

## Application of TOPSIS method in assessment of the best learning communication media for elementary school students

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### ABSTRACT

The spread of the COVID-19 virus that occurred so quickly and occurred almost all over the world caused the implementation of activities to be carried out online, including learning activities. The main thing that can help the online learning process is technology, especially communication technology. Commonly used communication media to assist the online learning process include Whatsapp, school e-learning Web, Youtube, Zoom, and Google Meet. Of course, every communication media used has advantages and disadvantages. This study aims to determine the best learning communication media using the TOPSIS method to assist users in choosing the best communication media for elementary school students based on the criteria for easy use and maintenance, completeness of features, quota requirements, understanding obtained, and the ability to re-access information. The results of this study indicate that the best communication media for elementary school student learning is the Whatsapp application. In addition, this research also produces a simple excel-based TOPSIS program that can be used by educators to determine what application is right for use in the learning process because many criteria are considered by an educator to determine the application.

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## 1. INTRODUCTION

In 2020 as we know all teaching and learning activities in Indonesia will be carried out online to avoid the spread of the COVID-19 virus. Coronavirus disease (COVID-19) is an infectious disease caused by a new type of corona virus. The virus that spread from China caused a pandemic that hit every country on various continents. To avoid the widespread spread in March, the President of Indonesia implemented a policy that forced us to do our activities *online*. Observations of the number of cases and the estimated risk of death indicate that increased public health mediation, good hygienic conditions, social distancing, and restrictions on public movement can control the COVID-19 epidemic [1].

However, the online learning process at home which has been carried out from March until now has made the learning process less effective, many students have lost the essence of learning itself [2]. One level of education that has felt the impact is the elementary school level. Elementary school itself is a level of education that is at the base of education for the next level of education [3].

To improve the quality of learning in a school during a pandemic like this, schools are required to utilize information technology in learning. This is also in line with Permendikbud Number 24 of 2012 which explains the implementation of Distance Education. Distance education itself is a learning process that is carried out remotely using various communication media. Learning communication media *online* which we often refer to as E-learning. E-learning systems have experienced increased use and research in the last decade [4]. In the use of E-learning, students can play an active role in the continuity of learning in various ways.

Materials and teaching materials that can be virtualized in various digital forms make learning more interesting and more dynamic and can be a reference and encourage students to understand the material more easily as a learning process [5]. E-learning is not judged by the ability to teach anyone, anytime, and anywhere, but E-learning is seen from the ability to apply a learning system to get the right knowledge [6], [7]. With E-learning, students are more flexible in learning, because learning materials can be stored and re-studied if needed. With E-learning, students are expected to be able to explore knowledge more broadly and get used to being independent in doing things. Students can interact with teachers using several applications such as Youtube, Whatsapp, school e-learning Web, and Google meet.

One of the problems experienced by educators is that it is not uncommon for educators to feel hesitant to decide what e-learning to use in their learning. Therefore, through a Decision Support System, it can assist educators in choosing or determining what applications are appropriate for use in learning in their classrooms. Many criteria are considered by an educator to determine what application he uses, namely functionality, ease of management, presentation of information, speed of access and not forgetting that educators must take into account the ability of students to utilize the applications used in this learning [8].

This study aims to find out what online learning applications are appropriate to use in E-learning learning for elementary school students. The achievement of goals with the existence of E-learning depends on the quality of the teaching process and the characteristics of the students as well as the effectiveness of online access. This can also be a benchmark in the process and readiness of online learning for elementary school students. Knowledge and technology-based systems can be developed and are useful for developing and assessing how an application can work optimally to support the learning system of elementary school students.

This study also looks for applications that are often used and easy to use by elementary school teachers to provide online learning through applications that are already circulating to carry out online learning activities, elementary school students will do online learning from applications that are often used by schoolteachers. This basis will be seen and the effectiveness of conducting online learning will be seen. Elementary school students will conduct online learning and will see their activeness and readiness in conducting online learning as it is now, which will assess the effectiveness of elementary school teachers in using applications that have been implemented to provide learning to elementary school students.

