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Evaluation of Online Learning Platform Usability Using the System Usability Scale Method and Nielsen's Usability Attributes

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Abstract

As digital transformation reshapes the educational landscape, the effectiveness of online learning platforms is critical to student success. This study evaluates the usability of a prominent online learning platform utilized by high school students across SMA, SMK, and MA levels. To ensure a comprehensive assessment, the evaluation employed a dual-methodological approach: the System Usability Scale (SUS) and Nielsen's Attributes of Usability (NAU). Primary data were gathered through structured questionnaires distributed to 115 active users. The quantitative analysis revealed that the platform achieved an average SUS score of 75.5. This score falls into the "Good" category (Grade B), signifying a high degree of user-friendliness and general acceptability among its target demographic. Further analysis of Nielsen's five attributes—learnability, efficiency, memorability, errors, and satisfaction—showed consistently high performance. Each attribute exceeded an average score of 4.21 on a Likert scale. Notably, learnability emerged as the strongest dimension (4.386), suggesting that new users find the interface intuitive. Conversely, memorability received the lowest relative score (4.293). These findings indicate that while the platform provides a positive and accessible experience, there is room for optimization. Future development should prioritize enhancing usage efficiency and reinforcing memorability to ensure that infrequent users can navigate the system without a steep re-learning curve, thereby maximizing the overall educational impact.

Keywords: Digital Learning Platform, Nielsen's Attributes of Usability, System Usability Scale, Usability

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I. Introduction

Digital transformation in education has given rise to various online learning platforms that aim to provide flexible and efficient access to learning. As the use of technology by students and educators increases, online learning applications are not only required to provide quality content, but also must have a good level of usability [1]. Usability in the context of human-computer interaction is a measure of the ease with which users can operate a system effectively, efficiently, and satisfactorily [2][3]. The platform evaluated is one of the online learning platforms widely used in Indonesia by students from various levels of education. This application provides a variety of learning features such as animated videos with tutors, interactive quizzes, practice questions, and material summaries [4]. It is one of the most widely used e-learning platforms in Indonesia, with more than 10 million downloads on the Play Store [5].

However, in practice, online learning still has many shortcomings, especially in terms of the platform used [1]. If usability is low, users may have difficulty understanding navigation, feel confused by the interface, become frustrated, and lose motivation to learn. This problem is often the main cause of decreased participation and learning success on digital platforms [5]. This poses a challenge for developers, as e-learning design must consider the synergy between the learning process and user interaction [2]. The success of an e-learning system is not only measured by user satisfaction or learning outcomes, but must also be evaluated in terms of usability through a systematic and continuous approach [2].

Previous research shows that there is room for improvement in terms of usability. The evaluation score using the System Usability Scale (SUS) was 65.6, which falls into category C or “marginal acceptance” [6]. Meanwhile, assessments using the User Experience Questionnaire (UEQ) showed effectiveness scores of 59.38, efficiency of 65.36, and satisfaction of 62.52, which are still below the excellent category [7]. Therefore, further evaluation with a more comprehensive approach is needed. The System Usability Scale (SUS) is a quick and reliable instrument for measuring users' general perceptions of a system's ease of use. Meanwhile, Nielsen's Usability Attributes (NAU) assess five main aspects: learnability, efficiency, memorability, errors, and satisfaction, thereby providing a more comprehensive picture of the user experience [8][9]. Several studies also suggest using a combination of these methods to obtain more holistic evaluation results.

Based on this background, this study aims to evaluate the usability level of an online learning application using the System Usability Scale (SUS) and Nielsen's Usability Attributes (NAU) methods. The specific objectives of this study include: (1) determining the level of usability based on the System Usability Scale (SUS) score, (2) analyzing usability attributes based on the Nielsen’s Usability Attributes (NAU) approach, and (3) providing development recommendations based on the evaluation results of both methods. This article is organized into several main sections, namely: introduction, research methods, results and discussion, conclusions and suggestions, and references.

