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Evaluation of the Usability of Online Learning Platforms Using the System Usability Scale Method and Nielsen Usability Attributes

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Abstract

This study aims to evaluate the usability level of one of the online learning platforms widely used by high school students, including those in SMA, SMK, and MA levels. The evaluation was conducted using two approaches: the System Usability Scale (SUS) and Nielsen's Attributes of Usability (NAU). Data were collected through questionnaires distributed to 115 active users of the platform. The results showed that the average SUS score was 75.5, which falls into the "Good" category (grade B), indicating that the platform has a good level of usability. Analysis of the five attributes of Nielsen's Attributes of Usability learnability, efficiency, memorability, errors, and satisfaction showed that all attributes received average scores above 4.21 on the Likert scale, with learnability being the highest (4.386) and memorability the lowest (4.293). These findings suggest that the online learning platform is considered easy to use and provides a positive learning experience, although there is still room for improvement, especially in terms of memorability and usage efficiency.

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

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].

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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 is a challenge for developers, because 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 sustainable 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, thus 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

Research on usability evaluation has been widely conducted in various digital systems, particularly in the field of educational technology and online learning platforms. Usability plays a crucial role in determining how effectively users can interact with a system, as it relates to the ease of learning, efficiency of use, error management, and overall user satisfaction. Systems with good usability are more likely to be accepted by users and can significantly improve the effectiveness of digital learning environments [2][3]. Several previous studies have evaluated the usability of educational applications and e-learning systems using various usability evaluation methods. For instance, research on the design analysis of the Ruangguru application interface found that interface design and usability aspects strongly influence the effectiveness of user interaction and learning experience [1]. In addition, other studies evaluating e-learning systems in higher education environments highlight the importance of usability in ensuring that digital learning platforms support effective and efficient learning processes [2].

One of the most widely used methods for usability evaluation is the System Usability Scale (SUS). SUS is a standardized usability testing method developed by Brooke that consists of ten questionnaire items designed to measure users' perceptions of system usability quickly and efficiently [12]. Because of its simplicity and reliability, SUS has been widely adopted in various studies involving digital platforms and mobile applications. Previous research evaluating the Ruangguru application using the SUS method reported usability scores that indicate the level of system acceptance among users [6]. Similarly, usability evaluation of mobile applications such as Tokopedia and other digital services using the SUS method demonstrates that SUS can effectively measure the overall usability perception of users toward a system [18][19].

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In addition to SUS, another widely used usability evaluation framework is Nielsen's Attributes of Usability (NAU). This framework evaluates usability based on five key attributes: learnability, efficiency, memorability, errors, and satisfaction. These attributes provide a comprehensive understanding of how users interact with a system and how easily they can perform tasks within it [14][15]. Previous studies applying the NAU approach have shown that usability attributes significantly influence user experience and system acceptance, particularly in applications that require frequent interaction, such as digital learning platforms and software applications [15][20].

Several studies have also suggested combining multiple usability evaluation methods to obtain more comprehensive results. For example, usability evaluation research on mobile banking systems using both SUS and NAU methods found that combining these methods provides deeper insights into both general usability perceptions and specific usability attributes [17]. Furthermore, studies evaluating user experience in mobile learning applications indicate that usability, interface design, and user interaction quality significantly influence user engagement and satisfaction when using educational technologies [23].

In the context of online learning platforms, usability evaluation is particularly important because these systems are extensively used by students to support learning activities. Applications such as Ruangguru have been widely adopted in Indonesia and have demonstrated positive impacts on learning motivation and academic performance when properly implemented [4][10][11]. However, several studies indicate that digital learning platforms may still face usability challenges related to interface complexity, navigation structure, and user interaction efficiency [5][21][22]. Based on these previous studies, it can be concluded that usability evaluation plays an essential role in improving the quality of digital learning systems. The use of both the System Usability Scale (SUS) and Nielsen's Attributes of Usability (NAU) allows researchers to evaluate usability from both general and attribute-based perspectives. Therefore, this study aims to evaluate the usability level of an online learning platform by applying these two methods in order to obtain a comprehensive understanding of user experience and to provide recommendations for system improvement.

III. Method

This study was conducted using a descriptive quantitative approach to obtain a clear picture of user experiences with an online learning platform. The subjects of 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 were among the main users of the application in the context of secondary education [11]. The object of the study was a digital-based educational platform that provides online learning services for elementary to high school levels, with features such as learning videos, practice questions, live classes, and material summaries [4].

3.1 Research Flow

This study 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, validity and reliability testing of instruments, as well as data analysis and discussion of results are carried out. In the output stage, this research produces recommendations based on the findings, and concludes with conclusions and suggestions.

