Usability Testing of KESAN-IDEA (Kansei Engineering-Based System for Agroindustry-Idea Generation) for Micro, Small, and Medium Enterprises

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Abstract. Micro, Small, and Medium Enterprises (MSMEs) owners are expected to have innovative and creative characters. Kansei Engineering-based System for Agroindustry (KESAN-IDEA) technology was developed for MSME owners to generate ideas for product design. KESAN-IDEA is a variant of KESAN, which has been developed by combining Kansei engineering with the artificial intelligence approach. This study aimed to test the usability of KESAN-IDEA by connecting the user perceptions and system developers based on feedback. The usability was tested by a questionnaire using the System Usability Scale (SUS) based on Nielsen's usability attributes. The data collection process was carried out on sampling of MSME Agroindustry in Sleman Regency. The results of the SUS score calculation were 59.08 with a grade of 'D,' adjective 'OK,' acceptable 'Less Acceptable,' and Net Promoter Score (NPS) 'Passive.' The results recommended that the cause-and-effect diagram include the user, system, procedure, and environment for continuous improvement. The results of recommendations for each attribute were formulated based on SUS scores and causal diagrams. The results concluded that KESAN-IDEA can be used and functions as intended. Several areas require further development to enhance user comfort and convenience.

1 Introduction

Micro, Small, and Medium Enterprises (MSME) are expected to conduct self-evaluations related to the position of products during the introduction, launch, growth, sustainability, and decline period. The position of this product is closely related to the inventive capability of MSME's management (owner/manager). Innovation is practically defined as the result of designing and developing new products that have the potential to increase income and improve the sustainability process of an MSME. Kansei engineering has been used as a method to assist MSME in product design and development.

KESAN-IDEA is a customization of KESAN (Kansei Engineering-based System for Agroindustry) for MSME owners to generate ideas for product design. KESAN-IDEA has been developed by combining Kansei engineering and artificial intelligence approaches [1]. It facilitates the compilation of ideas and concepts and develops creativity, leading to a clear and structured product development process. This study aimed to connect user perceptions and system developers based on feedback through the KESAN-IDEA usability test. Using KESAN-IDEA, MSME can compile ideas for the product design process.

1.1 KESAN-IDEA

1.1.1 Development process

KESAN was developed as Kansei Technology in the form of sensors and systems from 2014 to 2019 and customized in various platforms such as Android, web, and animation from 2020 to 2022.

In 2023, KESAN was customized from solving the ergonomic problem to product design and development. This kind of KESAN was defined as KESAN-IDEA[1]. The KESAN-IDEA was developed by a community-service program-based implementation of appropriate technology. This community service program will have two outcomes: testing the KESAN-IDEA prototype and developing KESAN-IDEA to simulate idea generation for product design and development.

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The KESAN-IDEA system tested in this study was developed using design and system thinking. KESAN-IDEA has developed through the stage of making a complete functional prototype with several improvements and additional follow-up features. The prototype for this study is a website model design with complete functionality tested in MSME community service activities. These activities were filled with trials carried out by giving assignments using the features of KESAN-IDEA, namely the account registration stage, initial mood survey, MSME products information, visualization, Bill of Material (BOM), evaluation, grouping Kansei words, making affinity diagrams, determining parameters, and getting the final recapitulation table results.

This study aimed to test the usability of KESAN-IDEA by connecting the user perceptions and system developers based on feedback.

1.1.2 Process flow

The procedures for using KESAN-IDEA are indicated in Fig. 1.

