



Implementation of The Analytical Hierarchy Process (AHP) Method in The Laptop Election Decision Support System for Students and Community in Medan City

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ABSTRACT

The development of an increasingly fast and instant era in this millennial era, makes electronic devices, especially laptops, also experience very fast and extensive development. The capacity of a laptop is closely related to the price of a laptop, if the capacity of the laptop is higher, the price of the laptop will also be higher, and vice versa if the capacity of the laptop is lower, the price of the laptop will also be lower. each laptop offers different features of each type and gives each type a unique look and shape. This is what makes students and the public confused about which laptop to choose according to their wishes and the money budget they have so that they don't make the wrong choice in determining the type of laptop that students and the community want later. On this basis, a study was made that is used in making decisions on laptop selection using the Analytical Hierarchy Process (AHP) method. This research was conducted to find out how the decision support system in choosing a laptop that suits the needs and economic conditions for students and the community.

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1. INTRODUCTION

The development of an increasingly fast and instant era in this millennial era, makes electronic devices, especially laptops, also experience very fast and extensive development. The capacity of a laptop is closely related to the price of a laptop, if the capacity of the laptop is higher, the price of the laptop will also be higher, and vice versa if the capacity of the laptop is lower, the price of the laptop will also be lower. However, each laptop offers different features of each type and gives each type a unique look and shape. This is what makes students and the public confused about which laptop to choose according to their wishes and the money budget they have so that they don't make the wrong choice in determining the type of laptop that students and the community want later.

Every student and society must have been in a position to determine a decision, to determine something between several choices or determine several things between certain choices. This is very difficult to decide if students and the community do not know what they want to decide whether it is in accordance with their needs and the financial budget they have. Each choice must have a path of determination or decision and a way to overcome it, whether it is solved directly or by using several alternative solutions to problems or solutions to problems that have been faced by students and the community.

Determining an election will be closely related to the decision support system. Therefore, this research was conducted to assist students and the community in choosing or determining which laptop suits their needs

and financial budget. This research was conducted using the Analytical Hierarchy Process (AHP) method. This method is a form of a hierarchical decision support system that is determined by various alternatives and criteria so that later alternatives and criteria are obtained that are in accordance with the desired goals (saaty, 1993). In this case, the goal in question is to be able to choose or determine which laptop is in accordance with the financial needs and budgets of students and the community.

2. RESEARCH METHODE

According to Scott, a decision support system is a system that has a computer base and helps in making decisions from data and decision models in solving semi-structured and unstructured problems so that effective decisions are obtained.

Alavi and Napier stated that, a decision support system is a set of steps in the process of data and information that aims to use a model in order to get results from several answers that help make a decision.

Meanwhile, Al-Hamdany said that, a decision support system is a system that has information so that it can support steps in making a decision by explaining some information to solve problems and get some decisions.

From the several definitions of decision support systems that have been mentioned by the experts above, it can be concluded that a decision support system is an information system that has a goal in obtaining decisions that can facilitate management in solving a problem.

Understanding Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) is a form of decision support introduced by Thomas L. Saaty. The form of decision support can solve a complex problem into a hierarchy. Saaty states, hierarchy is a view of a complex problem in a multi-level structure, where the first level is the goal, then there is the factor level, then the criteria, then the sub-criteria, and continues down to the final level of alternatives.

With a hierarchy, a complex problem with its group can be decomposed and then processed to form a hierarchy where all problems can be more structured and systematic.

AHP Stages

In the Analytical Hierarchy Process (AHP) there are the following steps (Kadarsyah Suryadi and Ali Ramdhani, 1998):

- a. Determine the problem and the expected solution.

In this step, it is necessary to define the problem to be solved clearly and in detail. With the problem defined, find a solution that fits the problem at hand. The solution obtained can be more than one which will be further developed in the next step.

- b. Defines a hierarchical structure starting with the main goal.

After determining the main objectives at the top level, it is continued to develop the hierarchical level at the bottom, namely the appropriate criteria in assessing the given alternatives and determining these alternatives.

- c. Create a pairwise comparison matrix that describes the relative contribution.