II. Related Work

The evaluation of online learning platforms has become a significant focus in educational technology research, particularly concerning user experience and interface effectiveness. Previous studies have highlighted both the potential and the shortcomings of existing digital learning tools in Indonesia. For instance, Mulyana et al. emphasized that online learning applications are not only required to deliver quality content but must also maintain high usability standards to be effective [1]. Several studies specifically evaluating the *Ruangguru* application have yielded varying results. Research by Hakim et al. using the System Usability Scale (SUS) method resulted in a score of 65.6, which falls into the "marginal acceptance" category [6]. In contrast, Kristanto et al. utilized the User Experience Questionnaire (UEQ) and found that

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while the platform was functional, its scores for effectiveness (59.38), efficiency (65.36), and satisfaction (62.52) remained below the "excellent" threshold [7]. Furthermore, Kusuma et al. identified specific usability issues in the mobile application using heuristic evaluation methods, noting that low usability can lead to user frustration and decreased learning motivation [5]. The importance of using standardized instruments like the System Usability Scale (SUS) and Nielsen's Attributes of Usability (NAU) is well-documented. SUS, developed by John Brooke, is recognized as a reliable tool for a quick global assessment of system ease of use. Meanwhile, Nielsen's framework provides a detailed breakdown of usability into five core attributes: learnability, efficiency, memorability, errors, and satisfaction. Recent trends in usability research suggest that combining these methods provides a more holistic and comprehensive understanding of the user experience than using a single metric alone. This dual-methodological approach has been applied in various contexts, such as evaluating video conferencing tools and office software, to provide actionable development recommendations.

III. Research Method

This study was conducted using a descriptive quantitative approach to obtain a clear picture of user experiences with an online learning platform. The research subjects in this study were high school/vocational school/Islamic high school students who were active users of the platform as a digital learning medium [10]. They were selected because they belonged to the main user group of the application in the context of secondary education [11]. The object of the study was a digital-based educational platform that provided online learning services for elementary to high school levels, with features such as learning videos, practice questions, live classes, and material summaries [4].

A. Research Process

This research followed several stages as shown in Figure 1, starting from the initial stage to the final stage to achieve the research objectives. In the input stage, problem identification and literature study were conducted as a preliminary basis. Next, in the process stage, data collection, instrument validity and reliability testing, data analysis, and discussion of results were conducted. In the output stage, this research produces recommendations based on the findings, and concludes with conclusions and suggestions.

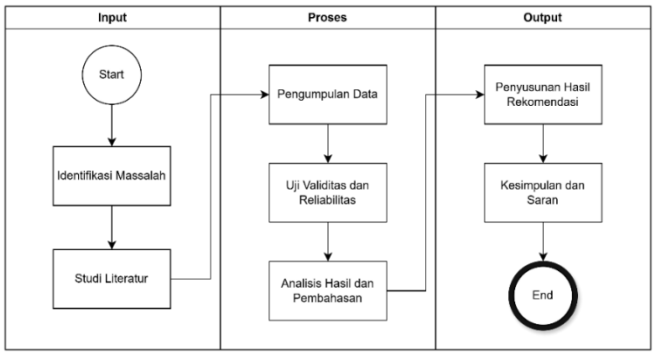

Fig. 1. Research Flow Chart

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1) Problem Identification

This study began with the problem identification stage. At this stage, the researcher identified the problems to be discussed. The main objective of this stage was to clarify the issues to be raised in the study and to provide a basis for further research development.

2) Literature Study

In the literature study stage of this research, the researcher observed and selected the methods to be used. A deep understanding of the methods is very important to achieve the expected objectives of the research. The method used in this study is the System Usability Scale (SUS) developed by John Brooke in 1996 [12][6]. SUS is a usability evaluation instrument that is quick, simple, and has been proven to have high validity in various types of systems [13]. This method produces an aggregate value that represents the overall perception of users regarding the ease of use of the system [13].

