DEVELOPMENT OF MOODLE-BASED LEARNING MANAGEMENT SYSTEM (LMS) ON DISCOVERY LEARNING MODEL

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Abstract. *This development research aims to produce valid, practical, and effective LMS products. The development of the LMS follows the ADDIE model. The research was conducted at SMAN 22 Makassar in August-December 2022. There were four subjects in this study, namely media experts and material experts as validity test subjects, chemistry subject teachers and 10 students of XII MIPA 2 students as subjects for small group test and participants students in class XI MIPA 2 totaled 34 students as practical and effectiveness test subjects. The instruments used for validity were validation sheets by media experts and material experts, practicality, namely LMS learning implementation observation sheets, teacher and student response questionnaires, and effectiveness, namely learning achievement tests. Based on data analysis, it was concluded that the developed Moodle-Based LMS was valid, practical, and effective for use in learning.*

Keywords: *LMS, Moodle, Blended Learning, Chemical Equilibrium and Equilibrium Shift.*

INTRODUCTION

The advancement of information technology has significantly benefited the field of education, leading to the emergence of electronic learning (e-learning) [1]. E-learning is an integrated network-based learning system that facilitates rapid updates, storage, retrieval, distribution, and dissemination of educational content and information through internet and intranet technologies to achieve distance or broad-based learning objectives [2].

Learning through e-learning is expected to provide benefits for students, namely using the internet as a tool to support the learning process. The requirements for electronic learning (e-learning) activities include: (a) conducting learning activities via a network, (b) providing learning materials accessible to participants, such as CD-ROMs or printed materials, and (c) ensuring the availability of tutor support to assist participants with any difficulties they may encounter [3].

Initial observations and interviews with teachers and students at SMAN 22 Makassar revealed several obstacles during learning activities, particularly concerning the media used. Teachers primarily relied on modules and textbooks as the sole learning materials for students. In the teaching and learning process, the teacher primarily relies on the lecture method without additional media so that learning only takes place in one direction and is less effective. As a result, students struggle to grasp the concepts in the material being taught and find it challenging to understand calculation problems due to a lack of interest and motivation. This has led to low learning outcomes among the students.

E-learning exists to address the limitations of traditional face-to-face teaching and learning processes, which are constrained by space and time, so that the relationship between students and teachers can be carried out anytime and anywhere in a controlled manner [4]. Currently and in the future, e-learning technology can serve as a solution and an alternative approach for enhancing learning methods [5].

E-learning learning is currently used quite often. This is due to various factors, such as technological innovation and information to conditional factors such as the Covid-19 pandemic. In 2020, the most frequently used e-learning is Google Classroom (Indonesian Survey Flow, 2020). Google Classroom is a blended learning tool designed for education that simplifies the process for teachers to create, share, and organize paperless assignments. Google Classroom was introduced as one of the

features of free internet learning media from Google Apps for Education (GAFE) [6].

Based on student responses, Google Classroom is considered less effective for two reasons. The first reason is because the appearance of Google Classroom does not attract students' attention. The second reason is if Google Drive is full the assignment cannot be sent and the assignment collection time can be set [7]. Some of these deficiencies can be overcome on learning platforms other than Google Classroom, namely Moodle.

Moodle stands for Modular Object-oriented Dynamic Learning Environment. Moodle is a software package designed for creating and delivering internet-based courses, training, and educational programs [8]. Moodle can also be defined as an open-source LMS provided free of charge under the GNU Public License [9]. It could be concluded that Moodle is a tool used to transform educational materials into web-based formats, making it a versatile platform for online learning. This application allows users to enter a virtual "classroom" to access learning materials. With Moodle, teacher can create learning materials, quizzes, e-journals, and other resources, much like a traditional classroom.

Moodle has many advantages, including: appropriate for use as an online class, relatively good learning outcomes and the same as face-to-face learning, teachers can modify and manage learning materials directly, simple operation, easy to install, relatively inexpensive, can be learned by anyone and in terms of security it is guaranteed because Moodle provides registration forms for students whose validity has been checked [10]. Additionally, Moodle includes learning assistance elements such as quizzes, assignments, chat rooms, and the ability to upload various formats of learning materials. These features enhance the effectiveness of the learning process, ensuring that learning objectives are achieved effectively while minimizing the occurrence of misconceptions among students.