In this step, the matrix used is a simple one, where the matrix has a strong level of position under consistent conditions, obtains other data that will be needed in all possible comparisons and can analyze prioritization awareness as a whole as a change in consideration. The matrix approach describes the dual aspects of prioritizing, namely mastering and being mastered. The comparison activity is carried out on the basis of criticism from decision makers where decision makers assess how important an element is over other elements. In starting the pairwise comparison process, a criterion is selected from the top level for example K, after that from the bottom level the elements to be compared are taken, for example E1, E2, E3, E4, E5.

- d. Determining pairwise comparisons which will later get the total number of $n \times [(n-1)/2]$ pieces, where n is the number of elements being compared.

The result of comparing each element will be in the form of a number from 1 to 9 which shows the comparison of the importance of an element. If an element in the matrix performs a comparison with itself, the result is 1. The pairwise comparison scale can be seen below.

1 = Two elements are equally important.

3 = One element is slightly more important than the other.

5 = One element is more important than the other.

7 = One element is clearly more absolutely important than the other.

9 = One element is absolutely important over another.

2,4,6,8 = It is a value that exists between two adjacent values of consideration.

- e. Looking for eigenvalues and testing for consistency. If the eigenvalues are not consistent then repeat the process of retrieving data.

f. Repeat steps 3,4, and 5 at all levels of the hierarchy. Looking for eigenvectors in all pairwise comparison matrices that form the value of all elements in determining the element at the lowest level of the hierarchy until the goal is achieved. Counting is done by adding up the values of all the columns in the matrix, dividing all the values in the column by the total column to get a normalized matrix, and summing the values in all rows and dividing by the number of elements so that an average is obtained.

g. Perform hierarchy consistency checks. What is calculated in the Analytical Hierarchy Process (AHP) is the consistency ratio by looking at the consistency index. The desired consistency is close to perfect so that close to valid decisions can be obtained. Although difficult to touch perfect, the expected consistency ratio is less than or equal to 10%.

The formula determines the consistency ratio (CR) of the consistency index of a matrix of order n: $CI = \frac{\lambda_{maksimum} - n}{n-1}$

Description :

CI = consistency index (consistency index)

λ maximum = the largest eigenvalue of a matrix of order n, maximum is obtained from the sum of the product of the column by the principal eigenvectors. Suppose C.I = 0, meaning the matrix is consistent.

The inconsistency limit is calculated using the consistency ratio (CR), which is the comparison of the consistency index with the random generator value (RI). The value of RI depends on the order of the matrix n.

N	RI
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49
11	1.51
12	1.58

Table 2- 1 Eigenvalues

CR formulated:

$$CR = \frac{CI}{RI}$$

3. RESULT AND ANALYSIS

Analytical Hierarchy Process (AHP) is a decision-making method that produces rational decisions. Rational decisions are defined as in making a decision to achieve the desired goal, one must be able to determine the best decision. Rational decisions include alternatives and desired criteria based on existing sources. There are several stages of decision making:

1. *Intelligent*

2. *Modeling*

3. *Choice*

3.1 *Intelligent Stage*

The intelligent stage is a stage where we must collect and develop a selection criteria. In this case there are several stages that must be considered in the selection of laptop criteria, namely:

1. Determine several alternatives for choosing a laptop.

In determining the alternative selection of this laptop, we chose 4 laptop brands, namely:

- a. Asus Vivobook A416MA = Laptop A
- b. Lenovo Ideapad Slim 3i = Laptop B
- c. Acer Nitro 5 = Laptop C
- d. MSI GF63 = Laptop D

2. Determine some laptop selection criteria

The criteria for selecting a laptop for comparison are as follows:

- a) Criterion 1: K1 = Price
- b) Criterion 2: K2 = Screen Size
- c) Criterion 3: K3 = Processor Type
- d) Criterion 4: K4 = Memory Capacity
- e) Criterion 5: K5 = Memory Type
- f) Criterion 6: K6 = Harddisk capacity
- g) Criterion 7 : K7 = Excellence

3. Determine the weight of the laptop selection criteria.

The weight of the laptop selection criteria that we have examined directly are:

- a) Asus Vivobook A416MA
 - 1) Price = Rp. 5,400,000
 - 2) Screen Size = 14 inches
 - 3) Processor Type = Intel Celeron N4020
 - 4) Memory Capacity = 4 Gb
 - 5) Memory Type = DDR 4
 - 6) Hard Drive Capacity = 256 GB SSD
 - 7) Advantage