In addition to SUS, this study also uses Nielsen's Attributes of Usability (NAU) approach developed by Jakob Nielsen [14]. NAU evaluates usability based on five main attributes, namely learnability, efficiency, memorability, errors, and satisfaction [14][15]. The combination of the SUS and NAU methods allows for a quantitative and in-depth analysis of usability in key aspects of user interaction. The SUS questionnaire consists of the following 10 statements:

1. I would be happy to use the Ruang Guru app frequently.
2. I feel that this app does not require technical assistance to use.
3. I find this application easy to use.
4. I think I need help from someone knowledgeable to be able to use this application.
5. The features in this application are well integrated.
6. I feel that many things are inconsistent in this application.
7. I am sure most people can learn to use this application quickly.
8. This application feels confusing to use.
9. I feel confident when using this application.
10. I need to learn a lot before I can use this application effectively.

TABLE I

SUS SCORE VALUE

Grade	SUS	Percentil Range	Adjectives	Acceptable
A+	84,1 - 100	96 - 100	Best Imaginable	Yes
A	80,8 – 84,0	90 - 95	Excellent	Yes
A-	78,9 – 80,7	85 - 89	Good	Yes
B+	77,2 – 78,8	80 - 84	Good	Yes
B	74,1 – 77,1	70 - 79	Good	Yes
B-	72,6 – 74,0	65 - 69	Good	Yes
C+	71,1 – 72,5	60 - 64	Good	Yes
C	65,0 – 71,0	41 - 59	Good	Yes
C-	62,7 – 64,9	35 - 40	OK	Marginal
D	51,7 – 62,6	15 -34	OK	Marginal
F+	25,1 – 52,6	2 - 14	Poor	No
F	0-25	0 -1,9	Worst Imaginable	No

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Here are the 25 NAU Questionnaire Questions:

1. I could easily understand how to use this application when I first tried it.
2. I feel that this application is designed to be easy to learn.
3. I did not experience any confusion when I started using this application.
4. The guides or instructions in this application are easy to understand.
5. I feel that I can use this application without needing special training.
6. I can complete tasks quickly using this application.
7. This application makes it easy for me to find the features I need.
8. Navigation in this application feels efficient and is not confusing.
9. I can achieve my goals in this application without unnecessary steps.
10. I feel that this app's performance is responsive and fast.
11. I can easily remember how to use this app after not using it for a long time.
12. I don't need to relearn how to use this app when I return to it after some time.
13. The layout and icons in this app are easy to remember.
14. I feel familiar when I return to using this app.
15. The app's menu structure makes it easy for me to remember the location of important features.
16. I rarely make mistakes when using this app.
17. If I make a mistake, I can easily correct it.
18. This app provides clear information when an error occurs.
19. I don't feel frustrated when an error occurs while using the app.
20. This app helps me prevent errors before they occur.
21. I am satisfied with the design and appearance of this application.
22. I am satisfied with the main features in the application.
23. This application meets my expectations in supporting the learning process.
24. I would recommend this application to others.
25. Overall, I am satisfied with the Ruang Guru application.

3) Data Collection

At this stage, data was collected through the distribution of questionnaires using Google Forms. The questionnaire consisted of two usability evaluation methods:

1. System Usability Scale (SUS): 10 questions.
2. Nielsen’s Attributes of Usability (NAU): 25 questions.

A total of 35 questions were distributed to respondents using simple random sampling, a method in which every individual in the population has an equal chance of being selected as a respondent at random. The population in this study consisted of high school, vocational school, and Islamic high school students who are active users of the online learning platform.

4) Validity and Reliability Test

This stage aims to ensure that the instruments used actually measure what they are intended to measure (valid) and provide consistent results (reliable) [16]. Data processing was carried out using SPSS Jamovi 2.6.44 software.

a. Validity test: Aims to determine the extent to which each question item has a significant relationship

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with the total variable score [17]. The validity test was conducted by analyzing the correlation between the score of each question item and the total variable score using the Pearson Product Moment test. Assessment criteria:

a) If the calculated r ≥ table r (with a significance level of 0.05), the item is declared valid.
b) If r count < r table, then the item is declared invalid.
b. Reliability test: Aims to assess whether the instrument used has a reliable level of consistency and produces stable results when retested [14]. Reliability testing is performed using Cronbach's Alpha coefficient to measure the internal consistency of items in the questionnaire. Decision criteria:
a) $\alpha \geq 0.60$: the instrument is reliable.
b) $\alpha < 0.60$: the instrument is not reliable.

