JSI : Jurnal Sistem Informasi *(E-Journal), VOL.13, NO.2, Oktober 2021*
*ISSN Print : 2085-1588*
*ISSN Online :2355-4614*
*http://ejournal.unsri.ac.id/index.php/jsi/index*
*email: jsifasilkom@unsri.ac.id*

# UTILIZATION OF MACHINE LEARNING TO IMPROVE USABILITY OF THE FEEDBACK PROCESS ON STUDENT LEARNING EVALUATION RESULTS

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***Abstrak***

*Penelitian ini bertujuan untuk merancang sistem E-learning dengan implementasi machine learning untuk membantu proses evaluasi hasil belajar siswa untuk peningkatan proses pembelajaran. Metode yang digunakan adalah Cosine Similarity Matching yang merupakan metode untuk mengukur komparabilitas antar dokumen atau teks. Dalam penelitian ini terdapat 15 siswa dan 15 guru yang dijadikan sampel dalam penerapan sistem E-Learning dan evaluasi kegunaan sistem E-Learning menggunakan metode SUS. Pengujian sistem yang dilakukan memperoleh kinerja yang cukup baik yaitu hasil pengujian presisi memiliki kinerja sebesar 86,67% dan berdasarkan hasil pengujian usability diperoleh nilai sebesar 61,33 yang terhitung dalam kategori Marginal High. Dengan demikian sistem E-Learning yang telah dibangun dapat membantu mempermudah proses evaluasi pembelajaran siswa. Diharapkan implementasi ini dapat membantu mempermudah pembelajaran online.*

***Kata kunci:*** *E-Learning, Esai Koreksi Otomatis, Pembelajaran Mesin, Persamaan Cosinus, Sistem Informasi*

***Abstract***

*This research aims to design an E-learning system with machine learning implementation to assist the process of evaluating student learning outcomes for improving the learning process. The method used is the Cosine Similarity Matching which is a method to measure the comparability between documents or text. In this study, there were 15 students and 15 teachers who were used as samples in the implementation of E-Learning system and evaluation of the usability of E-Learning system using the SUS method. The system testing carried out obtained a fairly good performance, namely the precision test results had a performance of 86.67% and based on the usability test results obtained a value of 61.33 which was counted in the Marginal High category. Thus the E-Learning system that has been built can help facilitate the process of evaluating student learning. It is hoped that this implementation can help make online learning easier.*

***Keywords****: Autocorrection Essay, Cosine Similarity, E-Learning, Information System, Machine Learning*

## 1. INTRODUCTION

Information technology is growing rapidly and widely adopted so that currently many human activities take advantage of the role of information technology to facilitate work. The growth of information technology can bring rapid growth of learning technology. However, current learning technology has not been able to answer the challenges of the world of education, especially in the implementation of the learning process. One of the challenges that are felt in the application of the current learning process is the process of providing feedback from teachers to students is still carried out manually so it is quite time-consuming, especially when using the form of essay evaluation.

With the growth of information technology and cross-platform capabilities, of course, information systems are the first choice to be used as a solution in developing learning technology needs. The E-Learning application is one of the solutions offered to answer the challenges of learning technology. Commonly used E-Learning applications often feature sharing materials and assignments, as well as creating quizzes with a timer. However, these E-Learning applications generally do not support virtual face-to-face and automatic feedback.

Table 1. E-Learning Application Features

| Edmodo | Google Classroom | Moodle |
|---|---|---|
| • Assignment Management<br>• Files & Links Management<br>• Quiz/Exam Management<br>• Polling Management<br>• Gradebook/Grade Report<br>• Digital Library<br>• Award Management<br>• Parents Code Management | • Assignment Management<br>• Video Conference<br>• One Single View<br>• Online Learning<br>• Rating Management<br>• Announcement Management<br>• Integration Class Management<br>• Google Form | • Dashboard View<br>• File Management<br>• Progress Learning Tracking<br>• Assessment Management<br>• Feedback Management |

According to research from Ann Hill Duin and Jason Tham, the learning management system used by teachers is considered only as a trading tool for teaching and learning. Most learning management systems do not cut processing time enough. LMS can provide adequate services to individuals and institutions because of their connectivity to systems to manage ongoing student tracking [1].

Based on research from Allison Hutchison, many online writing instructors are forced to use their institution's learning management system (LMS) as a result of interstate agreements for accreditation of online courses and the associated requirements for framing courses [2].

