Quality Analysis of University Websites from Usability Side with Multicriteria Decision Analysis Method

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Abstract. This research aims to (1) evaluate the usability performance of university website in Indonesia, and to (2) rank university websites in Indonesia based on usability performance. The result of this research will be presented in the form of ranking using VIKOR method. Object of this research are 30 university websites in Indonesia. Data were collected 15 times during 3 months by using website tools and then calculated to get rating result. Rating result are processed using Entropy Method to get weightage value and VIKOR Method to know the ranking of university websites in Indonesia. The result of this research are: (1) usability performance of university website in Indonesia if viewed from load time and markup validation are bad, but if viewed from response time and broken link are good, and (2) The ranked result showed that website belong to Universitas Sriwijaya has the highest rank with Q score is 0.03 whereas website belong to Universitas Pendidikan Indonesia has the lowest rank of Q with score is 0.540.

1. Introduction

Education has witnessed the introduction of the internet, a technology that has radically altered the way of teaching and learning, thanks to the fact that it can provide a rich environment in learning from any area of study, offering the opportunity to develop cognitive skills, such as search, evaluation, synthesis and basic skills to recognize the quality of the materials found in the network [1]. However, depending on technological advances, the products and services offered are almost identical, so the creation of any website must be based, mainly, on a visual strategy on which, to a large extent, the success, when the goal is to have a position in the network. User-centered development methods can assist in understanding the preferences of potential participants for website functions and content, and may lead to more effective programs and adhesion [2]. Part of the quality is defined by the ease of use [3], so the design has to be satisfactory at the time of use, approaching the criteria set by the standard International Organization for Standardization 9241-11 which conceive that usability is synonymous with effectiveness, efficiency and satisfaction [4].

The concept of usability is an attribute of quality that measures the ease with which to use the user interface [5], because the first capacity of the system is to respect the physical and psychological processes of the person who interacted with the system [6]. The usability evaluation ensures that the products are easy to use, efficient, effective and satisfactory for users [7]. There is a correlation between usability and ease of learning [8], that is, if the usability guidelines are met, a website can be
made useful and promotes learning. [9]. In this sense, there are two methodologies for the study of usability that are, mainly, the analysis of experts and the tests with users [10]. Expert analyzes try to make usability specialists evaluate and detect potential problems in reference to usability. Meanwhile, those of users, employ subjects to whom the web is directed. In themselves, both allow to find and prioritize usability problems but to be able to carry out a test with users, it is necessary to previously carry out a heuristic evaluation [3]. Employing experts, through heuristics, is a widely accepted method of evaluating usability in the development of different software. But also, techniques such as surveys, interviews and discussion groups are effective means to identify the needs of users, and can complement the analysis of experts [11].

In relation to the above, the purpose of the study are to evaluate the usability performance of university websites in Indonesia, finding design problems that could interfere with the training process using a methodology of heuristic evaluation by experts, and to rank university websites in Indonesia based on usability performance was to evaluate the usability of the website.

2. Research Method

The type of this research is quantitative research. The method used is Survey Method to collect data. The data that have been collected were analyzed using Entropy Method and VIKOR Method. The study begins on 1 of May 01, 2018 until 1 of July, 2018 located anywhere as long as there is an internet connection and an adequate computer. The sample of this study are 30 university websites in Indonesia. Samples were taken using the Purposive Random Sampling Technique which means all samples are sampled where the units that are investigated are based on the judgment of the researcher (See Table 1). The research procedure are : 1) Population and Sample are determined first, 2)Specify Variables / Criteria, 3)Determining Instruments, 4) Conducting data retrieval process, 4) Calculate the weighting of each variable using the Entropy Method, 5) Conduct a Method ranking VIKOR, 6) Ranking results are presented in the table.

This data collection technique using observation techniques. Observation using website tools that have been used in previous research. Each website tools can be used to test more than 1 variable (see Table 2). The data were collected 15 times by collecting data randomly. 15 times data retrieval is done to ensure data reliability. The purpose of using more than one website tool is to guarantee the validity of the data collected. The final value of the data per variable used in the analysis is the average of 15 times the data retrieval of the two instruments

| No | Variables       | Tools                  |
|----|-----------------|------------------------|
| 1  | Load Time       | Pingdom GT Metrix      |
| 2  | Response Time   | Site Speed Checker GT Metrix |
| 3  | Page Size       | Pingdom GT Metrix      |
| 4  | Number of       | Pingdom                |
2.1 Entropy

Entropy method was developed by Milan Zeleny [12] as an objective method for allocating weights based on the decision matrix without affecting the preference of the decision maker. The relative importance of criterion \( j \) in a decision situation, \( w_j \) measure its weight is directly related to the amount of information provided by the intrinsically set of alternatives with respect to that criterion [13]. There is greater diversity in evaluations of the alternatives then greater importance should be the criterion. This diversity is based conceptually on the solid, accepted concept of entropy in an information channel presented by Claude Shannon [14].

