The Comparison Between 3D Studio Max and Blender Based on Software Qualities

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Abstract. The purpose of this article is to determine the comparison of 3D Studio Max and Blender animation software in terms of software quality in accordance with ISO 9126. The quality matrix compared in this study is usability and efficiency. This type of research is descriptive comparative. The research subjects were taken by purposive sampling, consist of 3D Studio Max 3-dimensional users and Blender animation software, as well as experienced animation lecturers. Data collection techniques used were questionnaires, interviews, and documentation. Data analysis uses the ISO 9126 matrix based on the research stages and ends with a checking technique for processed questionnaire data. This study found that: 3D Studio Max animation software, although widely used by animators, the quality is still below Blender, which is still rarely used by animators. This is because the use of Blender animation software itself is very easy to facilitate its users and Blender's tools and facilities are more complete than 3D Studio Max. But in the rendering process, Blender still takes a long time, while 3D Studio Max does not require a long time in the rendering process. This is what makes 3D Studio Max still popular for use among animators.

1. Introduction

An increasingly advanced era makes many image lovers pour their creativity not only through two-dimensional images, but also can be developed into three dimensions. Animators or commonly called animators work using computer graphics software that helps them work on making an image. With a variety of graphics software, things that are initially impossible to describe with animation are possible and easier.

The development of computer technology today, allows people to easily create animations. The animation that is produced certainly depends on the expertise possessed and the software used by the animator. The rapid development of animation in Indonesia is inseparable from several influencing factors, one of which is the interest in studying animation itself and the internet. The acceleration of internet technology that cannot be stopped is one of the determinants of the rapid existence of the animation industry known by the public. With ease, now we can see content and also learn animation only from the internet. The choice of software you want to use also varies. The internet has provided all the animation resources needed.

Currently there are many types of animated software in circulation, both open source and close source. In terms of function, animation software can be grouped into 2-Dimensional Animation Software and 3D Dimension Animation Software. 2-dimensional animation software is software that is used to create traditional animation or commonly called flat animation. Examples of some 2-dimensional animation software are Macromedia Flash, Adobe Flash, Swish max, and so on. With the development of computer technology, 3-dimensional animation appears. This 3-dimensional
animation is the result of the development of 2-dimensional animation. In 3-dimensional animation the object will look more alive and real. Many examples of films that use this 3-dimensional technique. Some 3-dimensional animation software has special capabilities or features, for example for animated figures, landscape, title animation, and others. Some examples of 3-dimensional software are 3D Studio Max, Maya, Poser, Bryce, Vue, Blender, Cinema 4D, and Daz3D. There are 10 best 3D animation software that artists need to consider to start in the animation industry. The software mentioned is: Autodesk Maya, Blender, 3D Studio Max, Autodesk SoftImage, Cinema 4D, Houdini, Lightwave, Modo, Maxon Cinema 4D, and NewTek LightWave. Quoted from the website of the International Design School website also said there are 8 3-dimensional animation software that are familiar and widely used by animators, namely: Autodesk Maya, 3D Studio Max, Blender, Cinema 4D, Poser, ZBrush, Autodesk Mudbox, and Carrara. Of the several software mentioned earlier, the two sources mention the same 4 3-dimensional animation software, namely, 3D Studio Max, Autodesk Maya, Cinema 4D and Blender software [1].

3D Studio Max is a 3-dimensional animation software that is already quite well-known among animators who are already experts and amateurs because of its many and varied features. 3D Studio Max can provide new tools that are efficient, fast performance and efficient workflows to help increase overall productivity to work with complexes. Autodesk Maya is also a 3-dimensional animation software that is popularly used by animators. Maya also has a simulation tool that makes it easy to use. Unlike 3D Studio Max and Autodesk Maya, Cinema 4D besides software that is popular among animators, this software is also recommended for beginners because it is not as complicated as 3D Studio Max and Maya. Then the last one is Blender which is one of the most prominent open source graphics applications in the world managed by the Blender Foundation.