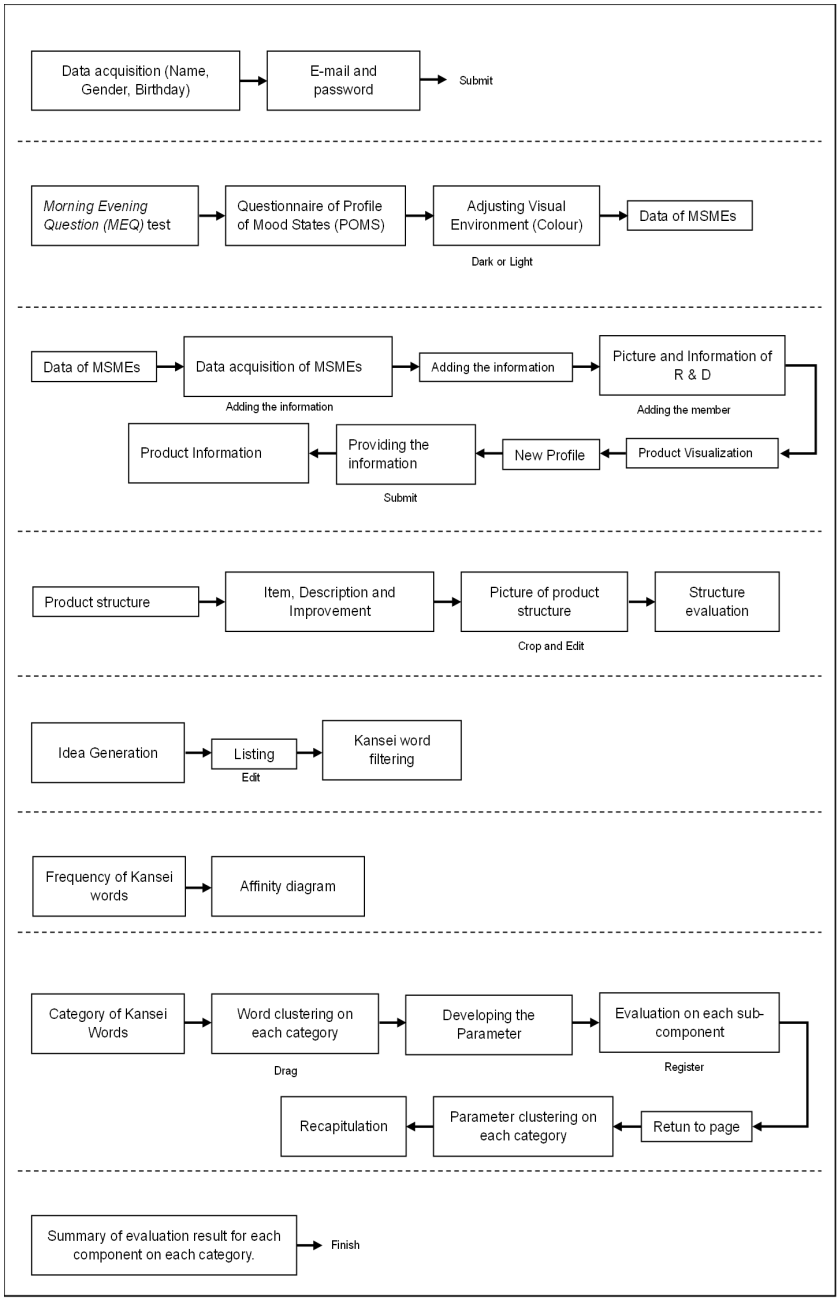

Fig. 1. Process flow of KESAN-IDEA.

The KESAN-IDEA flow process is multi-step, where each step has several further steps to be completed. Some steps have a higher level of importance and are the main stages, including account creation, MSMEs registration (data acquisition, product visualization, and adding product information), whole product structure steps, idea generation, every step in the affinity diagram page, and last, summary or recapitulation.

2 Methods

The tests carried out in this research are categorized as black box testing. Black box testing considers the value of inputs in a study and ignores the internal mechanisms of a system[2]. Cause-Effect Graphing (CEG) is one of the black-box testing methods that was used in this research. System Usability Scale (SUS) and usability attributes by Nielsen were also used as the testing methods for KESAN-IDEA. The methods were described as follows:

2.1 Usability testing

According to the International Organization for Standardization - ISO 9241-11: 1998, usability is defined as the level of usefulness of a product to achieve specified goals effectively and efficiently and provide satisfaction. Usability testing determines the effectiveness, efficiency, and satisfaction of a website according to the user [3].

Usability has five quality attributes used as the basis for measurement and evaluation based on the Nielsen model: learnability, memorability, efficiency, errors, and satisfaction [4]. Besides, a usability test has been pursued on the previous KESAN sensor for different ergonomic functions [5].

2.2 System Usability Scale (SUS)

SUS is a simple method with ten statements that provide a comprehensive view of objective evaluation. SUS uses a Likert scale where respondents are required to answer the level of agreement and disagreement on a scale of 5 or 7, as shown in Table 1[6].

