The class diagram is an interaction by describing the structure of the classes in the system. Class diagrams describe the attributes, operations, and relationships between classes. The following class diagram can be seen in Figure 7 below:

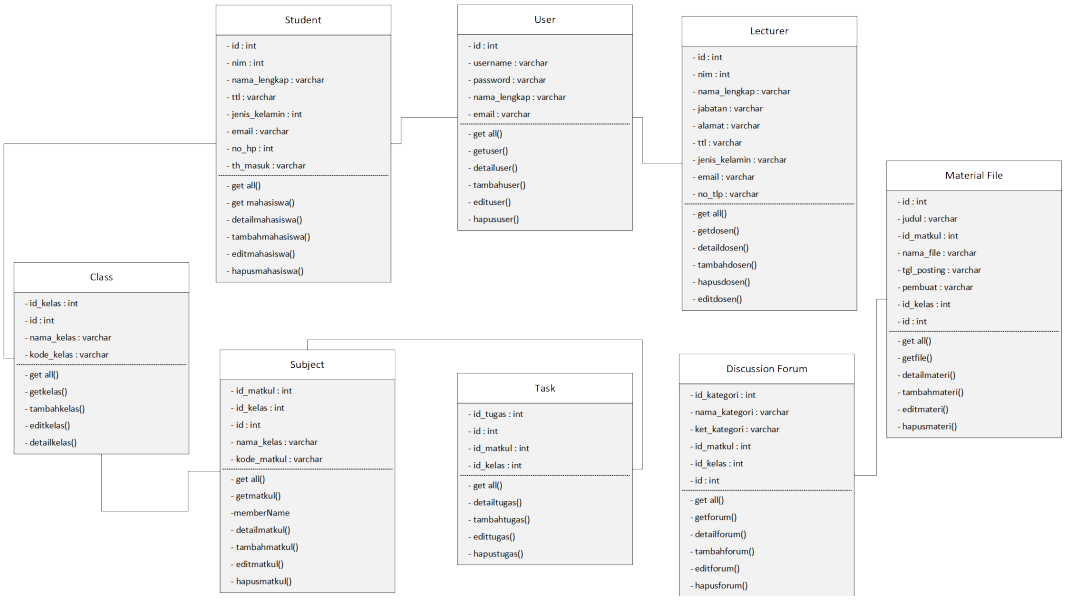
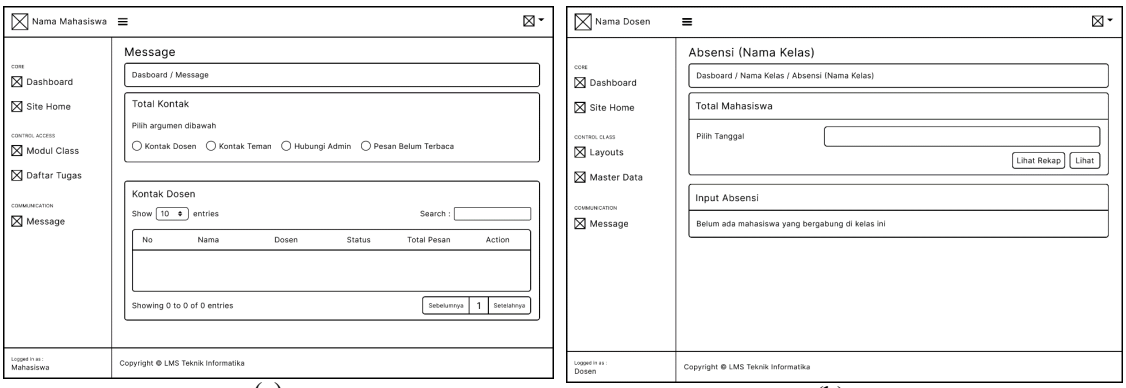


Figure 7. Class Diagram

5. *Wireframe*

The system interface is a means of system development that aims to facilitate communication with existing systems. The following is the design of the interface used to design the appearance of the system.



(a) (b)

Figure 8. (a) (b) Wireframe

III. RESULT AND DISCUSSION

This research produced a learning management system that can be used to facilitate physics education study programs at FKIP UNRI which is different from the existing LMS. LMS is a system that has features that are user-friendly, flexible, and can be used by users who are not familiar with the technology. LMS has analytical and graphical features that can monitor students in carrying out exams, there are online/offline features for students that can be seen by lecturers, there is a discussion forum feature, document headers that can be customized with

study program headers, can arrange schedules in exam settings, and design an easy-to-use interface so that it is responsive on various devices. In addition, at the admin level, there are blocking and password reset features for system users.