Suitable for light gaming, battery capacity of 2 cells 37WHr lithium-prismatic battery, connectivity relies on WiFi 802.11AC, Bluetooth 4.1, USB 3.2 Gen1 port, USB 3.1 Gen 1 Type-C port, USB 2.0 port, HDMI port, and Windows 10 operating system x64 original Microsoft Office Home and Student 2019 pre-installed.

b) Lenovo Ideapad Slim 3i

- 1) Price = Rp. 6,500,000

- 2) Screen Size = 14 inches
- 3) Processor Type = Intel Celeron N4020
- 4) Memory Capacity = 4 Gb
- 5) Memory Type = DDR 4
- 6) Hard Drive Capacity = 256 Gb . SSD
- 7) Advantage

It can be used for light gaming, 3 cell 35WHr battery capacity, connectivity relies on WiFi 802.11 2x2 AC, Bluetooth 5.0 Combo, USB 3.2 Gen1 Port, USB 2.0 Port, HDMI Port and Windows 10 Home x 64 + Genuine Microsoft Office Home and Student 2019 operating system pre-installed.

c) Acer Nitro 5

- 1) Price = Rp. 13,500,000
- 2) Screen Size = 15.6 inches
- 3) Processor Type = Intel core i5 - 11300H
- 4) Memory Capacity = 8 Gb
- 5) Memory Type = DDR 4
- 6) Hard Drive Capacity = 512 Gb . SSD
- 7) Advantage

Killer Ethernet (Gaming) facilities, NVIDIA GTX 1650 GPU battery capacity, connectivity relies on WiFi 6 AX201, 1x USB 3.2 Gen 2 Port Featuring Power-Off USB charging, 2x USB 3.2 Gen 1 Port HDMI 2.0 Port with HDCP Support, USB Type-C with Thunderbolt 4 ports supporting : USB 3.2 Gen 2 (up to 10 Gbps), and Windows 10 Operating system.

d) MSI GF63

- 1) Price = Rp. 12,600,000
- 2) Screen Size = 15.6 inches
- 3) Processor Type = Intel core i5 - 10200H
- 4) Memory Capacity = 8 Gb
- 5) Memory Type = DDR 4
- 6) Hard Drive Capacity = 512 Gb . SSD
- 7) Advantage

Blue Stack (Gaming) facilities, 3-cell 51 Wh Li-ion battery capacity, connectivity relies on WiFi 6 802.11 ax, Bluetooth 5.1, Gb LAN, USB 3.2 Gen 1 Port, USB 3.2 Gen1 Type-C Port, HDMI Port, operating system Genuine Windows 10 Home x64 pre-installed.

In accordance with the existing data, the weighting of each criterion is adjusted to the value of its importance and is also adjusted to the provisions of the Analytical Hierarchy Process (AHP) method as follows:

1 Price Weight

The price weight criteria consist of 5 Analytical Hierarchy Process (AHP) numbers as shown in the following table:

price	Weight	Description
< 4 - 5,5 million	5	Enexpensive
5,5 - 7 million	4	Currently
7 - 8,5 million	3	Expensive
8,5 - 13 million	2	Quite expensive
>13 - 20 million	1	Very expensive

Table 4- 1 Price Weight

In the weight criteria, this screen size consists of 5 Analytical Hierarchy Process (AHP) numbers as shown in the following table:

Screen size	Weight	Description
14 inchi	5	Very good
10 inchi	4	Good
13 inchi	3	Enough
12 or 11 inchi	2	Not good
17 or 15 inchi	1	Not good

Table 4- 2 Screen Size Weight

2 Processor Type Weight

According to the specific weight criteria, this processor consists of 5 Analytical Hierarchy Process (AHP) numbers as shown in the following table:

Procecor type	Weight	Description
Intel Core i5	5	Very good
Intel Core i3	4	Good
Intel Celeron N4020	3	Enough
Intel Celerom N4000	2	Not good
Pentium or atom	1	Not good

Table 4- 3 Processor Type Weight

3 Memory Capacity Weight

In the weight criteria, the memory capacity consists of 5 Analytical Hierarchy Process (AHP) numbers as shown in the following table:

Memory capacity	Weight	description
8 Gb	5	Very good
4 Gb	4	good
3 Gb	3	enaugh
2 Gb	2	No good
1 Gb	1	No good