Based on the research results conducted by Nhu-Ty Nguyen, a quantitative survey was applied to examine the effect of 4 factors: Announcement system, Instruction information, Interaction, Quality of technology on learning management system usability, and impact of learning management system usability on their satisfaction. The findings show a significant impact of the five mentioned factors on student satisfaction, including direct and indirect relationships. This study also examines the relationship between interactions provided by learning management tools and student satisfaction [3].

The current learning management system has not been fully able to improve the efficiency and effectiveness of teacher performance in the learning process. In this study, auto-correction was developed by applying machine learning to increase teacher performance effectiveness and efficiency through a maximum learning management system.

The use of E-Learning Applications, of course, cannot be separated from various obstacles experienced by end-users. Some of the obstacles that are often encountered

are providing feedback from teachers to students which is still manual so it is quite time-consuming, as well as E-Learning Applications which are considered impractical because there are several tools needed in the learning process that has not been integrated into the E-Learning application used. by the end-user, so that the end-user must adapt to several applications outside of the E-Learning application to support the smooth learning process.

Based on these problems, there are ideas and research ideas about the need to build an E-Learning system or online learning that has been integrated with the use of machine learning to help the process of evaluating student learning outcomes become more effective and efficient, making it easier for teachers to provide feedback to students, and has been integrated with SIAKAD.

This research aims to design an E-Learning system with the implementation of machine learning to assist the process of evaluating student learning outcomes for improving the learning process. The method used is the Cosine Similarity Matching which is a method to measure the comparability between documents or texts [4]. The Cosine Similarity method calculates the relevance of key queries and test data, the greater the relevance value, the more relevant key queries and test data. The Cosine Similarity Matching method has a lower error rate and a higher level of accuracy compared to other similarity measurement methods such as Coeficient, Jaccard Coeficient, Cosine Similarity, Euclidean Distance and other similarity methods [4]. In addition, by integrating into SIAKAD, the reporting process of student study results becomes effective and efficient.

In this study, there were 15 students and 15 teachers who were used as samples in the implementation of E-Learning with machine learning integration and evaluation of E-Learning usability, as well as testing the usability of the E-Learning system using the SUS method.

E-Learning can be defined as the packaging of Educational content in electronic form through application-based media and networks that are processed in such a way as to facilitate effective interaction between users and E-Learning content and features, support collaboration between users, and flexible access [5].

In any other sense, E-Learning is described as all educational sports completed through people or organizations who paintings online or offline, and synchronously or asynchronously via networked or unbiased computer systems and different digital devices [6].

The use of e-learning has been heavily adapted and developed to meet the needs of e-learning users, but there are still some obstacles to the use of e-learning that cannot yet be resolved. There have been many studies that raised E-Learning as a topic of research. The following are some previous studies related to E-Learning.

There are various previous studies raised topics related to the implementation of E-learning. For example, Panyajamorn et al. (2018) tested the effectiveness of E-learning design content and analyzed several variables, such as satisfaction, motivation, and student experience, that affect learning abilities. The results of their research show that the right content design of e-learning can increase the cumulative achievement index and intelligence indicators, and satisfaction with the right content design can affect the learning ability of some groups of students [7]. Not only the design of E-learning content, but the results of research conducted by Anza et al. (2019) show that teachers must pay attention to the importance of the Learning Management System so that students have a strong commitment to participating in the teaching and learning

process at school. Azis et al. (2019) conducted an analysis of the benefits of implementing e-learning on student learning outcomes. There is a significant influence on the e-learning experience and learning process, where the familiarity of students with e-learning methods and appropriate learning processes can improve student learning outcomes [8]. Then in the research conducted by Hutagalung et al. (2018) on how the effectiveness of learning with one of the e-learning applications, namely Edmodo, got overall results with a standard deviation of 10.01, and a standard error of 1.71 from a sample of 34 students who had used Edmodo. Based on these data, Edmodo is included in the very good category, but teachers are also advised to add a variety of learning models so that students can better understand the learning process [9]. Daniel Hermawan (2021) concluded that e-learning is the right solution to the learning process during the COVID-19 pandemic, and can provide students with acquiring and enhancing knowledge in new ways [10].

E-learning is a good learning method, but according to research conducted by Hamid et al. (2020), it reveals several obstacles that arise when implementing the E-learning method caused by several things, such as (1) wide area coverage; (2) the ability to carry network access and therefore the ability of the device to access the internet; (3) the implementation of virtual learning for students during the Covid-19 pandemic has not been fully effective [11].