**Step 1:**

1. Decide the criteria \( B_j \) (\( j=1,2,...,m \)) where \( m \) is the number of criteria/attributes) for selecting the alternative (university websites). The criteria or attributes will be load time, response time, page size, number of request, markup validation, and broken link.
2. Choose a set of university website alternatives \( A_i \) (\( i=1,2,...,n \) where \( n \) is the number of alternative websites considered in the study).
3. Measures the performance of each alternative with respect to attributes denoted as \( X_{ij} \) (for \( i = 1, 2,...,n; j = 1, 2,...,m \)).
4. Decide the weight or relative importance of each attributes, \( W_j \) (\( j=1,2,...,m \)).

The values associated with the attributes \( (x_{ij}) \) may be in different units. So the elements of the decision table are normalized for different alternatives using the following equation.

\[
X_{ij}^* = \frac{X_{ij}}{\sum_i X_{ij}}
\]

where \( X_{ij}^* \) is the normalized value of \( X_{ij} \) and \( \sum_i X_{ij} \) is the total of the values of \( j \)th attribute for ‘n’ number of alternatives.

**Step 2:**

Determine weights of importance of the attributes, which are load time, response time, page size, number of request, markup validation, and broken link by using Entropy method.

The procedure as follows:

1. The evaluations \( ij \) (\( i = 1, m \) \( j = 1, n \)) are taken as normalized as a fraction of the sum \( i j \Sigma \) to the original assessments of each criterion \( j \).

\[
\text{for } m > 1 \text{ and } i=1, 2, \ldots, m; \text{ and } j=1, 2, \ldots, n.
\]
2. Entropy (Ej) is calculated.

\[ E_j = \left[ - \frac{1}{\ln(m)} \sum_{i=1}^{m} a_{ij} \ln(a_{ij}) \right] \]  

(3)

where \( m \) = number of alternatives in the matrix standardized assessments and
\( ij \) = Criteria or standardized attributes.

3. Diversity criterion (Dj) is calculated.

\[ D_j = 1 - E_j \]  

(4)

4. The normalized weight of each criterion (Wj) is calculated.

\[ w_j = \frac{D_j}{\sum D_j} \]  

(5)

5. After all done, then each criterion already has a weight. The result of the sum of all criteria weighting must result in a value of 1. If not, then there is an incorrect calculation process.

2.2 VIKOR

Multi Criteria Decision Analysis (MCDA) is a branch of a general class of Operations Research models that is used in various fields such as engineering, economics, management sciences, transportation planning. VIKOR method is one of multi-criteria decision analysis method. The VIKOR (VlscKriterijumska Optimitacija I Kompromisno Resenje) method provides one or more compromise solutions for the set of alternatives. The VIKOR method is appropriate to solve decision problems with conflicting and non-commensurable criteria, that is, with different units, or in the case of quantitative and qualitative criteria. The compromise solution is determined as one that is at a shorter distance from the ideal solution, [15]. The VIKOR method is an effective tool as a multicriteria decision method in those cases in which the decision maker is not able, or does not know, to express his preferences at the beginning of the design process. The compromise solution obtained could be accepted by the decision maker, since it provides maximum group utility to the majority, represented by the minimum "S", and an individual minimum opposition represented by the minimum "R", [15]

Step 3:

For the ranking process, one method (VIKOR) was used. The Entropy and VIKOR methods are explained below. Determine the maximum \( f_j^* \) and the minimum \( f_j^- \) values of all criterion functions, \( j = 1, \ldots, m \).

\[ f_j^* = \max_i f_{ij} = \max_i \{ f_{ij} \mid i = 1, 2, \ldots, n \} \]  

(6)

\[ f_j^- = \min_i f_{ij} = \min_i \{ f_{ij} \mid i = 1, 2, \ldots, n \} \]  

(7)

\( f_{ij} \) is the value of \( j^{th} \) criterion function for the alternative \( A_i \).