Research by Usu reported that there were still misconceptions among students in understanding chemical equilibrium material [11]. Conceptual errors were also identified among students in Safitri's research findings. The study revealed that students studying chemical equilibrium encountered misconceptions regarding the concepts of chemical equilibrium itself, chemical equilibrium constants, and Le Chatelier's Principle [12]. The material of chemical equilibrium and equilibrium shift is one of the materials that is not just memorized but must be well understood. To enhance the quality of student learning outcomes, it is imperative for teachers to employ suitable teaching methodologies that resonate with students' preferences.

Based on the background, the authors are keen to undertake research titled "Development of a Moodle-Based Learning Management System (LMS) on the Discovery Learning Model."

METHOD

This research falls under the category of Research and Development (R&D). The development model chosen for this study was the ADDIE model, comprising five stages: analysis, design, development, implementation, and evaluation. The product development process was scheduled to take place from August to December 2022 at SMAN 22 Makassar.

The object of this research was a Moodle-Based LMS on the discovery learning model in the context of chemical equilibrium and equilibrium shifts material. The research subjects included 2 material experts, 2 media experts, and 2 lecturers who validated the research instruments. Additionally, 10 students from XII MIPA 2 participated as subjects for the small group test, while a total of 34 students from class XI MIPA 2 participated as subjects for the practical and effectiveness tests.

The instruments used included observation sheets, material expert validation sheets, media expert validation sheets, teacher response questionnaires, student response questionnaires, and learning outcomes tests. The observation sheet was utilized to assess the implementation of the developed LMS in the learning process. The media expert validation sheet was employed to validate the suitability and quality of the media. It comprised 21 question items with detailed grids, as presented in Table 1 below.

Table 1. Media Validation Sheet

No.	Aspects	ΣItem
1.	Software Engineering Aspects	5
2.	Display Aspect	10
3.	Technical Aspect	6
Total		21

The material expert validation sheet was utilized to verify the suitability of the material in the media. It comprised 23 question items with detailed grids, as presented in Table 2 below.

Table 2. Material Validation Sheet

No.	Aspects	ΣItem
1.	Learning Design	7
2.	Material Presentation	6
3.	Language Eligibility	10
Total		23

The teacher response questionnaire was used to obtain supporting data regarding the practicality of using the LMS. The sheet contains 24 question items with grid details can be seen in Table 3 below.

Table 3. Teacher Response Questionnaires

No.	Aspects	ΣItem
1.	Display Design	6
2.	Learning Design	8
3.	Material	6
4.	Implementation	2
5.	Accessibility	2
Total		24

This instrument was used to gather data regarding students' opinions on the utilization of the LMS in the learning process. The student response questionnaire sheet contained 22 question items with detailed grids, as displayed in Table 4 below.

Table 4. Student Response Questionnaires

No.	Aspects	ΣItem
1.	Display Design	6
2.	Learning Design	8
3.	Material	6
4.	Implementation	2
Total		22

The learning student outcomes, utilized to assess the effectiveness of the LMS, comprised learning achievement tests.

In this study, data analysis techniques encompassed both qualitative and quantitative approaches, focusing on the results of validity and practicality tests. Qualitative analysis was conducted on input, suggestions, and criticisms regarding the LMS during validation. Quantitative analysis, on the other hand, involved examining the results of validity tests completed by media and material experts.

The data obtained from the validation of materials and media were categorized into a highly feasible scale (0,80-1,00), decent (0.61-0.79%), quite feasible (0.40-0.59%), less feasible (0,20-0,39%), and very less feasible (0,00-0,1.%) [13]. Furthermore, the practicality test results provided by chemistry subject teachers and students after utilizing this LMS were categorized into different practicality levels. The criteria for LMS practicality were classified into a highly practical scale (75.01-100%), practical (50.01-75.00%), less practical (25.01-50.00%), and not practical (00.00%). Students were considered successful if they attained an evaluation test result score greater than or equal to 75. The effectiveness of the LMS was determined if the average student learning outcomes test score met the classical completeness criteria, which meant that 60-80% of all students achieved satisfactory results [14].