Based on the outline of the e-learning analysis literature, it may be over that e-learning has several uses with different functions and applications, therefore the facet that has got to be thought about in developing e-learning is that the aspect of ease of use to make sure ease of use of e-learning applications.

Usability is taken as a measure of the extent to which a user is bound to use the product to achieve certain goals with effectiveness, efficiency, and satisfaction during a particular context of use. Usability assessment should cover 3 aspects: (1) Effectiveness, (2) Efficiency, (3) Satisfaction [12].

SUS (System Usability Scale) is one of the questionnaires that can be used to measure the usability of the system. In the SUS survey, there are 10 questions, each question has 5 Likert points as an answer. The output results start from a scale of 1-10, where the higher the score, the higher the usability aspect [12].

There are various previous studies that raised topics related to usability. For example, the results of the analysis of usability calculations conducted by Alfageh and Demir (2018) on digital libraries show that 97% of students can complete their assignments well with the help of digital libraries and the majority of students are satisfied and allow students to read the library books online [13]. While the results of the usability evaluation conducted by Sujito et al. (2019) with the GOM method showed that there was a significant improvement in the Learning website before and after it was developed, which was more effective and efficient used to document learning media [14]. Alqahtani (2019) who conducted a usability analysis on the google cloud application found that there was some convergence in the test results, but the google classroom got a significant result, namely 86.7 on student achievement [15]. Meanwhile, the results of the USE Google Classroom evaluation used in Jannah's research, et.al (2020) obtained eligibility of 81%. This shows that Google Classroom is very suitable to be applied in the learning process [16]. The results of the usability evaluation conducted by Aziz et al. (2020) showed that the results of the T-test carried out obtained a result of 1.64, which means that the usability, information quality, and

service interaction quality variables have a positive influence on the user satisfaction variable [17].

Chaudhary & Upadhyay (2021) and Dhahir (2020) concluded that the mobile application has proven to be effective but its efficiency aspect needs to be improved [18].

Wirasasmiata and Uska (2019) got different results in the E-Report usability test. The results of the research conducted indicate that the e-report used is considered ineffective because there are many problems in completing the task (completion rate < 90), then expert and novice user tests on the efficiency aspect test there is no time difference (not significant < 0.05), and the results of the satisfaction test scores with SUS get a value of 64.26 < 68 [19].

In the development of information systems, one aspect that must be met properly is the aspect of software quality assurance. The Software Quality Assurance Plan defines the activities and tasks used to ensure that the software developed meets the initial specified requirements and is in accordance with the needs and budgeted project costs, and adapts to project risks. The first thing to do in a Software Quality Assurance Plan is to define the targets clearly and easy to understand [20].

Another aspect that also needs to be considered is the information security aspect. According to Grafinkel, there are four aspects of information system security, these four aspects include Privacy, Integrity, Authentication, and Availability [21].

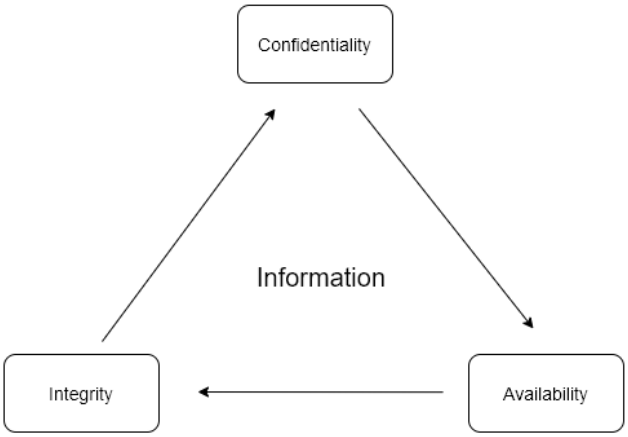


Figure. 1 Information System Security Aspects

The information system that will be built in this research will utilize machine learning to assist the process of evaluating student learning. Machine learning can be defined as the application of computers and mathematical algorithms adopted by means of learning that comes from data and produces predictions in the future. The learning process in question is an attempt to acquire intelligence through two stages, including training and testing [22].