5) Analysis of Results and Discussion

This stage aims to analyze quantitative data obtained from questionnaires using two usability evaluation methods, namely the System Usability Scale (SUS) and Nielsen's Attributes of Usability (NAU). Data processing and analysis were carried out using SPSS Jamovi 2.6.44 statistical software. The analysis began with a description of the respondents' demographic data to determine the profile of users participating in the study, such as year of birth, gender, education level, class, length of application use, frequency of use per week, duration of use, most frequently used features, and devices used. This information is important to provide context for the interpretation of usability results, as users' perceptions of the application can be influenced by these demographic characteristics.

Next, the analysis using SUS was conducted by calculating each respondent's score based on standard procedures, where each item was given a score according to the provisions and converted into a range of 0–100. The average score was then used to interpret the overall usability level of the application based on a qualitative scale (A-F). Meanwhile, data from the NAU questionnaire was analyzed descriptively by calculating the mean, median, and mode for each of the five usability attributes: learnability, efficiency, memorability, errors, and satisfaction. The results of both methods were used in an integrated manner to describe users' perceptions of the usability of the online learning platform in a more comprehensive and in-depth manner.

IV. Results and Discussion

A. Demographic Analysis of Respondents

1) Year of Birth

Most of the respondents in this study were high school/vocational school/Islamic high school students born in 2008, accounting for 40.69% of the total respondents. This was followed by respondents born in 2009, accounting for 25.02%, and those born in 2007, accounting for 22.71%. Meanwhile, respondents born in 2010 accounted for 9.46%, and those born in 2006 accounted for only 2.11% of the total respondents.

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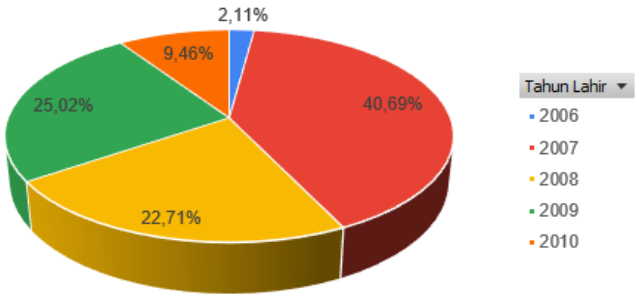

Fig. 2. Research Flow Chart

2) Gender

Based on the graph shown, the gender distribution of respondents in this study is fairly balanced. Female respondents are slightly more dominant with a percentage of 50.09%, while male respondents account for 49.91% of the total respondents. This shows that there is no significant difference between the number of respondents based on gender.

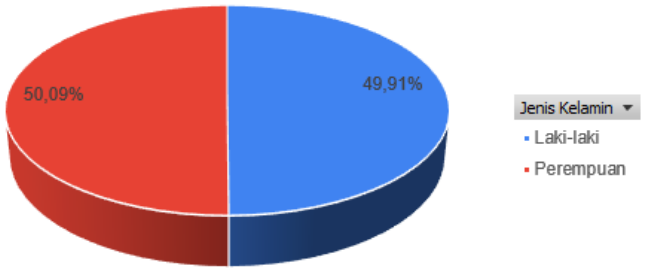

Fig. 3. Respondent Demographics by Gender

3) Education Level

Based on the data collected, the majority of respondents were high school students (66.54%), followed by Islamic high school students (17.69%) and vocational high school students (15.77%). These results indicate that most of the application users who were the subjects of this study were high school students.