Step 4:

Compute the values \( S_i \) and \( R_i \), \( i = 1, \ldots, n \).

\[ S_i = \sum_{j=1}^{m} W_j (f_j^* - f_{ij}) / (f_j^* - f_j^-) \]  

(8)

\[ R_i = \max_j \left[ W_j (f_j^* - f_{ij}) / (f_j^* - f_j^-) \right] \mid j = 1, 2, \ldots, m \]  

(9)

where \( S_i \) and \( R_i \) represent the utility measure and the regret measure respectively for the alternative \( i \). \( W_j \) is the weight of \( j^{th} \) criterion which represents the relative importance of criterion.
Step 5:
Compute the values $Q_i$, $i = 1, \ldots, n$.

\[ Q_i = v(S_i - S^*)/(S - S^*) + (1 - v)(R_i - R^*)/(R - R^*) \]  \hspace{1cm} (10)

\[ S^* = \min_i S_i = \min \{ (S_i) \mid i = 1, 2, \ldots, n \} \]  \hspace{1cm} (11)

\[ S = \max_i S_i = \max \{ (S_i) \mid i = 1, 2, \ldots, n \} \]  \hspace{1cm} (12)

\[ R^* = \min_i R_i = \min \{ (R_i) \mid i = 1, 2, \ldots, n \} \]  \hspace{1cm} (13)

\[ R = \max_i R_i = \max \{ (R_i) \mid i = 1, 2, \ldots, n \} \]  \hspace{1cm} (14)

where $v$ is the weight for the strategy of maximum group utility and $1 - v$ is the weight of the individual regret. $v$ is usually set to 0.5.

Step 6:
Rank the alternatives by $Q_i$. The less the value of $Q_i$ is, the better decision of the alternatives is.

3. Experiment Result and Analysis

Final Results Data is presented in Table 2 which are consist of 6 variables: A) Load Time (Second), B) Response Time (Second), C) Page Size (Mb), D) Number of Element (Unit), E) Markup Validation (unit), F) Broken Link. This data is derived from the average yield of each instrument. Data from each instrument is obtained from the average of data retrieval as much as 15 times from each sample per variable. The example of the last data result calculation is for the S1 Load Time criteria tested by using Pingdom and GTMetrix instruments, then 15 times data retrieval for Pingdom and GTMetrix respectively calculated on average, the average yield of the two instruments is summed and divided by two.

Table 2. Table of the collecting data

| No | Code | University                        | A   | B   | C   | D   | E   | F   |
|----|------|-----------------------------------|-----|-----|-----|-----|-----|-----|
| 1  | S1   | Universitas Gadjah Mada          | 6.14| 31  | 4.9 | 68  | 54  | 131 |
| 2  | S2   | Institut Teknologi Bandung       | 6.66| 44  | 3.6 | 88  | 11  | 23  |
| 3  | S3   | Institut Pertanian Bogor         | 10.18| 46  | 12  | 159 | 118 | 78  |
| 4  | S4   | Universitas Indonesia            | 9.19| 36  | 6.4 | 159 | 21  | 110 |
| 5  | S5   | Institut Teknologi Sepuluh Nopember | 4.99| 55  | 4.5 | 76  | 27  | 329 |
| 6  | S6   | Universitas Diponegoro           | 8.72| 29  | 5.1 | 107 | 246 | 145 |
| 7  | S7   | Universitas Airlangga            | 6.07| 31  | 12.4| 75  | 10  | 48  |
| 8  | S8   | Universitas Brawijaya            | 8.1 | 33  | 5.9 | 96  | 33  | 41  |
| 9  | S9   | Universitas Hasanuddin           | 8.71| 41  | 3.9 | 63  | 21  | 265 |
| 10 | S10  | Universitas Negeri               | 11.32| 32  | 2.5 | 94  | 59  | 56  |

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The average results in Table 2 of the university website for the load time in Indonesia is approximately 10 seconds. It shows that load time from university websites in Indonesia is slow. In addition, the average markup validation gives a value of 101, far more than required, which is 0. Based on load time and markup validation, the usability performance of the university website in Indonesia is poor. The results presented in Table 3 also give negative results to the university websites performance in Indonesia. Response time gives a value of 43.36 seconds. This indicates that the response time of the website belongs to the university is not responsive. In addition, the average broken link also shows the value of 7 of the required, which is 101. Based on the response time and broken links, the usability performance of the university website in Indonesia is not good.