The machine learning method used is the Cosine Similarity method. Cosine similarity is a calculation method between two documents which aims to determine the level of similarity between documents. The calculation of the cosine similarity method is based on two vectors that have the same number of words in the two documents being compared. The Cosine Similarity method is used because it has a higher accuracy value than the Coeficient, Jaccard Coeficient, Cosine Similarity, Euclidean Distance methods. This is as a result of the circular function Similarity methodology has the construct of

normalizing the length of vector knowledge by comparison N-grams that are parallel to every different from a pair of comparators [23].

Several studies on evaluating student learning outcomes using machine learning have been carried out, including by V. V. Ramalingam, APandian, Prateek Chetry, and Himanshu Nigam with the research title Automated Essay Grading using Machine Learning Algorithm [24]. Research by Huyen Nguyen and Lucio Dery with the research title Neural Networks for Automated Essay Grading [25]. Research by Aluizio Haendchen Filho, Fernando Concatto, Hércules Antonio do Prado, and Edilson Ferneda with the research title Comparing Feature Engineering and Deep Learning Methods for Automated Essay Scoring of Brazilian National High School Examination [26]. Research by Jiawei Liuy, Yang Xuz, and Yaguang Zhu with the research title Automated Essay Scoring based on Two-Stage Learning [27]. Research by Deva Surya Vivek Madala, Ayushree Gangal, Shreyash Krishna, Anjali Goyal, Ashish Sureka with the research title An empirical analysis of machine learning models for automated essay grading [28].

## 2. RESEARCH METHOD

The phases of the activities undertaken in this study include 1) The study of the literature to find the supporting theories of the study about the development of e-learning systems and to study the process of evaluating learning to assist the student with the cosine similarity pairing method,and collect Research data from the literature study and data from the stakeholder survey used as the subject of the case study in this study. 2) Designing E-learning system according to stakeholder needs, and cosine similarity comparison method. 3) Build an E-learning system according to an approved design and implement cosine similiarity method. 4) Test of the E-learning system to measure the level of usability of the E-learning system in terms of its influence or effect on supporting the process of evaluating student learning, and test accuracy of auto-correction system. 5) Documentation, documentation of the results of the implementation of the created and tested e-learning system.

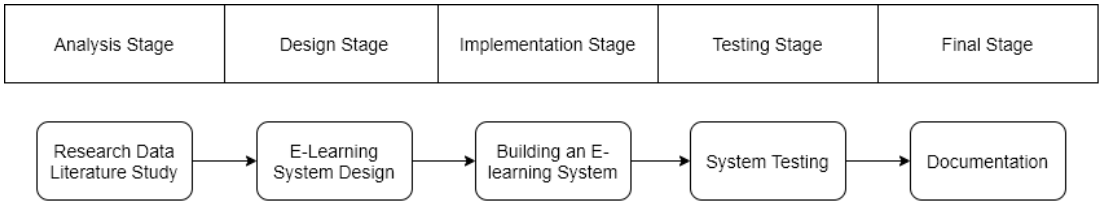


Figure 2. Research Activity Stages Scheme

In the implementation of the cosine similarity matching method, variable parameters are used to determine the similarity results. The variable parameters used in this research are the answer key data from the teacher and the student answer data. Before calculating the similarity between the teacher's answer query and the student's answer query, the preprocessing stage was carried out first.

The preprocessing stage includes:

Case Folding is the stage of changing all letters in the document to lowercase and characters other than letters will be removed.

Tokenizing/Parsing is the stage of breaking sentences into single words or phrases (Parsing).

Stopwords Removal is the stage of taking important words from the results of the tokenizing/parsing stage. The Stopwords Removal process is done by removing the stoplist/stopword. Stopwords can be in the form of conjunctions, pronouns, prepositions, and others such as the words "and", "or", "he", "at", "which", "from" and others.

Stemming is the stage of transforming a word into its root word. After the preprocessing stage, the weighting of each term (word) from the preprocessing results is carried out. The weighting used in this system is the TF-IDF weighting. TF-IDF is a weighting method that combines the TF (Term Frequency) and IDF (Inverse Document Frequency) methods. TFIDF weighting can be calculated using the equation:

$$\text{idf} = \log\left(\frac{\text{n}}{\text{df}}\right) \quad (1)$$

$$\text{w} = \text{tf} \times \text{idf} \quad (2)$$

Where n is the number of all documents used, df (Document Frequency) is the number of sentences containing terms in a collection of documents, and log is used to minimize the effect on relative tf .

The method used for measuring usability in this research is the System Usability Scale (SUS) Questionnaire according to the user's subjective point of view. The questionnaire consists of 10 question, items as shown in the following table.