In other research, Brooke collected 50 potential questionnaire statements and then selected two sample measurement systems based on the consensus that one was "very easy to use," and the other was almost impossible to use, even for users with high technical skills[7]. A total of 20 users from the entire group rated the agreement on both systems based on a 5-point scale ranging from "strongly agree" to "strongly disagree."[7].

Table 1. Use of Likert scale.

Answer	Score
Disagree (D)	1
Less Disagree (LD)	2
Undecided (U)	3
Agree (A)	4
Strongly Agree (SA)	5

2.3 Data collection

The respondents of the study were MSMEs owners in the agro-industry sector at DEKRANASDA (*Dewan Kerajinan Nasional Daerah*) Sleman Regency. The questionnaire was administered to 30 MSME owners based on the Slovin sample calculation formula. The questionnaire was delivered online from May 20 to June 11, 2024. This questionnaire contained 10 statements based on a study on the adaptation of SUS statements in Indonesian, as shown in Table 2[8].

Table 2. Questionnaire statements[8].

No	Statements
1	I will use KESAN-IDEA frequently and continuously
2	I feel that KESAN-IDEA should not be made this complicated, in terms of appearance or features and stages
3	I feel that KESAN-IDEA is easy to use
4	I need help while using KESAN-IDEA
5	I find various features in KESAN-IDEA to work well
6	I find many things that do not match their functions in KESAN-IDEA
7	I can easily explore KESAN-IDEA quickly and can complete what I want to do
8	I find it difficult while using KESAN-IDEA
9	I feel confident in using KESAN-IDEA
10	I need to adjust myself first prior to use KESAN-IDEA

2.4 Calculation of SUS score

The collected data were evaluated, and SUS score was calculated with specific rules as following[9]:

1. The final score is defined as the result of subtracting user score (x) minus 1 for each statement of odd-numbered (1, 3, 5, 7, 9).
2. For each even-numbered statement (2, 4, 6, 8, 10), the final score is defined by the result of subtracting 5 from the user score (x).

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3. SUS score weighting is obtained from the total sum of user scores multiplied by 2.5.
4. Based on the score of each respondent, the next step is to determine the average by adding up all the results and dividing by the number of respondents.

$$Odd\ SUS\ score = \sum\{P_x - 1\} \quad (1)$$
$$Even\ SUS\ score = \sum\{5 - P_x\} \quad (2)$$
$$(\sum odd\ score + \sum even\ score)\ x\ 2{,}5 \quad (3)$$
$$average\ score\ of\ SUS\ questionnaire: \bar{X} = \frac{\Sigma x}{n} \quad (4)$$

The notations defined $\bar{X}$ as the average score, $\sum x$ is the amount of SUS scores, and n is the amount of respondents. From these results, an average value of all respondent score assessments was obtained.

3 Results and Discussion

The results of this study were divided into three, namely, based on the calculation of SUS score, usability attributes, and cause-and-effect analysis of usability attributes with lower assessments compared to other attributes.

3.1 SUS Score

The calculated SUS score was analyzed based on the interpretation from several assessments, as shown in Table 3: grade, percentile rank, adjective, acceptable, and Net Promoter Score (NPS)[10].