The purpose of the software maker is to create software that is quality and can be understood by the user when used. This goal can be achieved by evaluating the quality of the software. To obtain the expected software quality, evaluating the product quality of a software is a critical element of software assurance so that it can represent the principal study of specifications, design and coding [16]. The assessment of the quality of the software involves many components and the components involved in the assessment are very dependent on the model used in conducting the assessment. Quality Model Software is a model used to determine the components involved in research. Software quality improvement methods have a valuable role in software engineering practice [14].

Some organizations, such as ISO and IEEE, try to create software quality standards by combining models and linking the characteristics and sub-characteristics of quality models. The purpose of the quality model is to provide operational definitions for quality. Some Software Quality Models that have been embraced by experts and have been developing since 1977 which were started by McCall Model then Boehm Model, FURPS Model, Dromey Model, BBN Model, Star Model, Kazman Model, ISO / IEC 9126 Model, IEEE Model and others other. But the ISO 9126 model is a model that has been agreed upon as an international standard in measuring the quality of software currently available. This model has evaluation criteria and separates existing external and internal qualities so that this model is suitable for research to be conducted by researchers later. According to ISO 9126-1, quality definition of the features and characteristics of products or bears on their ability to satisfy the stated or implied needs [11].

The ISO 9126 model is part of the ISO 9000 standard which is the most important standard in the field of quality assurance. From this model, the totality of software from product quality is classified in a hierarchical structure of characteristics and sub-characteristics. These six characteristics are functionality, reliability, usability, efficiency, maintainability, and portability. Figure 1 shows the hierarchical structure of ISO 9126. Characteristics that are defined can be applied in each software [12].
Figure 1. Structure of ISO 9126

Based on this description, researchers are interested in researching 3D Dimension Animation software using two characteristics in ISO 9126 Quality Model Software. The quality factors that researchers took in this study were Usability and Efficiency because these characteristics were based closer to users of 3-dimensional animation software. The researcher will compare two animation software from four popular animation software among animators, namely 3D Studio Max and Blender.

2. Methods

This research is a comparative descriptive study. Determination in the use of comparative descriptive research because this study aims to examine two different variables namely usability and efficiency in influencing software quality. In this study the problem raised was the comparison of two animation software seen from the quality of the software on usability and efficiency quality factors according to the ISO 9126 metric standard.

The sample in this study were 30 users who had studied animation and used 3D Studio Max and Blender animation software. In connection with sampling techniques, this study uses probability sampling techniques with Purposive Sampling.

The research instrument used was the result of software quality comparison from 3D Studio Max and Blender in the form of a questionnaire or questionnaire in the form of open questions to the research respondents. The way to measure that will be used in this study is the Likert scale, namely the scale used to measure attitudes, opinions, and perceptions of a person or group of people about social phenomena [20]. With a Likert scale, the variables to be measured are translated through variable indicators. Then the variable is used as a starting point for compiling instruments that can be in the form of questions or statements. In the measurement using a Likert scale containing five levels of response prefectures in this study with choices (a) strongly agree, (b) agree, (c) doubt, (d) disagree, and (e) strongly disagree.

Based on the results of the instrument trials that have been carried out to 20 people using 3D Studio Max and Blender animation software with the help of the SPSS computer program the results of the validity and reliability test of the research instruments were obtained as follows:

- Usability validity test results (X1): of 28 items, 22 items are valid.
- Efficiency test results (X2): of 12 items, 9 items are valid.
- Usability reliability test results (X1): Cronbach Alpha 0.956
- Efficiency reliability test results (X2): Al [ha Cronbach 0.885
After testing the questionnaire, the actual questionnaire was distributed. The data obtained is then calculated using the formula contained in the ISO 9126 Matrix. The stages of measuring 3D Studio Max and Blender animation software are as follows:

- Perform calculations to obtain sub-quality weights using the Centroid Order Rank (ROC).
- Rank Order Centroid (ROC)
  - is a method used by giving the weight of a number of ranking components based on the importance of these components. This method takes the ranking of importance in each component as input and changes it to the weight for each component.
  - In general, the weighting of the ROC can be formulated as follows:
    \[
    W_k = \frac{1}{K} \sum_{i=1}^{K} \left( \frac{i}{n} \right) \quad i = 1, \ldots, n
    \]
    where:
    K : number of components
    W_k : weight of last component

- Perform calculations to obtain quality characteristic weights.
- Perform calculations using metrics that match sub-quality characteristics.
- Normalize the value of the calculation results of the metrics on the questionnaire to have a scale and can be measured.
- Perform questionnaire calculations to obtain the average values of each sub-characteristic.
- Measuring the quality of sub-characteristics on external quality using the Weighted Summation (WSum)

The compensation method that can be used to calculate the value of a matrix with a "bad" score can be compensated for by a good score criterion to obtain a clear qualitative comparison value [15]. The equation of this method is:

\[
\text{score} (a_i) = \sum_{i=1}^{N} w_i v_i
\]

\[
\text{score} (ci) = \sum_{i=1}^{N} w_i v_i + w_2 v_2 + \ldots + w_n v_n (i)
\]

**note**

N : the number of sub-characteristics
v_i : quality value (X) on the i-sub-characteristics
score c_i : quality value of characteristics c_i
w_i : weights for characteristics c_i

- Measuring the value of quality characteristics on external quality using the Weighted Summation (WSum) method
- Measuring the total quality value of software using Weighted Summation (WSum)
- Perform analysis in the form of a table then compare the two software.
- Draw conclusions from the analysis.
- For the final rating scale on the quality of the software three quality categories are used, namely, superior level; medium level; and lower level [8].
3. Results and Discussion

3.1. Results

3.1.1. Calculation of Sub-Weight Characteristics of Software Quality
From the results of processing normality test data to determine the weight value for each sub-characteristic in software quality, it is determined based on the number of linkages with the criteria in the software described in Table 1. weight calculations are obtained using the calculation of the Centroid Order Rank (ROC) as can be seen in the following table:

| Quality characteristics | Sub-Quality Characteristics | Weight Sub-Quality Characteristics |
|-------------------------|----------------------------|-------------------------------------|
| Usability n=4           | Understandability          | \[\frac{1+1+1+1}{4} = 0.52\]       |
|                         | Learnability               | \[\frac{0+1+1+1}{4} = 0.27\]       |
|                         | Operability                | \[\frac{0+0+1+1}{4} = 0.145\]      |
|                         | Attractiveness             | \[\frac{0+0+0+1}{4} = 0.0625\]     |
| Efficiency n=2          | Time Behavior              | \[\frac{1+1}{2} = 0.75\]           |
|                         | Resource Utilization       | \[\frac{0+1}{2} = 0.25\]           |

As can be seen in the table, 1 weight for the Usability sub-characteristics is divided based on the number of sub-characteristics possessed, as well as the characteristics of efficiency divided by the number of sub-characteristics possessed.

3.1.2. Calculation of Weight of Software Quality Characteristics

| Quality Characteristics Software n=2 | Weight Quality Characteristics |
|-------------------------------------|---------------------------------|
| Usability                           | \[\frac{1+1}{2} = 0.75\]        |
| Efficiency                          | \[\frac{0+1}{2} = 0.25\]        |

Calculations for the weight of these quality characteristics as can be seen in table 2 Usability and efficiency are sorted based on the number of sub-characteristics possessed by both. In this case there are two characteristics to be tested, so each characteristic is divided into two (n = 2). And get Usability with a weight of 0.75 or 75% on a percent scale, and efficiency 0.25 or 25% on a percent scale.
Understandability metrics. Completeness of description formula \( X = \frac{A}{B} \). \( A = \) Number of functions understood and \( B = \) Number of functions tested. The results obtained by 3D Studio Max with 30 respondents are:

\[ X = \frac{A}{B} = \frac{3.28}{5} = 0.65 \]

with the results of the value 0.65 in terms of Understandability of 3D Studio Max animation software included in the medium category or quite easy to understand. While Blender with results:

\[ X = \frac{A}{B} = \frac{3.45}{5} = 0.70 \]

with the results of the value of 0.70 in terms of Understandability of animation software Blender is included in the medium category or quite easy to understand.