A. Implementation

Following is the appearance of the Learning Management System, the application design is dominated by colors, images, and icons related to the content of each feature.

1. Login Page

The login display in Figure 9 is the initial user verification to enter the system. The login page has 2 fields to fill in the email and password. On the login screen, 4 conditions will occur: 1) Email and Password not filled in will display a message that the email and password are required, 2) Email is filled in while the password is not filled in will display a message that the email/password must be filled in, 3) Email /the wrong password will display the wrong email/password message, 4) Wrong email/password up to four times, will display the message the user has been blocked.

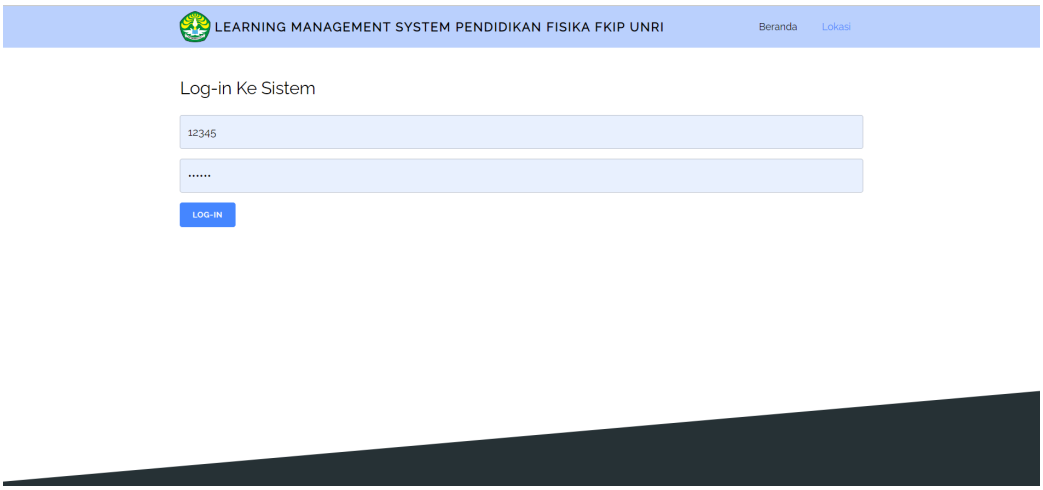


Figure 9. Login Page

2. Dashboard Page

On the dashboard page shown in Figure 10, there are several visualizations contained in the form of graphs and tables. The visualization contains a summary of the number of students, student activity logs, and the number of questions loaded in the system.

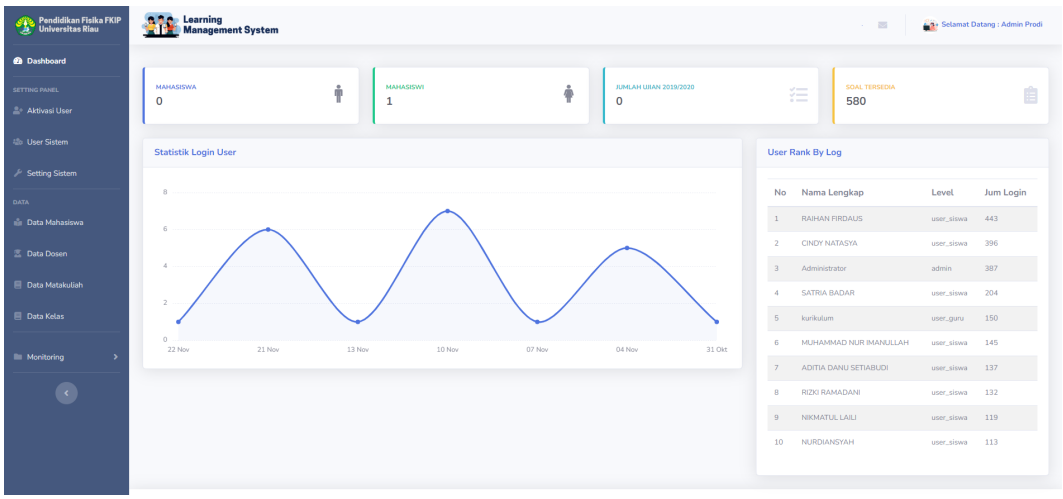


Figure 10. Dashboard Page

3. Learning Video Page

Learning videos function as learning media given to lecturers to students. Learning videos on the system can be uploaded locally from data sources on a laptop or can be uploaded using a link from YouTube. The learning video page can be seen in Figure 11.