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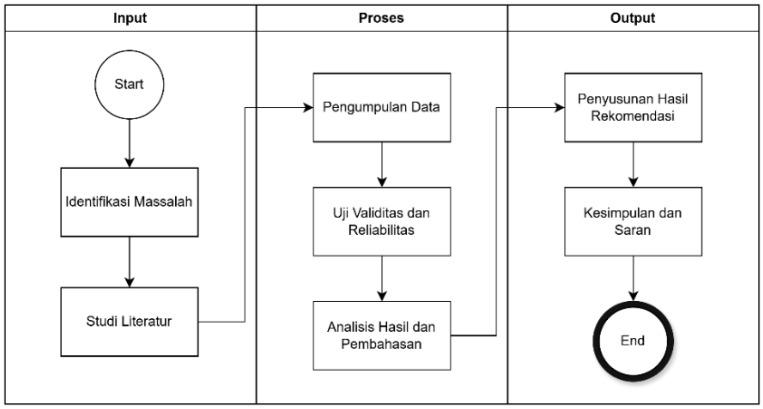

Figure 1. Research Flow Diagram

3.1.1 Problem Identification

This research begins with the problem identification stage. At this stage, the researcher identifies the problems to be discussed. The main objective of this stage is to clarify the issues to be raised in the research and to serve as a basis for further research development.

3.1.2 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 quick, simple usability evaluation instrument that has been proven to have high validity in various types of systems [13]. This method produces an aggregate score that represents the overall perception of users regarding the ease of use of the system [13].

In addition to SUS, this study also uses the Nielsen's Attributes of Usability (NAU) approach developed by Jakob Nielsen [14]. NAU evaluates usability based on five main attributes, namely learnability, efficiency of use, memorability (the ability of users to remember usage after being inactive for a certain period of time), errors (the level and impact of errors), and satisfaction (the level of user 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 application often.
2. I feel that this application does not require technical assistance to use.
3. I feel that this application is 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.

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Tabel 1. 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

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 application's performance is responsive and fast.
11. I can easily remember how to use this application after not using it for a long time.
12. I don't need to relearn how to use this application after some time.
13. The layout and icons in this application are easy to remember.
14. I feel familiar when returning to use this application.
15. The menu structure of this application 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 app.
22. I am satisfied with the main features of 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.

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3.1.3 Data Collection

At this stage, data was collected through a questionnaire distributed 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 was high school, vocational school, and Islamic high school students who are active users of the online learning platform.

3.1.4 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 performed using SPSS Jamovi 2.6.44 software. a. Validity test: Aims to determine the extent to which each question item has a significant relationship with the total variable score [17]. The validity test was performed 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 the calculated r < table r, the item is declared invalid.

Reliability test: Aims to assess whether the instrument used has a reliable level of consistency and produces stable results when re-measured [14]. Reliability testing was conducted 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

3.1.5 Analysis of Results and Discussion

This stage aims to analyze quantitative data obtained from the questionnaire 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.

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3.1.6 Compilation of Recommendations

This stage compiles recommendations based on the results of quantitative data analysis. Recommendations are given based on findings from measurements using the System Usability Scale (SUS) and Nielsen's Attributes of Usability (NAU) methods. Recommendations are not compiled based on theory alone, but are formulated directly from findings obtained through the processing and interpretation of respondent questionnaire data. SUS data analysis is used to identify the overall usability score and the distribution of user perceptions of the ease of use of the application. Meanwhile, the results of NAU are used to further evaluate specific aspects of usability based on five main attributes: learnability, efficiency, memorability, errors, and satisfaction. Aspects or attributes that receive relatively low scores are used as the basis for determining improvement priorities.

3.1.7 Conclusions and Recommendations

The final stage of this study produced conclusions based on the analysis conducted using the SUS and NAU methods, as well as data processing with the help of SPSS Jamovi 2.6.44 software. Recommendations were compiled based on findings on usability aspects that showed low scores and were directed towards application development and further research.

IV. Results and Discussion

4.1 Demographic Analysis of Respondents

4.1.1 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 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.