Learnability metrics. Help accessibility formula \( X = \frac{A}{B} \). \( A = \) The number of parts of the help topic that is understood and can be used by the user and \( B = \) The number of functions tested. The results obtained by 3D Studio Max with 30 respondents are:

\[ X = \frac{A}{B} = \frac{3.43}{5} = 0.69 \]

Then the value of Learnability results from the 3D Studio Max animation software 0.69, which means that in terms of convenience to be studied, it belongs to the medium category or quite easy to learn. While Blender with results:

\[ X = \frac{A}{B} = \frac{3.71}{5} = 0.74 \]

then the value of Learnability results from the Blender animation software 0.74, which means that in terms of convenience to be studied included in the medium category or quite easy to learn.

Operability metrics. Self-explanatory error formula \( X = \frac{A}{B} \). \( A = \) The amount of how consistent the components in the software are understood and the corrective action if an error occurs and \( B = \) The number of conditions tested. The results obtained by 3D Studio Max with 30 respondents are:

\[ X = \frac{A}{B} = \frac{3.515}{5} = 0.703 \]

Then the value of Operability for 3D Studio Max software is 0.703 which means that in terms of Operability included in the medium category or quite easy to operate by the user. While Blender with results:

\[ X = \frac{A}{B} = \frac{3.77}{5} = 0.754 \]

Then the value of Operability for Blender software is 0.754 which means that in terms of Operability included in the medium category or quite easy to operate by the user.

Attractiveness metrics. Interface appearance formula \( X = \frac{A}{B} \) where \( A = \) the number of user satisfaction with attractive and attractive interface elements and \( B = \) the number of conditions tested. The results obtained by 3D Studio Max with 30 respondents are:

\[ X = \frac{A}{B} = \frac{4.04}{5} = 0.808 \]

Then obtained an attractive value for 3D Studio Max 0.808 animation software which is included in the superior category which means this software is very interesting. While Blender with results:

\[ X = \frac{A}{B} = \frac{4.015}{5} = 0.803 \]

Then obtained an attractive value for Blender 0.803 animation software which belongs to the superior category which means this software is very interesting.

The Time Behavior metric used is response time with the formula \( T = \) the average time to get results from 30 respondents divided by the total time the command was completed, namely 5. Results obtained by 3D Studio Max with respondents 30 people are:

\[ T = \frac{2.775}{5} = 0.555 \]
In terms of time response in 3D Studio Max animation software, the results are 0.555 or entered into the low category, which means the old software in terms of response to an action during the animation creation process. While Blender with results:

\[ T = 3.43 / 5 = 0.686 \]

In terms of time response on Blender animation software, the results were 0.686 or entered into the medium category, which meant that the software was long enough in terms of the response to an action during the animation creation process.

- The Resource Utilization metric used is the ratio of memory error / time to the formula \( X = A/T \). Where \( A \) = average number of resources used during the process and \( T \) = number of response times tested. The results obtained by 3D Studio Max with 30 respondents are:

\[ X = 2.88 / 5 = 0.576 \]

In terms of Resource Utilization with the results of 0.576 in the 3D Studio Max software entered into the medium category, namely the use of resources when doing the process quite a lot. While Blender with results:

\[ X = 3.33 / 5 = 0.666 \]

In terms of Resource Utilization with the results of 0.666 in the Blender software entered into the medium category, namely the use of resources when doing the process quite a lot.