RESULT AND DISCUSSION

Product development in the form of a Moodle-Based LMS adheres to the ADDIE development model, comprising five research stages: the analysis stage, the design stage, the development stage, the implementation stage, and the evaluation stage. These steps are detailed as follows:

In the analysis stage, performance analysis and needs analysis were conducted to assess the requirements of class XI MIPA 2 at SMAN 22 Makassar. Observations and interviews with chemistry teachers at the school revealed that traditional teaching methods were predominantly employed, with minimal use of supplementary media. Additionally, the available textbooks were limited, posing challenges for students in accessing learning materials. Furthermore, the existing learning modules were described as monotonous and challenging to comprehend. It was also noted

that the chemistry teacher of class XI at SMAN 22 Makassar had not been actively implementing student-centered learning approaches. The two analyzes above are thought to be the reasons why students tend not to be actively involved in the learning process.

The needs analysis encompassed three activities: curriculum analysis, student characteristic analysis, and material analysis. Kurikulum 2013, which developed Competence Achievement Indicators and Learning Objectives to determine the abilities and competencies students must obtain during the learning process, was reviewed as part of the curriculum analysis process. Analysis of student characteristics focused on assessing their abilities, experiences, motivation, and attitudes. Material analysis entailed gathering various information related to the content on Chemical Equilibrium and Equilibrium Shifts.

In design stage, the researcher created a Moodle-Based LMS design that would be developed. Four activities were carried out, namely research instrument preparation, learning media preparation, benchmark reference tests preparation, and moodle-based LMS design. The research instruments compiled consisted of validity, practicality, and effectiveness instruments, which encompassed validation sheets for media experts and material experts, along with observation sheets to track the implementation of the Moodle-based LMS, teacher and student response questionnaires to Moodle-based LMS, as well as test questions for student learning outcomes. The learning tools prepared included the Learning Implementation Plan (RPP), Student Worksheets (LKPD), and Teaching Materials that are integrated into the Moodle-Based LMS. Benchmark reference tests was prepared in multiple choice form as much as 20 questions.

The concept designed is to make one Course namely Chemical Equilibrium and Equilibrium Shift. Then in the course several activities will be given, namely: Attendance (presence), Page (stimulus syntax and teaching materials), Forum (problem identification syntax), Student Folder (data collection syntax, data processing and verification), Assignment (generalization syntax), and Quiz (evaluation of each meeting).

In the development stage, three activities were undertaken: the preparation of the Moodle-based LMS, instrument validation, and feasibility analysis in small groups prior to product implementation. The LMS was created by installing it on a hosting service provided by Jagoan Hosting. Then, the new course name Chemical Equilibrium and Equilibrium Shift was made. the design of LMS then improved by using Moove as the LMS theme then adding logo and picture. Several features were included, such as attendance, URL, page, forum, student folder, assignment, quiz, and feedback. Accounts for 34 students were created and enrolled in the prepared course.

Instrument validation activity aimed to obtain validity information from the instrument used. The following evaluations led to the declaration of all validation results as very valid: With a percentage score of 94.75%, the instrument validation observation sheet result on the LMS implementation in learning was judged to be very valid. With a 97% percentage score, the teacher response questionnaire instrument validation was likewise considered very valid. With a percentage score of 96.25%, the validation of the student response questionnaire instrument was deemed very valid, and a score of 90.5% indicated the validity of the learning outcomes test instrument.

The Moodle-Based LMS was validated by two lecturers serving as media experts and two as material experts. The Moodle-Based LMS is revised until it is deemed practical to deploy in real-world settings. The evaluation of subject matter experts and media experts is as follows:

Table 6 below displays the data from the media validation results.