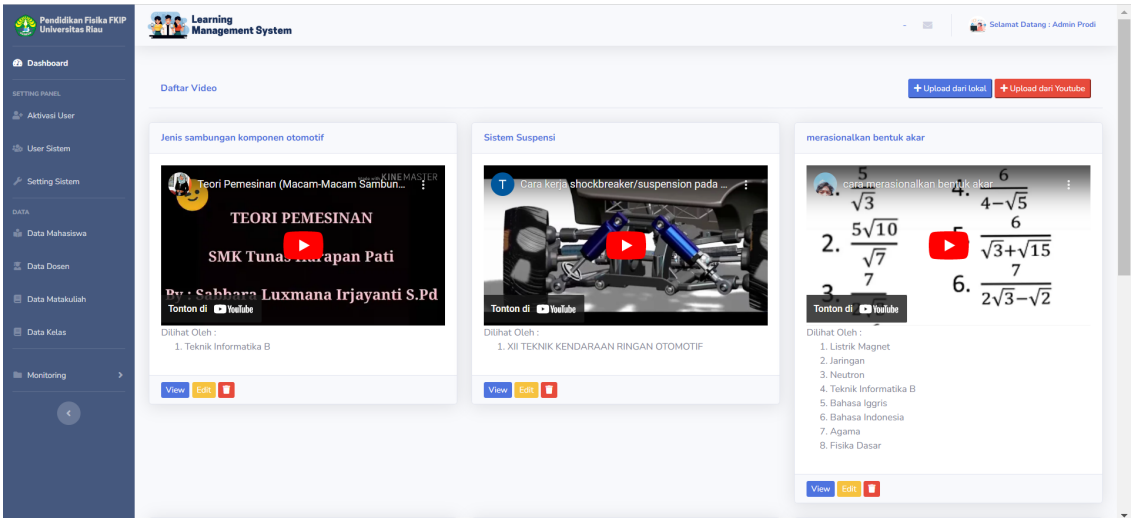


Figure 11. Learning Video Page

4. Disscusion Forum Page

Forum discussion functions as a discussion of lessons that do not have time to be carried out in class. Discussion forums can be posted by students and lecturers. Discussion forums allow students and lecturers to ask questions or discuss topics according to material that is usually done in class.

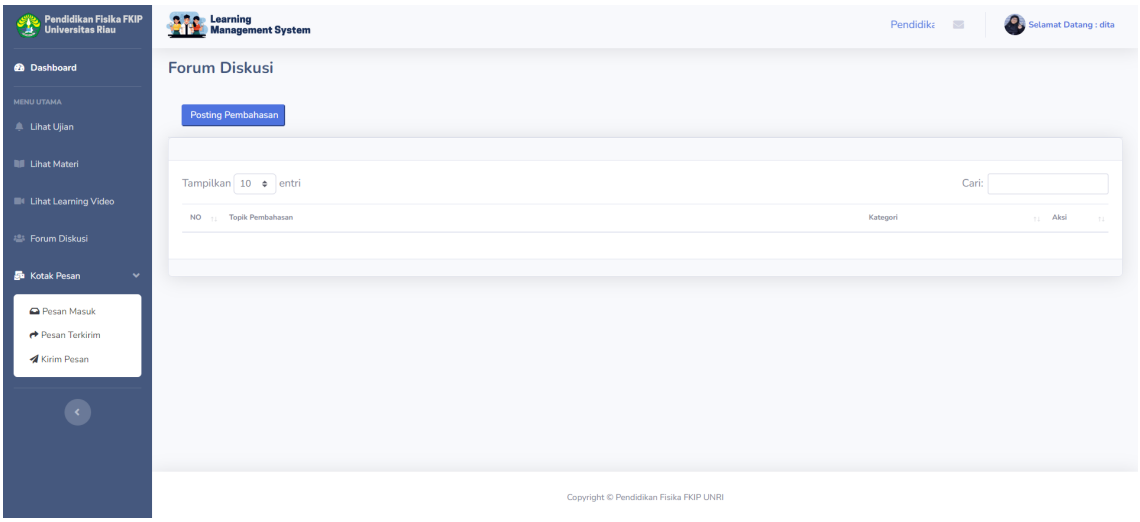


Figure 12. Discussion Forum Page

5. Course Lecturer Page

The course lecturer page functions as a link for courses taken by students so that they can connect with their course lecturers. The management of the course lecturers in Figure 13 is carried out by the study program.