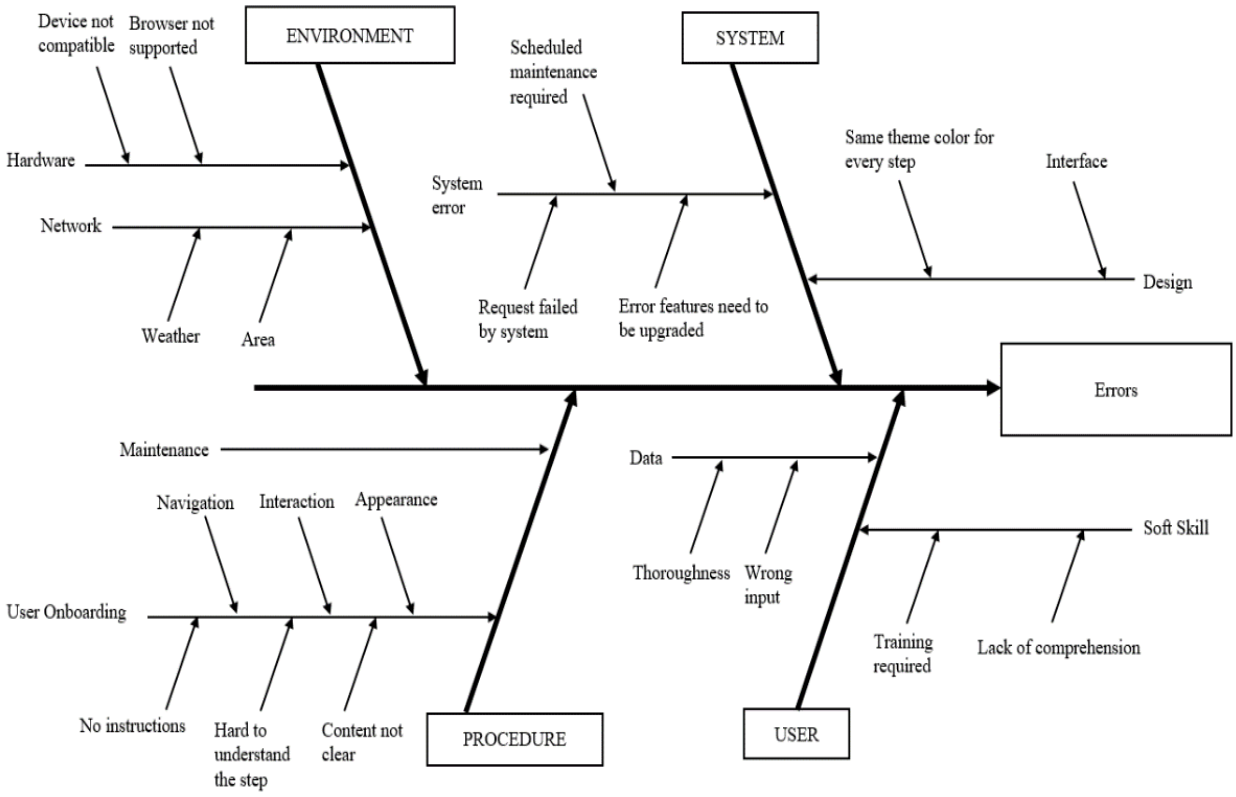

Fig. 2. Ishikawa diagram attribute errors.

Table 3. Interpretation of SUS scores [11].

Grade	SUS	Adjective	Acceptable	NPS
A+	84,1 – 100	Best	Acceptable	Promoter
A	80,8 – 84,0	Excellent	Acceptable	Promoter
A-	78,9 – 80,7	Good	Acceptable	Promoter
B+	77,2 – 78,8		Acceptable	Passive
B	74,1 – 77,1		Acceptable	Passive
B-	72,6 – 74,0		Acceptable	Passive
C+	71,1 – 72,5		Acceptable	Passive
C	65,0 – 71,0	OK	Less Acceptable	Passive
C-	62,7 – 64,9			Passive
D	51,7 – 62,6			Passive
F	0 – 51,6	Poor	Not Acceptable	Detractor

The result from the calculation using equations (1), (2), (3), and (4) shows that the average score of respondents is 59.08. The final score of SUS was further analyzed according to existing assessment standards (Table 3). This score was included in the grade 'D,' adjective 'OK,' acceptable 'Less Acceptable,' and NPS 'Passive.' The score of 59.08 was influenced by the respondent criteria percentage factor, where 36.7% had previously participated in

trial activities, and 63.3% had no prior experience with community service activities.

3.2 Usability Attributes

Attributes with a lower assessment were subsequently analyzed using the Ishikawa diagram. The cause-and-effect diagram was developed based on references related to the field of information systems[12]. Furthermore, this diagram was developed by sorting the causes from the references and integrating them with possible causes of the error attributes that were compiled in Figure 2.

Based on observations and references, the Ishikawa diagram was created by pre-categorizing the main root causes [12]. Based on the main root causes, the causal factors were classified according to the conditions during testing and also from discussions with research-related parties.