The results of the weighting of Entropy Method can be seen in Table 3. The criteria that get the highest score is Markup Validation criteria. It is in accordance with Markup Validation data has the most data variations so that Entropy gives the greatest weight. Meanwhile, in Response Time and Number of Request which has the smallest weight because of the least data variations.
Table 3. Results of variable weight based on entropy

| No | Variable/Criteria       | Weight |
|----|-------------------------|--------|
| 1  | Load Time               | 0.13   |
| 2  | Response Time           | 0.09   |
| 3  | Page Size               | 0.15   |
| 4  | Number of Request       | 0.09   |
| 5  | Markup Validation       | 0.31   |
| 6  | Broken Link             | 0.24   |
|    | Total                   | 1.00   |

The results of the VIKOR Method ranking can be seen in Table 4. The highest rank is given the S24 is the website of Sriwijaya University. Based data in Table 1, Sriwijaya University excels in all variables. Variables that have advantages far above the other ministries are the Markup Validation with a value of 0.31. The lowest rank is coded by S13 depicted in Table 4.

Table 4. Usability ranking result

| No | Si    | Ri    | Qi    |
|----|-------|-------|-------|
| 1  | 0.798 | 0.354 | 0.421 |
| 2  | 0.886 | 0.409 | 0.533 |
| 3  | 0.621 | 0.272 | 0.201 |
| 4  | 0.777 | 0.396 | 0.404 |
| 5  | 0.649 | 0.388 | 0.255 |
| 6  | 0.522 | 0.149 | 0.063 |
| 7  | 0.865 | 0.410 | 0.509 |
| 8  | 0.854 | 0.381 | 0.490 |
| 9  | 0.731 | 0.396 | 0.351 |
| 10 | 0.827 | 0.348 | 0.453 |
| 11 | 0.753 | 0.364 | 0.371 |
| 12 | 0.879 | 0.405 | 0.524 |
| 13 | 0.899 | 0.371 | 0.540 |
| 14 | 0.654 | 0.355 | 0.254 |
| 15 | 0.601 | 0.248 | 0.174 |
| 16 | 0.715 | 0.258 | 0.307 |
| 17 | 0.724 | 0.315 | 0.327 |
| 18 | 0.845 | 0.388 | 0.482 |
| 19 | 0.657 | 0.393 | 0.265 |
| 20 | 0.760 | 0.406 | 0.386 |
| 21 | 0.838 | 0.399 | 0.475 |
| 22 | 0.788 | 0.357 | 0.409 |
| 23 | 0.524 | 0.369 | 0.107 |
| 24 | 0.467 | 0.165 | 0.003 |
| 25 | 0.815 | 0.382 | 0.446 |
| 26 | 0.748 | 0.374 | 0.366 |
| 27 | 0.886 | 0.391 | 0.530 |
| 28 | 0.843 | 0.409 | 0.482 |
| 29 | 0.631 | 0.335 | 0.224 |
Now, the alternative university website are arranged in descending order according to their relative closeness values. It is observed that the Uni S24 website is the best choice and followed by Uni S6 based on VIKOR method.

Table 5. Final ranking

| No | University | Q Value |
|----|------------|---------|
| 1  | S24        | 0.003   |
| 2  | S6         | 0.063   |
| 3  | S23        | 0.107   |
| 4  | S15        | 0.174   |
| 5  | S3         | 0.201   |
| 6  | S29        | 0.224   |
| 7  | S14        | 0.254   |
| 8  | S5         | 0.255   |
| 9  | S19        | 0.265   |
| 10 | S16        | 0.307   |
| 11 | S17        | 0.327   |
| 12 | S9         | 0.351   |
| 13 | S26        | 0.366   |
| 14 | S11        | 0.371   |
| 15 | S20        | 0.386   |
| 16 | S4         | 0.404   |
| 17 | S22        | 0.409   |
| 18 | S1         | 0.421   |
| 19 | S25        | 0.446   |
| 20 | S10        | 0.453   |
| 21 | S30        | 0.468   |
| 22 | S21        | 0.475   |
| 23 | S18        | 0.482   |
| 24 | S28        | 0.482   |
| 25 | S8         | 0.490   |
| 26 | S7         | 0.509   |
| 27 | S12        | 0.524   |
| 28 | S27        | 0.530   |
| 29 | S2         | 0.533   |
| 30 | S13        | 0.540   |
4. Conclusion

Based on the results of research and discussion can be concluded as follows:

1. Web Based on load time and markup validation, the usability performance of the university website in Indonesia is poor.
2. Sriwijaya University (S24) gets the highest ranking with the value of 0.003 while S13 get the lowest value with a value of 0.540.
3. Entropy Method and VIKOR Method can be used for University website performance analysis in term of usability in Indonesia.

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