Table 2. Survey Question

| Code | Statements Items |
|---|---|
| Q-1 | I will use/visit this site often |
| Q-2 | I find this site too complex (contains a lot of unnecessary stuff) |
| Q-3 | I find this site easy to browse |
| Q-4 | I need tennis help to use/browse this site |
| Q-5 | I think the functions/features provided on this site are well designed and prepared |
| Q-6 | I rate too many inconsistencies on this site |
| Q-7 | I feel most people will find it easy to use/browse this site quickly |
| Q-8 | I find this site very complicated to navigate |
| Q-9 | I feel very confident browsing this site |
| Q-10 | I need to learn a lot of things before I can explore this site properly |

The questionnaire uses a 5-point Likert scale. The respondents to this research were asked to rate the 10 items of the SUS statement based on their subjective assessment as “Strongly disagree”, “Disagree”, “Neutral”, “Agree”, and “Strongly agree”.

## 3. RESULTS AND ANALYSIS

The image below is a page for creating test data on a teacher account in the built E-Learning system. On this page the teacher fills in the test data that will be given to students, the data include, the title of the exam, the type of exam, the category of the exam, the start date of the exam, the start time of the exam, the end date of the exam, the time of the end of the exam, the duration, and the description of the exam.

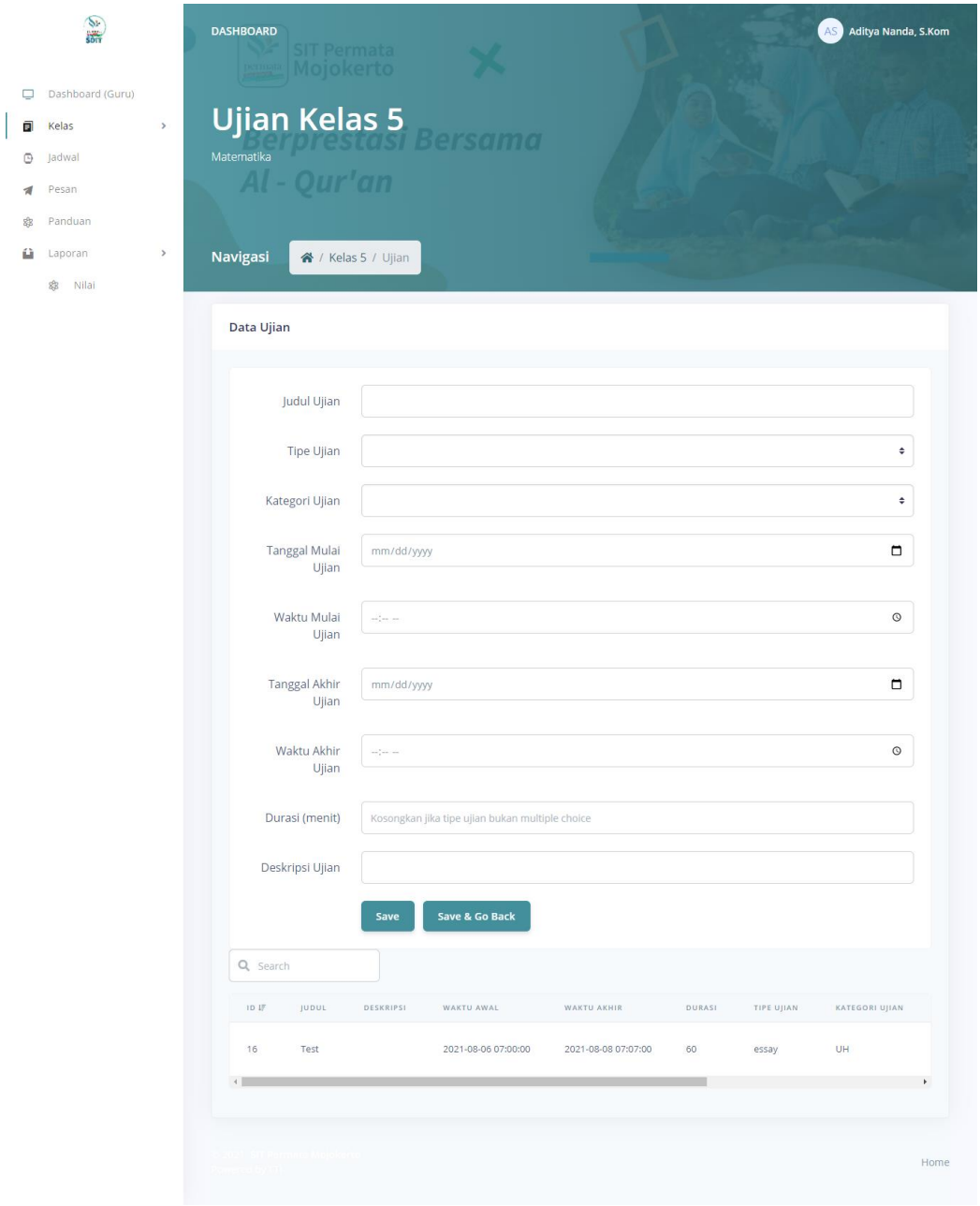


Figure. 3 Exam Page

After the teacher completes the test data, the teacher will be directed to the next page to fill in the test question data, test answer keys, and determine the score for each question given in the exam as shown in the image below.

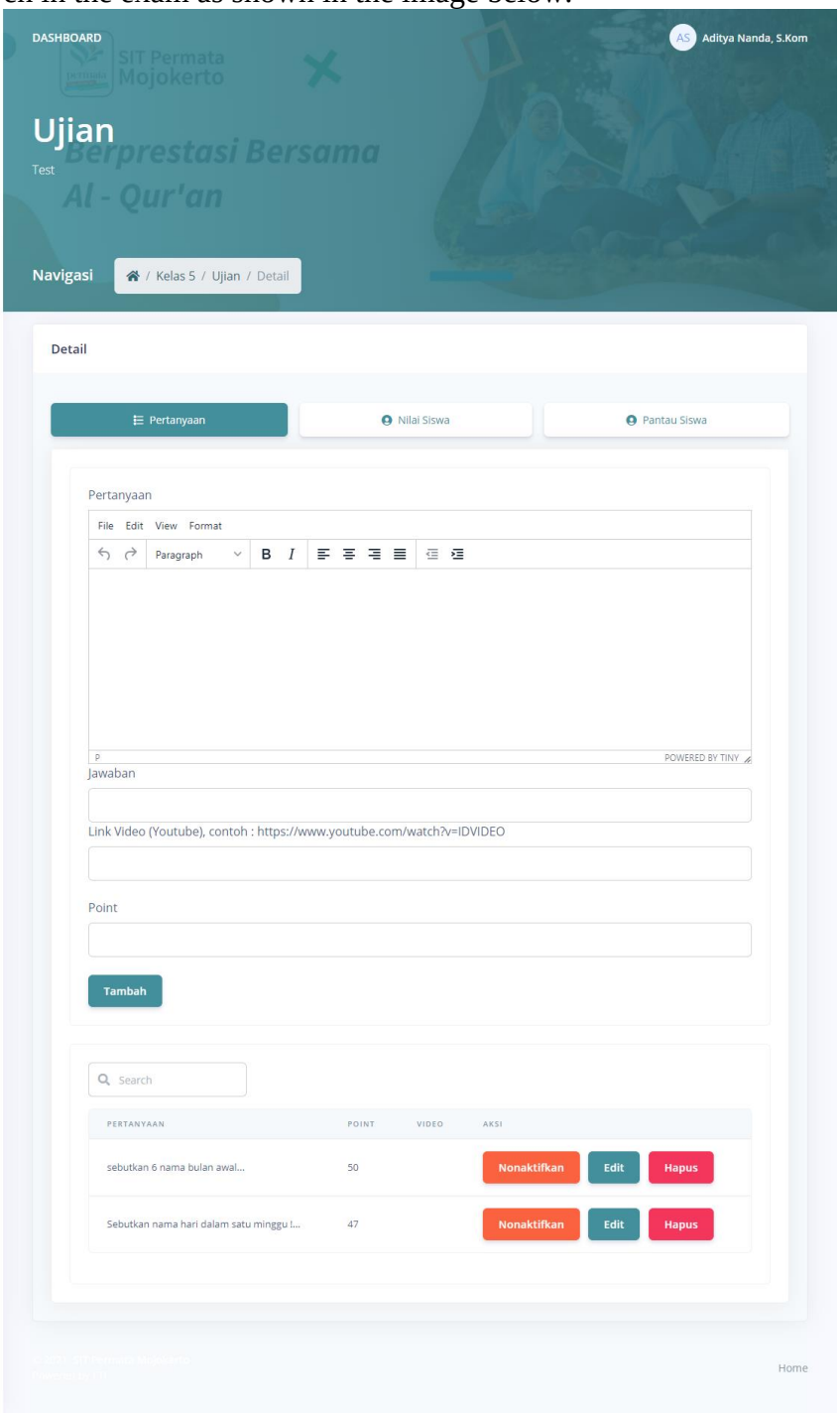


Figure. 4 Exam Question Page

After the exam is saved and done by the student, the student's exam answers will be processed and calculated by the system automatically using the cosine similarity method.