Table 4- 4 Weights of Memory Capacity

4 Memory Type Weight

The weight criteria for this type of memory consist of 2 Analytical Hierarchy Process (AHP) numbers as shown in the following table:

Memory type	Weight	description
DDR 4	5	Very good
DDR 3	3	good

Table 4-5 Memory Type Weight

5 Harddisk Capacity Weight

On the criteria for the weight of this hard disk capacity, it consists of 5 Analytical Hierarchy Process (AHP) numbers as shown in the following table:

<i>Harddisk kapasitas</i>	Weight	description
>512 Gb	5	Very good
512 Gb	4	good
256 Gb	3	enough
250 Gb	2	Not good
120 Gb	1	Not good

Table 4-6 Harddisk Capacity Weight

6 Advantage Weight

On the criteria for the weight of excellence consists of 5 numbers Analytical Hierarchy Process (AHP) as shown in the following table:

MERK	Edvantage														
	battery					connektivty					Operating system				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Asus Vivobook A416MA				√					√						√
Lenovo Ideapad Slim 3i					√				√						√
Acer Nitro 5					√					√					√
MSI GF63					√					√					√

Table 4-7 Weights of Excellence

Table description: 1 (not good), 2(not good), 3(enough), 4(good), 5(very good). From the weights listed above, it can be determined the weight of the laptop selection, namely:

1 Asus Vivibook A416MA

- Price = 5 (Cheap)
- Screen Size = 5 (Very good)
- Processor Type = 3 (Enough)
- Memory Capacity = 4 (Good)
- Memory Type = 5 (Very good)
- Hard disk capacity = 3 (enough)
- Excellence = 4 (Good)

2 Lenovo Ideapad Slim 3i

- Price = 4 (Medium)
- Screen Size = 5 (Very good)
- Processor Type = 3 (Enough)
- Memory Capacity = 4 (Good)
- Memory Type = 5 (Very good)

- f. Harddisk Capacity = 3 (Enough)
 - g. Excellence = 4 (Good)
- 3 Acer Nitro 5
- a. Price = 1 (Very expensive)
 - b. Screen Size = 1 (Not good)
 - c. Processor Type = 5 (Very good)
 - d. Memory Capacity = 5 (Very Good)
 - e. Memory Type = 5 (Very good)
 - f. Harddisk Capacity = 4 (Good)
 - g. Excellence = 5 (Very good)
- 4 MSI GF63

Price = 2 (Quite Expensive)

- b. Screen Size = 1 (Not good)*
- c. Processo Type = 5 (Very good)*
- d. Memory Capacity = 5 (Very good)*
- e. Memory Type = 5 (Very good)*
- f. Harddisk Capacity = 4 (Good)*
- g. Excellence = 5 (Very good)*

3.2 Modeling Stage

In the modeling stage, the approach model we chose was the Analytical Hierarchy Process (AHP). Entering this stage there are several things that must be considered, namely: Penggambaran *Hierarchy* keputusan

In this section, we will discuss the grouping of the data results that have been described in the intelligent stage above, such as:

- a. The purpose that will be discussed regarding the selection of a laptop
 - b. The criteria discuss price, screen size, processor type, memory capacity, memory type, hard disk capacity and advantages
 - c. Alternatives to discuss laptop brand names
- 1 Determine the weight of the criteria based on voters' perceptions
- In this section, we will discuss determining the weight of the criteria based on a voter which has a scale value from 1 to 9 according to the interests of the voter.
- a. Criterion 1: K1 : Price : 5 (More Important)
 - b. Criterion 2: K2 : Screen Size : 5 (More Important)
 - c. Criterion 3: K3 : Processor Type : 3 (Slightly More Important)
 - d. Criterion 4: K4 : Memory Capacity : 5 (More Important)
 - e. Criterion 5: K5 : Memory Type : 5 (More Important)
 - f. Criterion 6: K6: Harddisk Capacity: 3 (Slightly More Important)
 - g. Criterion 7 : K7 : Excellence : 9 (Absolutely Important)
- 2 Determine the comparison matrix of voters' perception criteria
- In making this comparison matrix, we have to adjust to inputting data from voters using the following steps:
- a. Creating a comparison matrix
 - b. Create a criterion value matrix
 - c. Using the consistency index (CI) formula

d. Using the consistency ratio (CR) formula The table for the overall weight of the voter perception criteria is as follows:

criteria	Priority weight
K1	0,14286
K2	0,14286
K3	0,08571
K4	0,14286
K5	0,14286
K6	0,08571
K7	0,25714