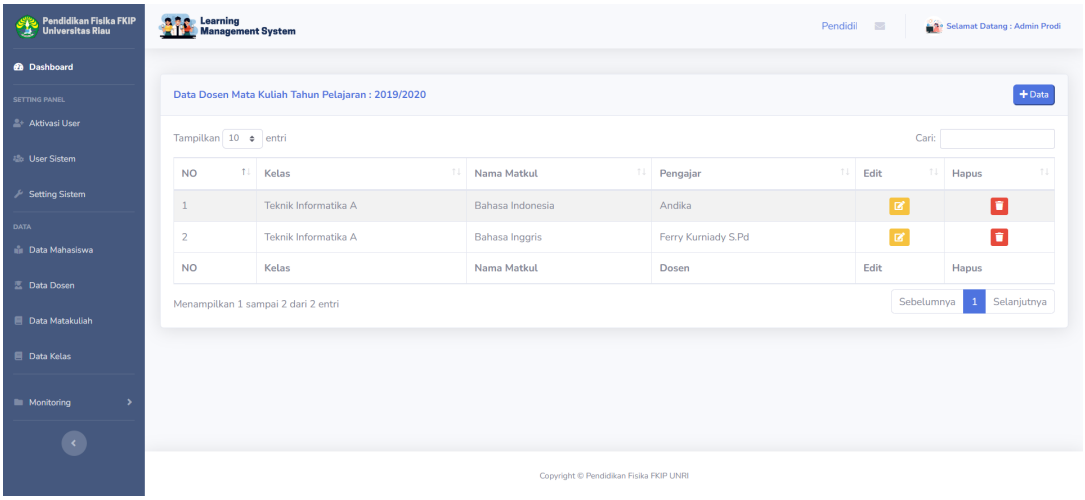


Figure 13. Course Lecturer Page

B. Testing

1. Blackbox Testing

System testing is done to test a system that has been built properly using black box testing. In black box testing, each unit must be free from faulty functionality. The following are the results of system testing in Table I.

TABLE I
SYSTEM TEST RESULT

No.	Testing	Test Result
1.	Login	Successfully logged in according to the access rights of each actor
2.	User Management	Successful activation of user accounts, blocking users, editing users, and deleting users who have connected to the system
3.	Data Management	Successfully added, edited, deleted, imported, and exported student data, lecturer data, course data, and lecturer data
4.	Monitoring Management	Successfully monitoring, editing, deleting, and adding relationships between classes, students, courses, and lecturers
5.	Setting Password	Successfully changed the password on the lecturer and student users
6.	Exam Management	Successfully add, edit, delete, import, and export essay and multiple choice exam questions
7.	Theory Management	Successfully added, edited, and deleted material that had been uploaded per class
8.	Learning Video Management	Successfully add, edit, and delete uploaded videos both from local and youtube
9.	Message Management	Successfully receive, send, and write messages from lecturers to students or from students to lecturers
10.	Forum Management	Successfully added, edited, and deleted discussion topics

2. User Experience Quistionnaire (UEQ)

User experience was tested using the user experience questionnaire method. This UEQ aims to test the success and user experience in using the system. The data obtained will be entered into the tools, then the calculation transformation is carried out by calculating the questionnaire on the UEQ_data_analysis_tool. The results of the UEQ test on 50 participants

showed that the Learning Management System in Physics Education FKIP UNRI already had a positive scale on attractiveness, clarity, efficiency, accuracy, stimulation, and novelty. So, it can be concluded that the Learning Management System can be used as an effective online learning system for physics education at FKIP UNRI. Here are the UEQ results in Table II.

TABLE II
UEQ CALCULATION RESULT

Scale	Mean	Comparisson to benchmark
Attractiveness	1,68	Good
Perspicuity	1,78	Good
Efficiency	1,89	Excellent
Dependability	1,56	Good
Stimulation	2,05	Excellent
Novelty	1,38	Excellent

Then for the UX test results using UEQ shown in Figure 15.