The following is an example of the test results filled out by students in the E-Learning system. If, for example, the query, the answers entered by the students are as follows:
Answer to question number 1 = Monday Tuesday Wednesday Thursday Friday Sunday
Answer to question number 2 = January February March April May June

The data on the student's answer query above will be compared with the teacher's answer key data that has been previously determined, namely:
Answer key number 1 = Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday
Answer key number 2 = January, February, March, April, May, June

Furthermore, the similarity of the student's input data with the teacher's answer key query will be assessed, namely by comparing the student's answer query with the teacher's answer key query. The naming of data variables as follows:
P1 = Answer to Question 1
P2 = Answer to Question 2

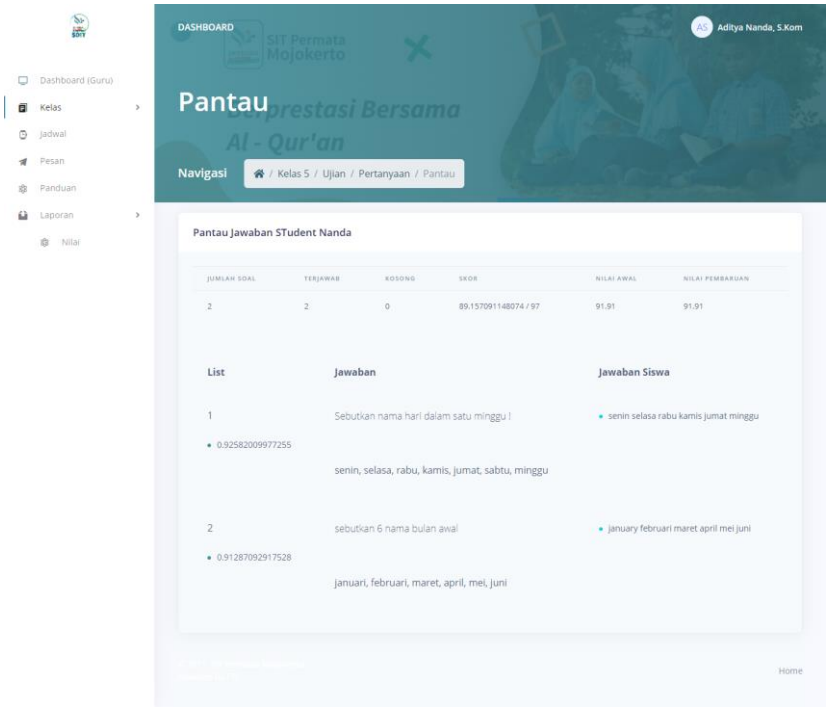

Figure. 5 Exam Watch Page

The final results of student examination assessments are obtained from calculating the average value of each question similarity value using the cosine similarity method.

Table 3. Survey Question

| Similarity Value | P1 | P2 |
|---|---|---|
| | 0.926 | 0.913 |

Based on the data in the similarity value table above, the final score for the student exam will be calculated using the following formula:

$$\text{Student Exam Final Score} = \frac{\sum(\text{Similarity Score} \times \text{Score})}{\text{Total Score}} \times 100 \quad (3)$$

So that it can be seen the final score of the student's exam is as follows:

$$\text{Student Exam Final Score} = \frac{(0{,}9258 \times 50) + (0{,}9129 \times 47)}{97} \times 100 \quad (4)$$

$$\text{Student Exam Final Score} = 91{,}91$$

From the process of assessing 30 student exams, 27 test results obtained scores according to the predictions and calculations of the teacher's manual. So that precision calculations can be done to determine the level of accuracy of a system.
The calculation of the recall value is carried out using the formula as below.

$$\text{Precission} = \frac{26}{30} \times 100 = 86{,}67\ \% \quad (5)$$

The responses obtained from the results of filling out the questionnaire were 30 respondents. 15 respondents are teachers, and the remaining 15 are students.