Table 6. Media Validation Results

No.	Assessment Aspects	%	Category
1.	Software Engineering Aspects	95	Very Valid
2.	Display Aspect	91.25	Very Valid
3.	Technical Aspect	97.75	Very Valid
Percentage		94.75	Very Valid

The Moodle-Based LMS assessment from technical aspects by two media experts obtained a percentage score of 94.75%, placing it in the very valid category. The built Moodle-Based LMS may be utilized independently and

is rated as simple to use by laypeople in the technology field, according to the validation's results.

Table 7 below displays the data from the material validation results.

Table 7. Material Validation Results

No.	Assessment Aspects	%	Category	Criteria
1.	Learning Design	85.50	Very Valid	D
2.	Material Presentation	87.50	Very Valid	D
3.	Language Eligibility	90.75	Very Valid	D
Percentage		87.50	Very Valid	Very High

The assessment of the language feasibility aspect obtained a score of 90.75%, placing it in the very valid category. This indicates that the language used in the Moodle-Based LMS is communicative, simple to comprehend, and appropriate for the developmental stage of the students using the learning materials. This complies with the assertion made by Walker & Hess, according to which media needs to possess certain technical attributes, such as readability, the ability to handle student reactions well, program management excellence, and documentation excellence [15].

The Moodle-Based LMS validity evaluation findings fall into the very valid category if they are converted using Widyoko's validity criteria table [14]. According to Gregory's validity criteria in Table 7, the material expert assessment analysis's end results display a validity criterion value of D. This value falls into the extremely high criterion, with a consistency test between validators of 100%.

The Moodle-Based LMS that has been developed, validated and revised will be tested on small groups involving 10 Class XII MIPA 2 students at SMAN 22 Makassar. The following table summarizes the findings from the mean small group response for class XII MIPA 2, which has ten students.

Table 8. Small Group Students Responses Questionnaires

No.	Assessment Aspects	%	Category
1.	Display Design	93	Very Practical
2.	Learning Design	93	Very Practical
3.	Material	94	Very Practical
4.	Implementation	91	Very Practical
Percentage		93	Very Practical

During the deployment stage, 34 students in class XI MIPA 2 participated as responders to ascertain the practicality and effectivity of Moodle-Based LMS. Observers evaluated observations of the LMS deployment to ascertain the degree to which learning could be conducted with the Moodle-Based LMS. The factors taken into account on the observation sheet comply with Discovery Learning's syntax. Table 9 displays the findings from the observation of the learning media implementation.

Table 9. Observation Sheet Results

No.	Assessment Aspects	%	Category
1.	Introduction	93.75	Very High
2.	Stimulation	100	Very High
3.	Problem Identify	100	Very High
4.	Data Collecting	100	Very High
5.	Data Processing	100	Very High
6.	Verrification	100	Very High
7.	Generalization	100	Very High
8.	Closing	95.83	Very High
Percentage		98.69	Very High

The use of Moodle-Based LMS in the process of learning was not fully implemented due to poor internet connection. This happened because the internet network in the school environment was too full due to the large number of users congregating in one place. Another reason is that some student gadgets do not yet support the use of Moodle-Based LMS. In order to address this shortcoming and ensure that the Moodle-Based LMS could still be utilized appropriately, an LCD projector was installed, and students were instructed to use the LMS in groups.

After the learning process, questionnaires were given to students and teachers to find out their responses to the products being developed.

Table 10 below presents the findings from the teacher response questionnaire.

Table 10. Teacher Response Questionnaires

No.	Assessment Aspects	%	Category
1.	Display Design	87.5	Very Practical
2.	Learning Design	78.13	Very Practical
3.	Material	87.50	Very Practical
4.	Implementation	100	Very Practical
5.	Accecibility	75	Very Practical
Percentage		85.63	Very Practical

Table 11 displays the results from the student response questionnaire.