## 2. METHOD

The research methodology describes the stages carried out in a study. The methodology flow can be shown in Figure 1.

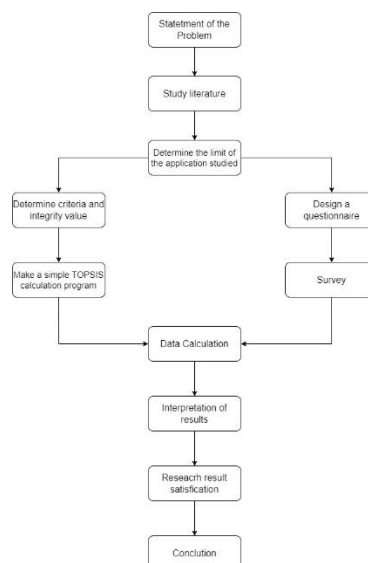


Figure 1. Methodology Flow

### 2.1. Statement of the Problem

In this stage the researcher observes and analyzes the problems that occur around him. It was found that the change in lifestyle due to the COVID-19 virus caused learning to be carried out online at almost all levels of education, one of which was Elementary School. Students who are still in elementary school are still classified as children and have limitations in using technology to participate in online learning. Therefore, it is necessary to have knowledge regarding the best applications for elementary school students.

### 2.2. Study Literature

Researchers conducted a literature study to gain knowledge regarding the methods to be used to calculate and rank the best applications. This research uses the *Technique for Order Preference by Similarity to Ideal Solution* (TOPSIS) method where this method can assist in the data calculation process as the weight of the suitability of alternative approaches which will later produce the best assessment [9], [10]. The TOPSIS method based on this concept has been widely used in the MADM model for solving practical decision problems. The concept is widely used because it is simpler and easier to understand, and the applied computing is very efficient and can measure the level of relative performance and alternatives to decisions that can be made in a simple mathematical form.

### 2.3. Determine Limitations of the Researched Application

These limitations were obtained through the results of observations which were then discussed by the researchers in this study. From several existing learning communication media, 4 applications were selected which were considered to have almost the same function and all four were popular applications that were widely used by people in Indonesia, namely Whatsapp, Telegram, Zoom, and Google meet.

### 2.4. Determining Criteria and Integrity value

Criteria are selected based on observations of user needs and capabilities, namely easy use and maintenance, completeness of features, quota requirements, understanding obtained, and the ability to re-access information. Meanwhile, the weights are determined by considering the condition of most Indonesian people.

### 2.5. Creating a Simple TOPSIS calculating program

This program was created to make it easier for users to find the best ranking of communication media according to user criteria points. The TOPSIS formula is entered into excel so that the calculations can be easier because it will be done automatically. Then, simple excel-based TOPSIS program display, can be seen in Figure 2.

## DSS Calculation Application with TOPSIS Method

this application can helps do  
TOPSIS calculation with 6 criteria  
notes: C4 as a cost and the other as a Benefit

start calculate

Figure 2. Simple Excel-Based TOPSIS Program Display

### 2.6. Designing a Questionnaire

The questionnaire was created based on predetermined criteria. The questionnaire was made using a Likert scale of 1-5.

### 2.7. Conducting a Survey

Data collection was carried out using a survey method. The data obtained in this study came from questionnaires distributed to teachers, parents, and elementary school students in Central Java.

### 2.7.1. Population and Sample

According to [11] the sample is part of the number and characteristics possessed by a population. Researchers take samples from members of the population who are the object of research, this model is called simple random sampling. The researcher applies the sampling calculation formula proposed by Slovin in [12]. The population in this case is elementary school teachers in Central Java, totaling 17,859 teachers. Calculate of population and sample, can use equation (1).

$$n = \frac{17.859}{1 + 17.859(0,1)^2} = 99,44 \approx 100 \quad (1)$$

Formula:

$$n = \frac{N}{1 + Ne^2}$$

Where:

n = Number of samples

N = Number of populations

e = The level of error in selecting members of the sample that is tolerated is 10%.

Samples that can still be tolerated or desired are 10%. So, for elementary school teachers to be sample, From the sample calculation above, it can be taken a sample of 100 teachers from elementary school teachers in Central Java.