3.3 Recommendations

Recommendations were formulated from the direct observation process, SUS scores, user feedback, and Ishikawa attribute error diagrams. The recommendations were formulated as follows:

1. Mapping
   Navigation bars, namely visualization, evaluation, word filter, affinity diagram, and recapitulation, were provided for each stage on the product page. This enables the user to efficiently visit the desired section (Fig. 3).
2. Consistency
   Continuous and consistent application of guidelines and interface design were provided, such as tooltips (modals).
3. User
   a. Training or trial was provided for the user, specifically for new users, regarding accessibility use.
   b. The knowledge of direct interaction between user and system was provided.
   c. An additional dialog box was provided for accuracy next to the information input column (Fig. 4).
4. System
   a. The improvements were made to the crop feature in the image upload section, specifically on mobile devices. The crop feature was developed using a drag model.
   b. Each stage page was assigned a title at the top (Fig. 3).
5. Procedure
   a. Creating onboarding for new users:
      Instructions were provided next to the feature and usage examples such as GIFs and hotspots to facilitate navigation (Figs. 5 and 6).
   b. Regular maintenance scheduling was needed to determine the condition of system and fix when necessary.
6. Environment
   a. Pop-up notification to provide suggestions for changing devices and browsers in the case of a sign-in or sign-up failure (Fig. 4).
   b. Notification on the home page to ensure the user has a good signal.

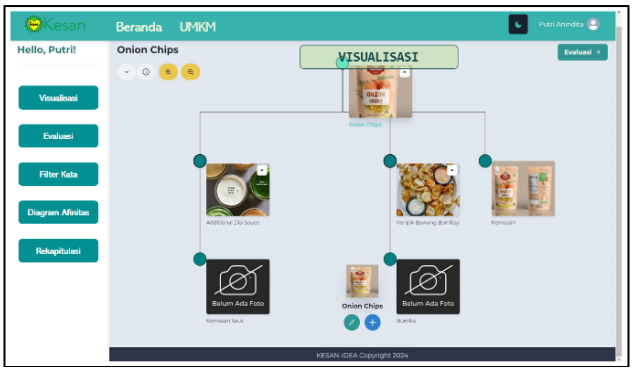

Fig. 3. Navigation bar and page title recommendations.

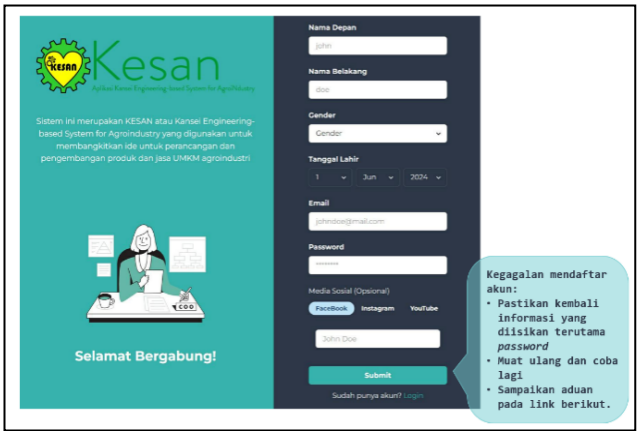

Fig. 4. Dialog box (pop-up) recommendations.

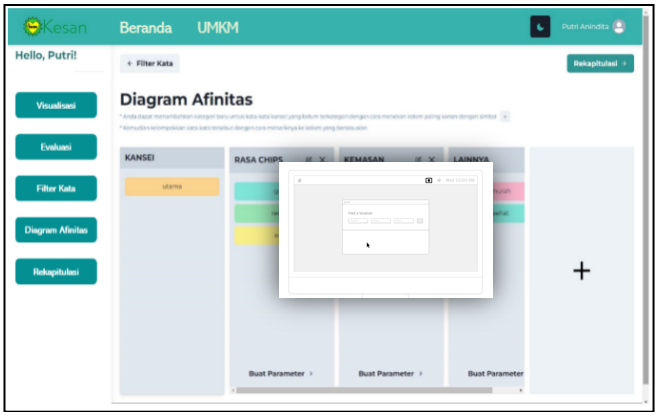

Fig. 5. User onboarding recommendations.

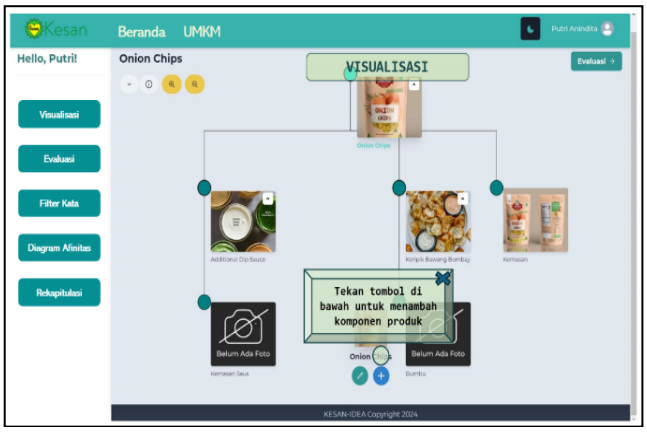

Fig. 6. Hotspots recommendations for user onboarding.