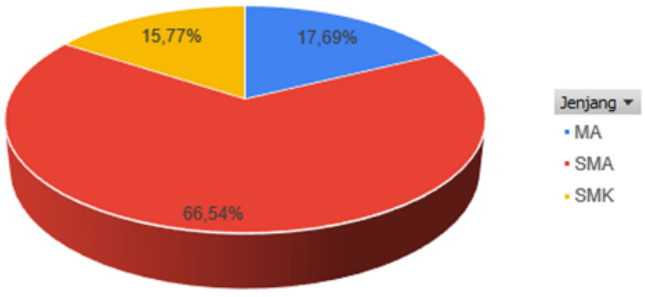

Fig. 4. Respondent Demographics Based on Education Level

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4) Grade Level

The respondents in this study consisted of students in grades 10, 11, and 12. The composition of respondents showed that grade 10 students were the largest group with a percentage of 35.95%, followed by grade 12 students with 35.92%, and grade 11 students with 28.13%.

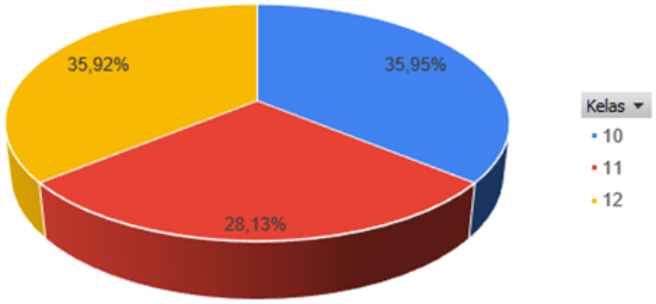

Fig. 5. Respondent Demographics Based on Grade Level

5) Length of Use of Online Learning Platforms

The analysis results show that most respondents have used the online learning platform for 4–6 months, namely 41.35%. This is followed by respondents who have used the application for 1–3 months (30.96%), more than 6 months (16.19%), and those who have only used it for less than 1 month (11.50%).

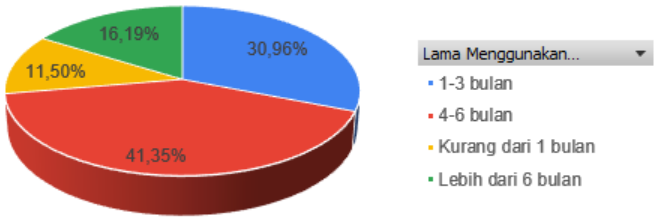

Fig. 6. Demographics Long-term Using Online Learning Platforms

6) Frequency of Use per Week

Based on usage frequency data, the majority of respondents use the online learning platform 3–5 times a week, accounting for 51.54%. This is followed by respondents who use the application 6–7 times, accounting for 23.61%, then 1–2 times, accounting for 21.47%, and only 3.37% of respondents who use the application every day.

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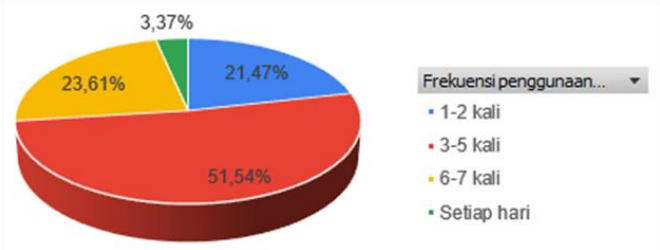

Fig. 7. Weekly Usage Frequency Demographics

7) Average Duration of Online Learning Platform Use per Access

From the data obtained, most respondents used the online learning platform for an average duration of 30–60 minutes per session, accounting for 49.15%. This was followed by respondents who used it for 15–30 minutes, accounting for 36.67%, then more than 60 minutes, accounting for 7.54%, and less than 15 minutes, accounting for 6.64%.