### 2.8. Calculations

Calculations are carried out by entering survey data into a simple program that has been created. The points are entered in the form of the average value chosen by the respondent. This simple TOPSIS program can calculate and determine the order of the best communication media automatically.

### 2.9. Interpretation of Results

Interpretation aims to describe the results of the calculation process carried out previously. At this stage the researcher describes the results obtained.

### 2.10. Research Results Satisfaction

Survey This survey was conducted to find out how accurate the research results were. This survey was also distributed to teachers, parents, and elementary school students. This survey uses *Usability Testing* on the Whatsapp application. *Usability Testing* itself is a survey that is used to determine *user* about the usability of a system or application [13].

### 2.11. Conclusion Drawing

After getting the results of the calculation and assessment of satisfaction with the results of the study, the researchers drew conclusions objectively.

## 3. RESULTS AND DISCUSSIONS

### 3.1. Alternative

- a. Whatsapp
- b. Telegram
- c. Zoom
- d. Google meet

### 3.2. Criterion

- a. C1 = Use Variable

An attribute can be called a benefit if the higher the value, the better. While the attribute is said to be cost, if the greater the value, the worse it is [14].

In the Usage attribute, the greater the weight value, the easier it is to use the application. Because in this criterion the greater the weight value the better, then the "Usage" criterion is included in the **benefit**. The weight criteria can be shown in Table 1.

Table 1. Weight use variable

Use	Weight
Very easy	5
Easy	4
Average	3
Difficult	2
Very difficult	1

## b. C2 = Application maintenance Variable

Value weight the greater the weight value, the easier it is to maintain the application. Because in this criterion the greater the weight value, the better, then the "Application maintenance" criterion is included in the **benefit**. The weight criteria can be shown in Table 2.

Table 2. Weight use variable

Maintenance	Weight
Very easy	5
Easy	4
Average	3
Difficult	2
Very difficult	1

## c. C3 = Availability Variable

The greater the weight value, the easier it is to use the application. Because in this criterion the greater the weight value the better, then the "Feature Availability" criterion is included in the **benefit**. The weight criteria can be shown in Table 3.

Table 3. Weight use variable

Availability	Weight
Complete	5
Moderately	3
Incomplete	1

## d. C4 = Internet Quota Usage Variable

The greater the weight value, the higher the internet quota usage (wasteful). Because in this criterion the greater the weight value the worse it is, then the "Using Internet Quota" criterion is included in the **cost**. The weight internet quota usage variable can be shown in Table 4.

Table 4. Weight internet quota usage variable

Use	Weight
Very wasteful	1
Wasteful	2
Medium	3
Efficient	4
Very efficient	5

## e. C5 = Learning Understanding Variable

The greater the weight value, the easier the understanding in learning. Because in this criterion the greater the weight value the better, then the "Learning Understanding" criterion is included in the **benefit**. The weight learning understanding variable can be shown in Table 5.

Table 5. Weight learning understanding variable

Knowledge	Weight
Very easy	5
Easy	4
Average	3
Difficult	2
Very difficult	1

## f. C6 = Re-access Information Variable

The greater the weight value, the user can use the application. Because in this criterion the greater the weight value, the better, then the "Application maintenance" criterion is included in the **benefit**. The weight re-access information Variable can be shown in Table 6.

Table 6. Weight re-access information variable

Accessibility	Weight
Can be access	5
Can't be access	1

### 3.3. Weight of Interest

Value of the weight of importance can be determined based on the subjectivity of the audience's response as an object, several possibilities that occur in the alternative ranking process can be determined freely. While in the objective approach, the weight value is calculated mathematically so that it ignores the subjectivity of the decision maker [15]. The research uses a subjective approach so that the value of the weight of the criteria is determined freely by the decision maker based on certain considerations. Each criterion is given a weighted value with a total of 10. The weight criteria can be shown in Table 7.

Table 7. Weight of criteria

Criteria	Weight
C1	2
C2	1
C3	2
C4	2
C5	2
C6	1
<b>Total</b>	<b>10</b>

### 3.4. Calculation

#### 3.4.1. Data Input

The first step is to determine the average value of each respondent's choice. Figure 3 shows the data input process.