4 Conclusion

The research results concluded that the score result of the system usability scale of KESAN-IDEA was 59.08 with interpretations of grade 'D,' adjective 'OK,' acceptable 'Less Acceptable,' and net promoter score of 'Passive.' KESAN-IDEA functioned according to the expected functionality. However, many aspects could be improved and added to ensure user comfort and long-term use.

Recommendations for improvement were divided into three aspects. The first was based on the attributes of learnability, memorability, and efficiency. The second was based on the attributes of errors, and the third was satisfaction. The main recommendations for KESAN-IDEA were related to the interface design, appearance, navigation, and interaction.

While usability testing was conducted, the analysis of user feedback could be expanded to provide more insight into the challenges faced by MSME users. A more detailed follow-up discussion on how the changes and improvements from the recommendations of this study influence the development or future iterations of KESAN-IDEA. Based on these recommendations, up to date, a new platform of virtual reality has been developed for KESAN. Future research entailed the application of Virtual Kansei Engineering to support immersive learning and training for product design and development.

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References

1. M. Ushada, F. Trapsilawati, Y.P. Mulyani, Y. Sari, A. Wicaksono, F. Yudanto, M.A. Putra, Perangkat Platform Simulasi Ide Produk dan Jasa Menggunakan Inovasi Terbuka Berbasis Kata Kansei. Patent Registration P00202306953 (2023).
2. E. Selviana, H. Zuni, Wahanani, F. Aditiawan, Black Box Testing in Community Service Systems Using Boundary Value Analysis and Cause Effect Graph Methods (Case Study of Jombang District Community and Village Empowerment Service). East Asian J. Multidiscip. Res. **2**(10), 4161–4184 (2023). https://doi.org/10.55927/eajmr.v2i10.6435
3. H.N. Aprilia, P. Insap Santoso, R. Ferdiana, Pengujian usability website menggunakan system usability scale. J. IPTEKKOM (Jurnal Ilmu Pengetah. Teknol. Informasi) **17**(1), 31–38 (2015).
4. A. W. Soejono, A. Setyanto, A. Sofyan, Evaluasi usability website unriyo menggunakan system usability scale (studi kasus: website UNRIYO). Respati **13**(1), 29–37 (2018). https://doi.org/10.35842/jtir.v13i1.213
5. M. Ushada, N. Khuriyati, S. Agustriana, T. Okayama, Evaluation of Kansei engineering-based sensor for Agro-industry (KESAN). Agric. Eng. Int. CIGR J. **22**(1), 133–144 (2020).
6. J. Brooke, SUS: A quick and dirty usability scale, in Usability Evaluation in Industry (CRC Press, London, 1996), pp. 4–7. https://doi.org/10.1201/9781498710411
7. J. Brooke, SUS: a retrospective. J. Usability Stud. **8**(2), 29–40 (2013).
8. Z. Sharfina, H. Santoso, An Indonesian adaptation of the system usability scale (SUS), in 2016 Int. Conf. Adv. Comput. Sci. Inf. Syst. (ICACSIS) (IEEE, 2016), pp. 145–148. https://doi.org/10.1109/icacsis.2016.7872776
9. D. Setiawan, N. Rafianto, Pengukuran usability pada learning management system perguruan tinggi menggunakan pedoman system usability scale. Teknol. J. Ilm. Sist. Inf. **10**(1), 23–31 (2020). https://doi.org/10.26594/teknologi.v10i1.2010
10. J.R. Lewis, J. Sauro, Item benchmarks for the system usability scale. J. Usability Stud. **13**(3), 158–167 (2018).
11. J. Sauro, Five Ways to Interpret a SUS Score (Measuring Usability LLC, 2018).
12. R. Cahyana, A preliminary investigation of information system using Ishikawa diagram and sectoral statistics, in IOP Conf. Ser. Mater. Sci. Eng. (IOP Publ., 2018). https://doi.org/10.1088/1757-899x/434/1/012050