Table 11. Students Response Questionnaires

No.	Assessment Aspects	%	Category
1	Display Design	84.56	Very Practical
2.	Learning Design	81.07	Very Practical
3.	Material	83.21	Very Practical
4.	Implementation	86.76	Very Practical
Percentage		83	Very Practical

According to the results of the student response questionnaire, 86.76% of the responses to the questions on the media's implementation came from students, and 100% of the responses from teachers fell into the category of being very practical [16]. This demonstrates whether using the created Moodle-Based LMS has a favorable impact on students. The inclusion of pictures and videos within the Moodle-Based LMS facilitates the mastery of concepts in chemical equilibrium material and equilibrium shifts, thereby aiding students in understanding the material more easily. This aligns with research by Hutahaean, which suggests that utilizing multiple senses to receive information enhances the likelihood of both remembering and understanding the information. Experts have demonstrated notable differences in learning outcomes when information is presented through the senses of sight and hearing [17].

In order to motivate students to be active, creative, and independent learners, Moodle-Based LMS is used in conjunction with two or more media, such as text, images, and videos. This facilitates a bidirectional interaction between users and the LMS, engaging both the senses of sight and hearing. The developed Moodle-Based LMS has many advantages, including having an attractive appearance, easy to access on laptops and smartphones, easy to operate, economical, and equipped with audio-visual media which makes it easy for students to study independently.

The effectiveness of the Moodle-based LMS is demonstrated through student learning outcomes. The effectiveness test was conducted with 34 students from class XI MIPA 2 at SMAN 22 Makassar. The student learning outcomes are presented in Table 12.

Table 12. Student Learning Outcomes Results

Variable	Descriptive Score XI MIPA 2
Research Subject	34
Ideal Score	100
KKM	75
Average	83.08
Maximum Score	95
Minimum Score	65
Completed Students	31
Incompleted Students	3
Class Completeness Percentage	91.17%

The data from the learning achievement test obtained by the students was quite promising, with the class completeness percentage in class XI MIPA 2 at SMAN 22 Makassar reaching 83.08%, surpassing the KKM score of 75 for individual completeness (Table 12). These results indicate the effective utilization of the product in blended learning. Moreover, they align with the regulations of the Ministry of National Education (2006), which stipulate that learning is considered complete if, classically, the students who achieve based on the KKM reach 80% of the total number of students. Additionally, these outcomes are consistent with the theory suggesting that one of the factors influencing learning outcomes is the learning media employed during the learning process [18].

At the evaluation stage, any deficiencies in the developed Moodle-Based LMS are addressed through revisions, especially if inputs and suggestions are provided during its implementation in the learning process. The developed Moodle-Based LMS has been deemed valid by the validators of media experts and material experts based on the analysis of the data obtained. The percentage score for all aspects of the media experts' validation results is 94.75%, and the material experts' validation is 87.5% with very valid criteria. Analysis of learning observation sheets, teacher response questionnaires, and student response questionnaires verified the Moodle-Based LMS's practicality by showing that it satisfied all practical requirements for usage in the teaching and learning process. Meanwhile, the effectiveness of the Moodle-Based LMS was determined through the analysis of student learning outcomes tests, which confirmed if the Moodle-Based LMS met the criteria for effectiveness.

CONCLUSION AND SUGGESTION

In conclusion, the development of the Moodle-Based LMS, guided by the systematic approach of the ADDIE model, has resulted in a robust and effective learning solution. Through meticulous analysis, design, development, implementation, and evaluation stages, the LMS has been successfully crafted to address the identified challenges in the learning environment. The validation by both media and material experts attests to its high validity, while practicality is confirmed through the positive feedback from teachers and students. Moreover, the demonstrated effectiveness of the LMS, as evidenced by improved student learning outcomes, further underscores its suitability for educational use. Overall, this study showcases the effectiveness of employing structured instructional design methodologies in creating impactful and adaptable learning technologies.

In light of the study's outcomes, the researchers offer recommendations that include: 1) Online learning requires various preparations in implementing Moodle-based LMS learning, namely a strong internet network, devices or materials so that learning can run smoothly. 2) The developed Moodle-based LMS still has many shortcomings both in terms of appearance and content, so improvisation can be done by adding third-party websites to improve the quality of the LMS interface. 3) The usefulness of this media for learning should be determined by extensive trials and additional research.

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