3.1.3. Measurement of External Quality Characteristics

Measurement of external quality characteristics is done after getting the results of the quality values of each sub-characteristic of each three-dimensional animation software and also the weight values of each sub-characteristic to be able to calculate the characteristic quality with the Weighted Summation method by multiplying the value the quality of the sub-characteristics with their respective weight values then the results are added together.

- **3D Studio Max**
  - Usability quality:
    \[
    Q_{Usability} = W_{Understandability} \times V_{Understandability} + W_{Learnability} \times V_{Learnability} + W_{Operability} \times V_{Operability} + W_{Attractiveness} \times V_{Attractiveness} = (0.52 \times 0.65) + (0.27 \times 0.69) + (0.145 \times 0.703) + (0.0625 \times 0.808) \\
    = 0.338 + 0.1863 + 0.101935 + 0.0505 \\
    = 0.6768
    \]
  - Efficiency quality:
    \[
    Q_{Effeciency} = W_{Time Behavior} \times V_{Time Behavior} + W_{resource utilisation} \times V_{resource utilisation} = (0.75 \times 0.555) + (0.25 \times 0.576) = 0.41625 + 0.144 = 0.5602
    \]

- **Blender**
  - Usability quality:
    \[
    Q_{Usability} = W_{Understandability} \times V_{Understandability} + W_{Learnability} \times V_{Learnability} + W_{Operability} \times V_{Operability} + W_{Attractiveness} \times V_{Attractiveness} = (0.52 \times 0.70) + (0.27 \times 0.74) + (0.145 \times 0.754) + (0.0625 \times 0.803) = 0.364 + 0.1998 + 0.10933 + 0.0501875 = 0.7233
    \]
  - Efficiency quality:
    \[
    Q_{Effeciency} = W_{Time Behavior} \times V_{Time Behavior} + W_{resource utilisation} \times V_{resource utilisation} = (0.75 \times 0.686) + (0.25 \times 0.666) = 0.5145 + 0.1665 = 0.681
    \]
3.1.4. External Quality Evaluation of Three Dimensional Animation Software to Software Quality

The results of the assessment on the external sub-characteristics can be seen in the following table 3:

**Table 3. Results of sub-characteristic quality values for scale [0,1]**

| Sub-Quality Characteristics | Sub-Quality Characteristics value |
|-----------------------------|----------------------------------|
|                             | 3D Studio Max | Blender  |
| Understandability          | 0.650         | 0.700    |
| Learnability                | 0.690         | 0.740    |
| Operability                 | 0.703         | 0.754    |
| Attractiveness              | 0.808         | 0.803    |
| Time Behavior               | 0.555         | 0.686    |
| Resource Utilization        | 0.576         | 0.666    |

The sub-characteristic quality values obtained from the two three-dimensional animation software are not much different. But it can be seen that the value of sub-characteristic quality in Blender's three-dimensional animation software is higher in almost all aspects of sub-characteristics that have been tested.

Whereas for the level of dominance based on the quality sub-characteristics with grouping each quality characteristic obtained from the weight of each component can be seen in the following table 4:

**Table 4. Sub-characteristic Assessment Domination Metrics**

| Quality Characteristics | Sub-Quality Characteristics | Percentage of dominance of sub-characteristics assessment (%) |
|-------------------------|-----------------------------|------------------------------------------------------------|
| Usability               | Understandability           | 53.2                                                      |
|                         | Learnability                | 27.0                                                      |
|                         | Operability                 | 14.5                                                      |
|                         | Attractiveness              | 6.2                                                       |
| Efficiency              | Time Behavior               | 75.0                                                      |
|                         | Resource Utilization        | 25.0                                                      |

It can be seen in table 4 that the dominance of each sub-characteristic is determined by how much each characteristic has its sub-characteristics. In Usability characteristics, there is understandability that has the highest domination points while the highest domination points for efficiency characteristics are Time Behavior.