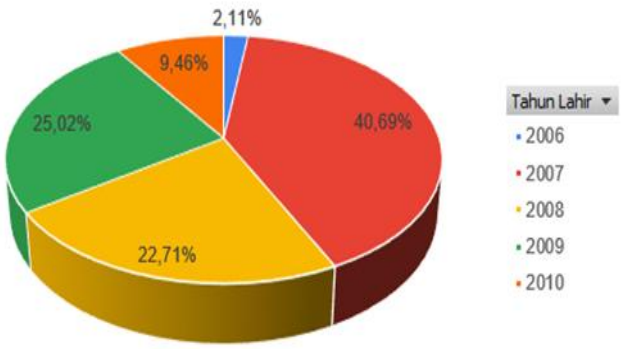

Figure 2. Respondent Demographics Based on Year of Birth

4.1.2 Gender

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

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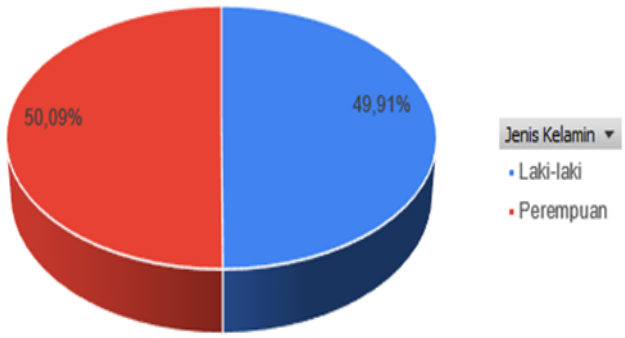

Figure 3. Respondent Demographics Based on Gender

4.1.3 Education Level

Based on the data collection results, the majority of respondents came from high school level, amounting to 66.54%, followed by respondents from MA level at 17.69%, and SMK at 15.77%. These results indicate that most of the application users who were the subjects of this study came from high school level.

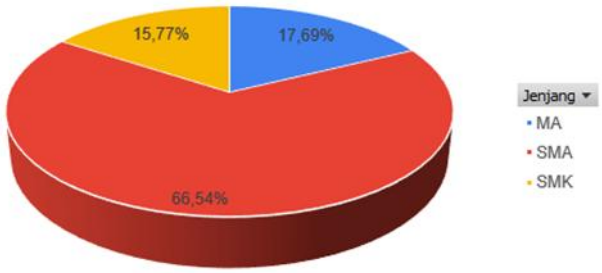

Figure 4. Respondent Demographics Based on Education Level

4.1.4 Grade

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

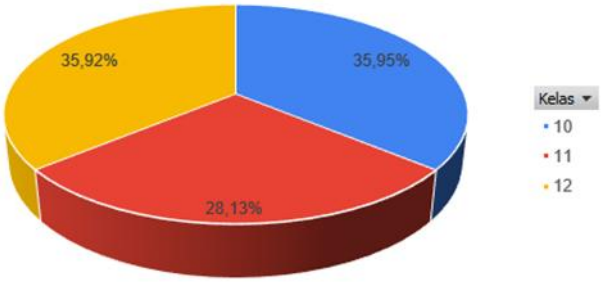

Figure 5. Respondent Demographics Based on Grade Level

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4.1.5 Length of Time Using the Online Learning Platform

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, namely 30.96%, more than 6 months, namely 16.19%, and those who have only used it for less than 1 month, namely 11.50%.

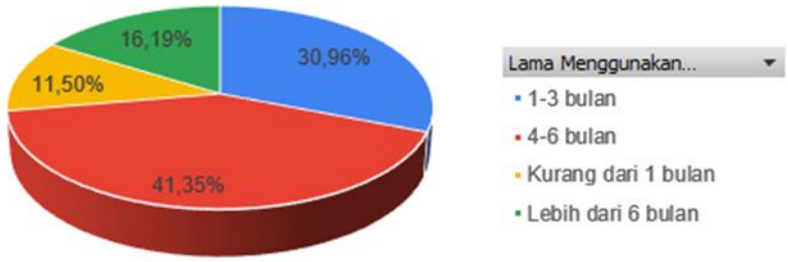

Figure 6. Demographics of Length of Use of Online Learning Platforms

4.1.6 Frequency of Use per Week

Based on the frequency of use data, the majority of respondents used online learning platforms 3–5 times a week, namely 51.54%. This was followed by respondents who used the application 6-7 times, amounting to 23.61%, then 1-2 times, amounting to 21.47%, and only 3.37% of respondents who used the application every day.