The results of the form are then calculated employing a planned formula to urge the SUS score. The results of the Sus score assessment are shown within the table below. The results showed a median SUS score of 61.33.

Table 4. SUS Usability Test

| **Respondent** | **R1** | **R2** | **R3** | **R4** | **R5** | **R6** | **R7** | **R8** | **R9** | **R10** | **SUS Score** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 2 | 5 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 80 |
| 2 | 3 | 1 | 2 | 1 | 1 | 3 | 1 | 4 | 3 | 2 | 47.5 |
| 3 | 1 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 4 | 32.5 |
| 4 | 4 | 2 | 4 | 1 | 4 | 2 | 5 | 1 | 5 | 3 | 82.5 |
| 5 | 4 | 5 | 3 | 5 | 3 | 4 | 5 | 5 | 5 | 4 | 42.5 |
| 6 | 5 | 3 | 4 | 2 | 4 | 5 | 4 | 3 | 4 | 3 | 62.5 |
| 7 | 2 | 3 | 3 | 4 | 4 | 3 | 3 | 2 | 2 | 4 | 45 |
| 8 | 3 | 2 | 4 | 1 | 2 | 2 | 4 | 2 | 3 | 2 | 67.5 |
| 9 | 5 | 4 | 5 | 2 | 4 | 4 | 4 | 2 | 4 | 2 | 70 |
| 10 | 2 | 2 | 2 | 1 | 3 | 1 | 3 | 1 | 4 | 1 | 70 |
| 11 | 2 | 2 | 4 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 60 |
| 12 | 3 | 4 | 2 | 3 | 5 | 3 | 2 | 4 | 3 | 4 | 42.5 |
| 13 | 3 | 2 | 4 | 1 | 3 | 3 | 4 | 1 | 2 | 3 | 65 |
| 14 | 5 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 60 |
| 15 | 4 | 2 | 4 | 1 | 4 | 2 | 4 | 2 | 4 | 2 | 77.5 |
| 16 | 5 | 2 | 3 | 4 | 5 | 4 | 3 | 2 | 2 | 4 | 55 |
| 17 | 3 | 2 | 4 | 1 | 3 | 3 | 4 | 1 | 2 | 3 | 65 |

| Respondent | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 | SUS Score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 50 |
| 19 | 4 | 2 | 4 | 1 | 4 | 2 | 4 | 2 | 4 | 2 | 65 |
| 20 | 4 | 3 | 5 | 1 | 4 | 2 | 4 | 2 | 4 | 1 | 80 |
| 21 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 4 | 3 | 2 | 45 |
| 22 | 3 | 2 | 3 | 1 | 4 | 2 | 4 | 1 | 4 | 1 | 77.5 |
| 23 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 62.5 |
| 24 | 4 | 2 | 4 | 1 | 4 | 2 | 4 | 1 | 4 | 1 | 82.5 |
| 25 | 3 | 3 | 1 | 2 | 4 | 3 | 2 | 2 | 5 | 2 | 57.5 |
| 26 | 1 | 5 | 5 | 2 | 5 | 3 | 2 | 1 | 5 | 2 | 62.5 |
| 27 | 4 | 2 | 5 | 5 | 3 | 4 | 4 | 2 | 4 | 4 | 57.5 |
| 28 | 5 | 2 | 5 | 4 | 5 | 2 | 3 | 4 | 5 | 2 | 72.5 |
| 29 | 5 | 3 | 5 | 3 | 5 | 2 | 5 | 5 | 5 | 5 | 67.5 |
| 30 | 3 | 4 | 2 | 3 | 2 | 3 | 2 | 4 | 3 | 4 | 35 |
| Average SUS Score | | | | | | | | | | | 61.33 |

The SUS score obtained is 61.33 which is included in the Marginal High category and in the OK category in the results category using the SUS method.

## 4. CONCLUSION

The conclusion that may be drawn from the results of the design, implementation, and testing of the E-Learning system during this study is that Cosine Similarity is enforced in an E-Learning system that can facilitate the analysis method or student learning assessment automatically. This can be indicated by the system testing distributed to get a reasonably good performance, particularly the exactitude test results have a performance of 86.67% and supported the usability test results obtained a worth of 61.33 that is enclosed within the Marginal High category. Thus the E-Learning system that has been built can help facilitate the process of evaluating student learning. It is hoped that this implementation can help make online learning easier.

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