3.1.5. Assessment of External Quality Characteristics

The results of the assessment on external characteristics can be seen in the following table:

**Table 5. The results of external quality characteristic values for scale [0,1].**

| Quality Characteristics | Quality Value |
|-------------------------|---------------|
|                         | 3D Studio Max | Blender  |
| Usability               | 0.6768        | 0.7233   |
| Efficiency              | 0.5602        | 0.6810   |
From the results that can be seen in table 5 that has been obtained, it can be seen that the quality of three-dimensional animation software seen from each characteristic, Blender animation software has a higher quality value compared to 3D Studio Max animation software both in terms of Usability characteristics and efficiency. While for the level of dominance based on the quality characteristics obtained from the weight of each component, can be seen in the following table:

Table 6. Domination Metrics for Assessment of External Quality Characteristics.

| Quality Characteristics | Percentage of quality dominance (%) |
|-------------------------|-------------------------------------|
| Usability               | 75                                  |
| Efficiency              | 25                                  |

This weight has been obtained based on the calculation of the weight of software quality characteristics in table 2 before, and in table 6 above the weight is converted into a percentage scale so that it gets 75% of the characteristic weights dominated by Usability.

3.1.6. Final Assessment of External Quality

The final quality assessment is carried out by weighting all perfactors with the weight determined by the ROC method as in Table 4.7. Then obtained an external value on each software that can be seen in the calculation below:

- **3D Studio Max**
  
  External Value  = (WUsability * VUsability ) + (Wefficiency * Vefficiency)
  
  = (0,6768 * 0,75) + (0,5602 * 0,25)
  
  = 0,5076 + 0,14005
  
  = 0,648

It can be concluded that from the final value of the external quality of 3D Studio Max, which is 0.648 included in the medium category or enough, which means that the quality of 3D Studio Max software in terms of external users is sufficient.

- **Blender**
  
  External Value  = (WUsability * VUsability ) + (Wefficiency * Vefficiency)
  
  = (0,7233 * 0,75) + (0,681 * 0,25)
  
  = 0,542475 + 0,17025
  
  = 0,713

It can be concluded that from the final value of the external quality of Blender which is 0.713 is included in the medium category or sufficient, which means that the quality of the software from the external aspect of the Blender software is sufficient..

3.2. Discussion

There are differences in the value of external quality obtained from both three-dimensional animation software, 3D Studio Max and Blender. The quality values of the two software that are obtained are both in the "medium" category but from the two software, Blender's three-dimensional animation software has the highest external quality value of 0.713 on a scale of [0.1] which means Blender quality is viewed in terms of users are better than 3D Studio Max.

With the results of 3D Studio Max software quality assessment based on the ISO 9126 matrix that uses two characteristics, namely usability and efficiency. The value of understandability, learnability, operability, time behavior, and resource utilization has been obtained with medium category quality while attractiveness with superior quality. The usability aspect test results state that an average of 0.6768 or 67.68% of users is quite easy to use software. The efficiency aspect test results state that an average of 0.5602 or 56.02% of users need considerable resources in the operation of 3D Studio Max software. Obtained the value of
undestandability, learnability, operability, time behavior, and resource utilization quality with medium category quality while attractiveness with superior quality. The usability aspect test results state that an average of 0.7233 or 72.33% of users is quite easy to use software compared to 3D Studio Max. The efficiency aspect test results stated that an average of 0.681 or 68.1% of users needed considerable resources in the operation of the Blender software. The results of the study show that the two variables have an influence on the quality of a software.

4. Conclusion

- For users of three-dimensional animation software or animators, you can use Blender software without having to reduce the performance produced later.
- For further researchers can assess the quality of software with a different matrix from ISO 9126 so that the quality can be seen based on the other matrices.
- Examiners can then test not only from the point of view of the software as the product and the end user, but also expand it by examining the complexity of each software algorithm.
- Based on the results of data analysis and processing questionnaire data from 30 respondents, the results obtained that the variable Usability and Efficiency affect software quality in a software.
- In this study also found that the software quality obtained was different but not too significant. There are drawbacks and strengths in each of the software that is examined.

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