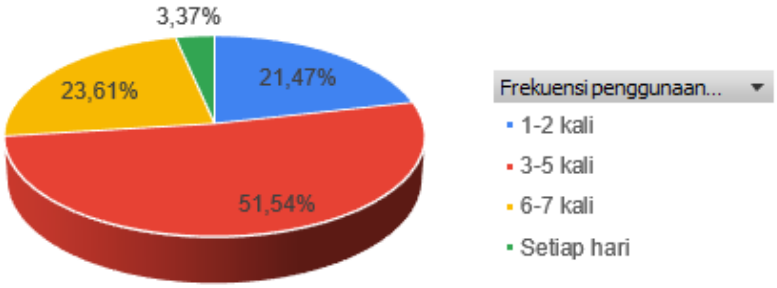

Figure 7. Demographics of Frequency of Use per Week

4.1.7 Average Duration of Use of the Online Learning Platform per Access

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

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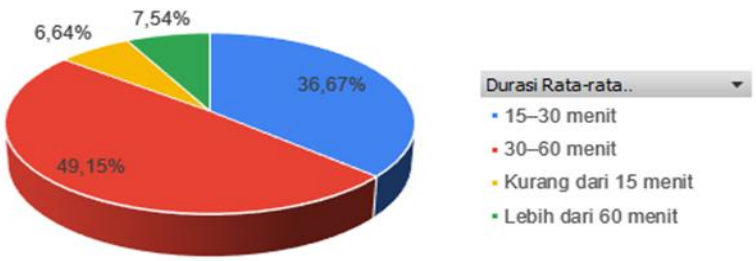

Figure 8. Demographics of Average Duration of Use per Access

4.1.8 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 was followed by Q&A/Discussion Forum at 29.60% and Practice Questions at 16.12%. Meanwhile, only a small number of respondents chose the Video and Practice Questions features at 0.96% and the All category at 2.09%, with others at 1.31%.

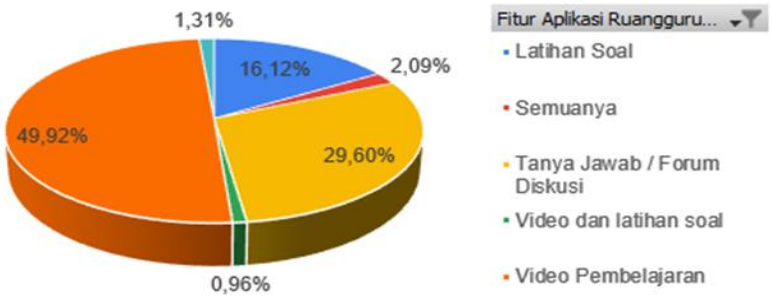

Figure 9. Demographics of the Most Frequently Used Online Learning Platform Features

4.1.9 Devices Most Frequently Used to Access Online Learning Platforms

The results show that most respondents in this study use smartphones as their main device to access digital applications or services, with a percentage of 48.73%. Furthermore, laptops were used by 32.73% of respondents, while tablets were the least used device, with only 18.55% of respondents using them.

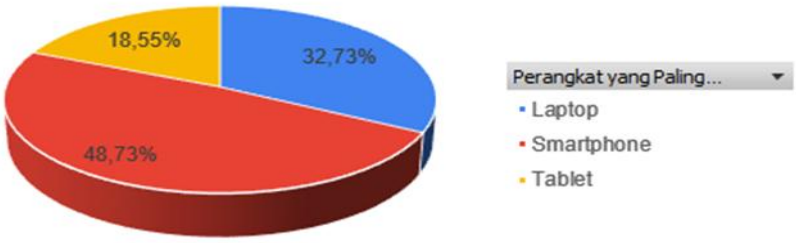

Figure 10. Demographics of the Most Frequently Used Devices to Access Online Learning Platforms

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4.2 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.

Tabel 2. SUS Questionnaire Validity Test

Pertanyaan	r Hitung	Df (N-2)	r Tabel	Keterangan
1	0,201	115-2 =	0,145	Valid
2	0,246	113		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

Tabel 3. NAU Questionnaire Validity Test

Pertanyaan	Indikator	r Hitung	Df (N-2)	r Tabel	Keterangan
1	1	0,568	115-2 = 113	0,145	Valid
2	2	0,215			Valid
3	3	0,453			Valid
4	4	0,254			Valid
5	5	0,247			Valid
6	6	0,495			Valid
7	7	0,278			Valid
8	8	0,378			Valid
9	9	0,459			Valid

4.3 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.

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Tabel 4. SUS Score Tabulation

Responden	Skor SUS
1	100
2	100
3	100
4	100
5	97.5
6	65
7	65
8	70
9	75
10	70

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 falls within the "Yes" acceptability level, 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.

4.4 Descriptive Analysis of the NAU Questionnaire

The results of the descriptive test of the Nielsen's Attributes of Usability (NAU) questionnaire consist of five main attributes, namely Learnability, Efficiency, Memorability, Error, and Satisfaction. Each attribute is 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.

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.

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

The usability evaluation results for the online learning platform showed a SUS score of 75.5, which falls into the "Good" (grade B) category, 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 the application has been rated quite well by users, 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 application's functions and navigation after not using it for a certain period of time. To overcome this, the development of re-onboarding features, quick tutorials, and interactive elements such as tooltips and contextual clues is highly recommended so that users can intuitively recognize the main functions without the need for repeated exploration. This recommendation is in line with recent studies that suggest the importance of re-familiarization features for platforms with high complexity [21].

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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 a more informative and responsive error notification system 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 (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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