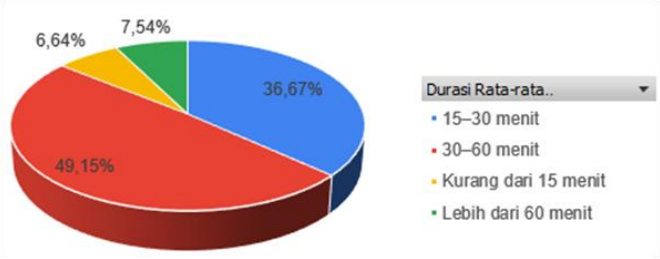

Fig. 8. Demographics Average Duration of Each Access

8) Most Frequently Used Online Learning Platform Features

The survey results show that the majority of respondents stated that the feature they use most often is Learning Videos, at 49.92%. This is followed by Q&A/Discussion Forums at 29.60% and Practice Questions at 16.12%. Meanwhile, only a small percentage of respondents chose the Video and Practice Questions features at 0.96% and the All category at 2.09%, with others at 1.31%.

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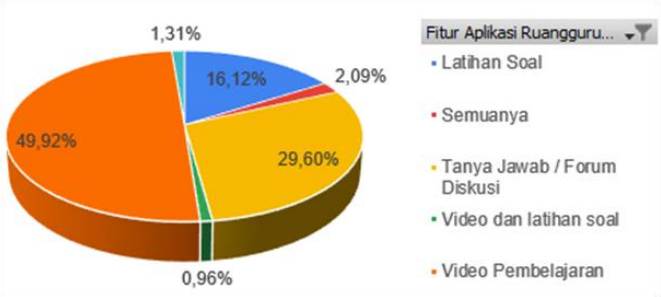

Fig. 9. Demographics of the Most Frequently Used Online Learning Platform Features

9) Most Frequently Used Devices for Accessing Online Learning Platforms

The majority of respondents in this study use smartphones as their primary device for accessing digital applications or services, with a percentage of 48.73%. Next, laptops are used by 32.73% of respondents, while tablets are the least used option, with only 18.55% of respondents using them.

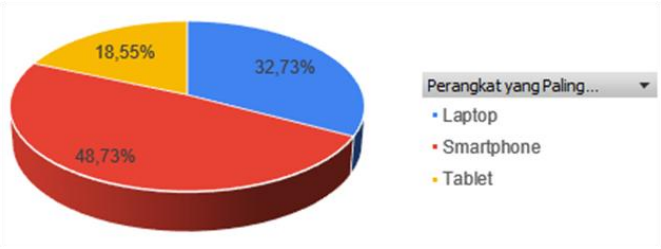

Fig. 10. Demographics of Devices Most Frequently Used to Access Online Learning Platforms

B. Validity and Reliability Tests

The validity test was conducted to measure the extent to which the items in the questionnaire were able to represent the construct being measured, namely usability. The test used Pearson Product Moment correlation with the help of the SPSS Jamovi 2.6.44 application, at a significance level of 5% ($\alpha = 0.05$). With a total of 115 respondents, the table r value was 0.145 (df = 113). The validity test results showed that all items in the SUS and NAU questionnaires had a correlation value greater than the table r = 0.145, so they could be declared valid.

Next, a reliability test was conducted to measure the internal consistency between items in each construct. The analysis results showed that the Cronbach's Alpha value for the SUS instrument was 0.785 and for NAU was 0.847. Based on general interpretation, both values are in the high category, so it can be concluded that the instruments have excellent reliability. Thus, all items in the SUS and NAU questionnaires are declared suitable for use in evaluating platform usability. The results of the online learning platform validity test are shown in Table 2 and Table 3.

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TABLE II

SUS QUETIONARY VALIDITY TEST

Question	r Count	Df (N-2)	r Table	Description
1	0,201	115-2 = 113	0,145	Valid
2	0,246			Valid
3	0,283			Valid
4	0,739			Valid
5	0,156			Valid
6	0,687			Valid
7	0,281			Valid
8	0,705			Valid
9	0,434			Valid
10	0,672			Valid