Table 4- 8 Overall Weight of Voter Perception Criteria

3. Make a comparison matrix of laptop criteria

The table is as follows:

a. Table of Overall Weight Criteria Laptop A

criteria	weight	Priority weight
K1	5	0,09375
K2	5	0,09375
K3	3	0,15625
K4	4	0, 14563
K5	5	0,09375
K6	3	0,15025
K7	4	0,14563

Table 4- 9 Overall Weight of Laptop A . Criteria

b. Overall Weight Table for Laptop B . Criteria

criteria	weight	Priority weight
K1	4	0,14563
K2	5	0,09375
K3	3	0,15025
K4	4	0, 14563
K5	5	0,09375
K6	3	0,15625
K7	4	0,14563

Tabel 4- 1 Bobot Keseluruhan Kriteria Laptop C

3.3 Choice Stage

In this choice stage, it discusses the comparison of each existing comparison multiplied by the priority weight value of the voters' perception with the priority weight in each alternative laptop, as follows:

Criteria	Priority weight laptop A	Priority weight laptop B	Priority weight laptop C	Priority weight laptop D
K1	0,09375	0,14563	0,34549	0,23438
K2	0,09375	0,09375	0,34549	0,34549
K3	0,15625	0,15025	0,09375	0,09375
K4	0,14563	0,14563	0,09375	0,09375
K5	0,09375	0,09375	0,09375	0,09375
K6	0,15025	0,15625	0,14563	0,14563
K7	0,14563	0,14563	0,09375	0,09375

Table 4- 13 Overall Comparison

Multiplied by the table on the overall weight of the perception criteria, namely:

criteria	Priority weight
K1	0,14286
K2	0,14286
K3	0,08571
K4	0,14286
K5	0,14286
K6	0,08571
K7	0,25714

Table 4- 14 Overall Weight of Perception Criteria

To find out the global priority value, it is obtained by multiplying the alternative criteria with the adjusted voter perceptions. Example :

On laptop A = (Weight K1 x Weight K1 Perception) + (Weight K2 x Weight K2 Perception) + (Weight K3 x Weight K3 Perception) + (Weight K4 x Weight K4 Perception) + (Weight K5 x Weight K5 Perception) + (K6 Weight x Perception K6 Weight) + (K7 Weight x Perception K7 Weight)

Then get, $(0,9375 \times 0,14286) + (0,09375 \times 0,14286) + (0,15625 \times 0,08571) + (0,14563 \times 0,14286) + (0,09375 \times 0,14286) + (0,15025 \times 0,08571) + (0,14363 \times 0,25714) = 0,12470149$

And so on to find the global priority value on Laptop B, Laptop C, and Laptop D. so that you get the following results:

ALTERNATIF	PRIORITAS GLOBAL
LAPTOP A	0,12470
LAPTOP B	0,13211
LAPTOP C	0,17012
LAPTOP D	0,15425

Tabel 4- 2 Nilai Prioritas Global

So from the results of the calculations that have been carried out and are also supported by the determination of predetermined criteria, it is concluded that Laptop C is recommended as the best choice to buy because the highest value of global priority obtained by Laptop C is 0.17012.

CONCLUSION

The conclusions that can be drawn from this research are:

- 1 This study uses the analytical hierarchy process (AHP) method with seven criteria, namely, price, screen size, processor type, memory capacity, memory type, hard disk capacity, and excellence. As well as four alternatives that support, namely, Asus Vivibook A416MA, Lenovo Ideapad Slim 3i, Acer Nitro 5, and MSI GF63.
- 2 And after performing calculations using the analytical hierarchy process (AHP) method, the following results were obtained:
 - a. Laptop A, namely the Asus Vivibook A416MA, got a result of 0.12470.
 - b. Laptop B, namely the Lenovo Ideapad Slim 3i, got a result of 0.13211.
 - c. Laptop C, namely Acer Nitro 5, got a result of 0.17012.
 - d. Laptop D, namely MSI GF63, got a result of 0.15425.
- 3 Laptop C, namely Acer Nitro 5, received the highest score from the global priority of 0.17012, so

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