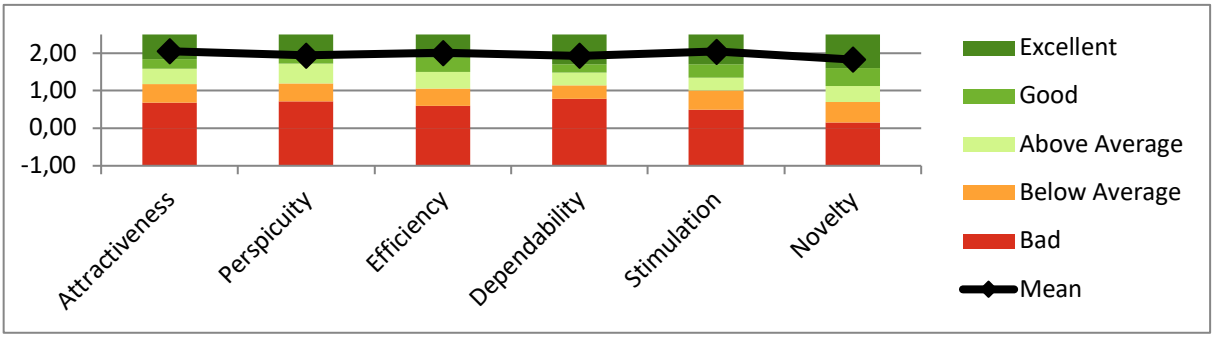


Figure 14. UX Test Result

IV. CONCLUSION

The conclusion obtained in this study is that a design of a website-based learning management system has been successfully designed and built. Based on black box testing, LMS managed to run 100% well. The UEQ test showed an attractiveness of 1.68 (good), perspicuity 1.78 (good), efficiency of 1.89 (excellent), dependability of 1.56 (good), stimulation of 2,05 (excellent), and novelty of 1,38 (excellent). This online learning system can facilitate learning that previously ran conventionally into web-based, digitalized learning. Suggestions for further research include the development of Android and iOS-based mobile systems to provide easy access to students and lecturers when implementing the system widely.

REFERENCES

[1] P. Mishra and M. J. Koehler, "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge," *Teach. Coll. Rec. Voice Scholarsh. Educ.*, vol. 108, no. 6, pp. 1017–1054, 2006, doi: 10.1177/016146810610800610.

[2] L. Sulistyorini and Y. Anistyasari, "Studi Literatur Analisis Kelebihan dan Kekurangan LMS Terhadap Pembelajaran Berbasis Proyek pada Mata Pelajaran Pemrograman Web di SMK," *IT-Edu J. Inf. Technol. Educ.*, vol. 5, no. 01, pp. 171–181, 2020.

[3] A. D. Nurhayati, D., Az-Zahra, H. M. & Herlambang, "Evaluasi User Experience Pada Edmodo Dan Google Classroom Menggunakan Technique for User Experience Evaluation in e-Learning (TUXEL) (Studi pada SMKN 5 Malang)," *J. Pengemb. Teknol. Inf. dan Ilmu Komput.*, vol. III, no. 4, pp. 3771–3780, 2019.

[4] R. Pradana, D. B. & Harimurti, "Pengaruh Penerapan Tools Google Classroom pada Model Pembelajaran Project Based Learning Terhadap Hasil Belajar Siswa," *IT-Edu*,

vol. II, no. 1, pp. 59–67, 2017.
[5] A. Sahi, "Aplikasi Test Potensi Akademik Seleksi Saringan Masuk Lp3I Berbasis Web Online Menggunakan Framework Codeigniter," *Tematik*, vol. 7, no. 1, pp. 120–129, 2020, doi: 10.38204/tematik.v7i1.386.
[6] I. Rahmat, "Manajemen Sumber Daya Manusia Islam: Sejarah, Nilai Dan Benturan," *J. Ilm. Syi'ar*, vol. 18, no. 1, p. 23, 2018, doi: 10.29300/syr.v18i1.1568.
[7] M. D. Prayoga, "Pengertian Dan Komponen Sql," *Osf.Io*, pp. 1–7, 2017, [Online]. Available: https://osf.io/kj43y/download%0Ahttp://www.sistem-informasi.xyz/2017/02/pengertian-dan-komponen-dalam-processor.html.
[8] Nana Syaodih Sukmadinata, *Metode Penelitian Pendidikan*. Bandung: Remaja Rosda Karya, 2005.
[9] A. D. Herlambang, A. Rachmadi, A. P. Rahmatika, D. I. D. Utami, and S. W. Hapsari, "V- Model untuk Pengembangan Sistem Informasi Manajemen Ruang Rapat," *J. Teknol. Inf. dan Ilmu Komput.*, vol. 7, no. 2, p. 313, 2020, doi: 10.25126/jtiik.2020721893.
[10] T. A. Kurniawan, "Pemodelan Use Case (UML): Evaluasi Terhadap beberapa Kesalahan dalam Praktik," *J. Teknol. Inf. dan Ilmu Komput.*, vol. 5, no. 1, p. 77, 2018, doi: 10.25126/jtiik.201851610.