TABLE III

NAU QUETIONARY VALIDITY TEST

Question	Indicator	r Count	Df (N-2)	r Table	Description
1	L1	0,568	115-2 = 113	0,145	Valid
2	L2	0,215			Valid
3	L3	0,453			Valid
4	L4	0,254			Valid
5	L5	0,247			Valid
6	E6	0,495			Valid
7	E7	0,278			Valid
8	E8	0,378			Valid
9	E9	0,459			Valid
10	E10	0,382			Valid
11	M11	0,466			Valid
12	M12	0,390			Valid
13	M13	0,441			Valid
14	M14	0,382			Valid
15	M15	0,423			Valid
16	R16	0,437			Valid
17	R17	0,495			Valid
18	R18	0,320			Valid
19	R19	0,415			Valid
20	R20	0,393			Valid
21	S21	0,460			Valid
22	S22	0,406			Valid
23	S23	0,213			Valid
24	S24	0,560			Valid
25	S25	0,329			Valid

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C. Calculating the SUS Score

Data from 115 respondents that had been declared valid and reliable was then used to calculate the average SUS score on the online learning platform. This value reflects the level of usability based on users' perceptions of the application. The results of the average SUS score calculation are shown in Table 4.

TABLE IV

SUS SCORE TABULATION

Respondent	SUS Score
1	100
2	100
3	100
4	100
5	97.5
6	67.5
7	65
8	60
9	70
10	75
11	70
12	72.5
13	85
14	55
15	55
16	55
17	82.5
18	50
19	52.5
20	65
21	52.5
22	92.5
23	60
24	55
25	52.5
26	62.5
27	50
28	85
29	65
30	47.5
31	90
32	70
33	60
34	80
35	92.5
36	87.5
37	85
38	90
39	92.5
40	87.5
41	87.5
42	72.5
43	70
44	87.5
45	60
46	90
47	60
48	77.5
49	80
50	85
51	92.5
52	92.5
53	85
54	92.5
55	80
56	80
57	82.5
58	87.5
59	77.5
60	90
61	77.5
62	70
63	80
64	55
65	57.5
66	47.5
67	92.5
68	47.5
69	52.5
70	85
71	55
72	55
73	55
74	85
75	50
76	40
77	80
78	90
79	85
80	60
81	90
82	85
83	82.5
84	90
85	82.5
86	90
87	85
88	85
89	87.5
90	67.5
91	42.5
92	70
93	82.5
94	82.5
95	87.5
96	77.5
97	87.5
98	90
99	85
100	85
101	85
102	87.5
103	95
104	77.5
105	60
106	60
107	62.5
108	75
109	55
110	82.5
111	92.5
112	97.5
113	92.5
114	60
115	82.5
SUS Average Score	**75,5**

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Based on the results of processing the System Usability Scale (SUS) questionnaire, an average score of 75.5 was obtained. Referring to the SUS interpretation standard according to Brooke's rating scale (2013) and other related studies, this score falls into category B, which is in the 70–79 percentile range [18]. Qualitatively, this value is classified as "Good" and is at the "Yes" level of acceptance, which means that the system or application is considered to have a good level of usability and is suitable for use by users [19]. This value also indicates that the overall user experience is positive and adequate to support the effectiveness of the system's use.

D. Descriptive Analysis NAU Questionnaire

The results of the descriptive test of the Nielsen's Attributes of Usability (NAU) questionnaire consisted of five main attributes, namely Learnability, Efficiency, Memorability, Error, and Satisfaction. Each attribute was measured using five statements (items) with a 1-5 Likert scale, where a score of 1 indicates "Strongly Disagree" and a score of 5 indicates "Strongly Agree" [20]. The results of data processing for each attribute are shown in Table 5.

TABLE V

DESCRIPTIVE ANALYSIS OF NAU QUESTIONNAIRE

Variable Attribute	Code	Variable Mean	Mean	Median	Modus	Result
Learnbility	L1	4,408	4,386	4,40	4,40	Strongly Agree (SA)
	L2	4,478				
	L3	4,295				
	L4	4,478				
Efficiency	E6	4,434	4,373	4,40	4,60	Strongly Agree (SA)
	E7	4,391				
	E8	4,417				
	E9	4,286				
Memorability	M11	4,339	4,293	4,40	4,60	Strongly Agree (SA)
	M12	4,060				
	M13	4,382				
	M14	4,391				
	M15	4,295				
Error	R16	4.452	4,297	4,40	4,40	Strongly Agree (SA)
	R17	4,295				
	R18	4,391				
	R19	4,060				
	R20	4,286				
Satisfaction	S21	4,313	4,354	4,40	4,40	Strongly Agree (SA)
	S22	4,313				
	S23	4,365				
	S24	4,391				
	S25	4,391				

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Based on the calculation results, all usability attributes have a mean value above 4.21, which indicates that respondents gave ratings in the "Strongly Agree" category. This shows that the application is considered easy to learn, efficient to use, and easy to remember when used again. In addition, users also rarely experience errors and are generally satisfied with their experience using the application. These findings reflect that the application has a very good level of usability in the eyes of users.

E. Recommendations for Improving the Online Learning Platform Based on SUS and NAU Evaluations

The results of the usability evaluation of the online learning platform showed a SUS score of 75.5, which falls into the "Good" category (grade B), and an average score for all NAU attributes above 4.21, with the highest learnability (4.386) and lowest memorability (4.293). These findings indicate that although users have rated this application quite highly, there is still room for improvement, particularly in terms of memorability and efficiency. The following are development recommendations based on empirical data and recent studies. First, improving memorability should be a top priority. The average score of 4.293 indicates that users have difficulty remembering the app's functions and navigation after not using it for a certain period of time. To address this, the development of re-onboarding features, quick tutorials, and interactive elements such as tooltips and contextual hints is highly recommended so that users can intuitively recognize key functions without the need for repeated exploration. This recommendation is in line with recent studies that suggest the importance of re-familiarization features for highly complex platforms [21].

Second, although the online learning platform interface includes various learning features such as live classes, learning videos, and practice questions, some menu structures are still considered dense and inefficient. Many users need more than two navigation steps to access core features, which indicates an additional cognitive load. Therefore, a more minimalist redesign of the navigation that focuses on essential features is highly recommended in order to improve usage efficiency and reduce potential confusion for new users. This adjustment is also supported by findings that show that complex navigation structures can reduce overall user satisfaction and interaction effectiveness [22]. In addition to these two main aspects, strengthening the error notification system to make it more informative and responsive is also recommended. Several reports mention that users still face technical obstacles such as login failures or videos that do not open optimally due to unstable connections. For this reason, the presence of an automatic assistance system such as a chatbot, interactive help center, and easy-to-understand error explanations can increase user confidence when facing technical obstacles in the application.

Equally important is refreshing the visual design of the application to better suit the characteristics of Gen Z users who dominate the high school/vocational school/Islamic high school segment. Refining colors, icons, and interface elements with a flat and modern approach can increase user aesthetic satisfaction and engagement. Additional accessibility features such as dark mode and font size adjustment also need to be added to make the application more inclusive [22]. Finally, the implementation of personalization systems such as automatic study reminders, interest-based content recommendations, and gamification through a points and achievement system, is believed to strengthen user engagement and increase long-term retention of the application [23].

V. Conclusion

Based on the results of the usability evaluation of the online learning platform using the System Usability Scale (SUS) and Nielsen's Attributes of Usability (NAU) methods, the average SUS score was 75.5, which falls into the "Good" (Grade B) category. This indicates that the application is generally considered suitable and comfortable for users. Further analysis using the five NAU attributes revealed that all usability dimensions scored above 4.21 on the Likert scale, with learnability as the highest attribute

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(4.386) and memorability as the lowest (4.293). These findings reflect that the online learning platform has an excellent level of usability in terms of ease of learning and user satisfaction, but there are still challenges in terms of memorability and efficiency of use.

Therefore, application developers are advised to focus on strengthening the re-onboarding feature and simplifying the navigation structure to improve memorability and efficiency. In addition, improvements to the error feedback system and updates to the interface design and personalization elements are also expected to improve the overall quality of user interaction. The combination of the SUS and NAU methods has proven to be effective in providing a comprehensive overview of the user experience and can serve as a strategic reference for the development of application-based online learning systems in the future.

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