2		C1	C2	C3	C4	C5	C6
	Whatsapp	4490196	4.411765	3.705882	2.686275	3.72549	4.764706
	Telegram	3078431	3.235294	2.803922	3.019608	3.058824	3.823529
	Zoom	3196078	3.098039	2.843137	2.137255	3.509804	2.803922
	Google Meet	2980392	3.117647	2.72549	2.45098	3.313725	2.647059

Figure 3. Data input process

#### 3.4.2. Calculating the Value of the Normalized Decision Matrix

The formula for the Normalized Decision Matrix is as follows as in equation (2).

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{t=1}^m x_{it}^2}} \quad (2)$$

In the simple TOPSIS program, the first step in this stage is to determine the divisor for each column. The next step is the program will divide each existing data by the divisor of each column that has been obtained in the previous step.

3	Pembagi	6981135.194	7.017718015	6.091573173	5.18741436	6.8216697	7.224312923
		C1	C2	C3	C4	C5	C6
	Whatsapp	0.6431899505	0.6286609109	0.6083620593	0.5178446936	0.546125826	0.659537599
	Telegram	0.4409642436	0.4610179538	0.4602952177	0.5821027183	0.4483981392	0.5292584971
	Zoom	0.4578163739	0.4414596017	0.4667327994	0.4120077656	0.5145080536	0.3881229994
	Google Meet	0.4269208255	0.4442536724	0.447419726	0.4724858725	0.4857645042	0.3664097926

Figure 4. Process of computing normalized decision matrix value

#### 3.4.3. Calculating the Value of the Weighted Normalized Decision Matrix

The value of the Weighted Normalized Decision Matrix is obtained using the following formula:

$$y_{ij} = w_i r_{ij} \quad (3)$$

4		C1	C2	C3	C4	C5	C6
	Whatsapp	1.286379901	1.257321822	0.6083620593	1.035689387	0.546125826	1.319075198
	Telegram	0.8819284871	0.9220359077	0.4602952177	1.164205437	0.4483981392	1.058516994
	Zoom	0.9156327477	0.8829192034	0.4667327994	0.8240155313	0.5145080536	0.7762459987
	Google Meet	0.853841651	0.8885073447	0.447419726	0.944971745	0.4857645042	0.7328195852

Figure 5. Process of computing weighted normalized decision matrix value

#### 3.4.4. Determining the Positive Ideal Value and Negative Ideal Value

After the normalized data is weighted, the next step is to find the positive ideal value (maximum) and negative ideal value (minimum) from each column with the following formula:

With premersion:

$$y_i^+ = \begin{cases} \max y_{ij} : \text{If } j \text{ is a value attribute} \\ \min y_{ij} : \text{If } j \text{ is a cost attribute} \end{cases}$$

$$y_i^- = \begin{cases} \max y_{ij} : \text{If } j \text{ is a cost attribute} \\ \min y_{ij} : \text{If } j \text{ is a value attribute} \end{cases}$$

**a. Positive Ideal**

Value The positive ideal value is the sum of all the best values achievable for each attribute

$$D_i^+ = \sqrt{\sum_{i=1}^n (y_i^+ - y_{ij})^2} \tag{4}$$

**b. Negative Ideal Value Negative**

ideal value is the sum of all the worst values that can be achieved for each attribute

Figure 6 present the results in excel show a positive ideal value (maximum) and negative ideal value (minimum) as follows:

5	MAX	1.286379901	1.257321822	0.6083620593	1.164205437	0.546125826	1.319075198
	MIN	0.853841651	0.8829192034	0.447419726	0.8240155313	0.4483981392	0.7328195852

Figure 6. Process for calculating positive ideal values and negative ideal values

**3.4.5. Determining the Distance Between Positive Ideal Values and Negative Ideal Values**

$$D_i^- = \sqrt{\sum_{i=1}^n (y_{ij} - y_i^-)^2}$$

After getting each ideal value, proceed to find the distance between the positive ideal value and negative ideal value using the formula listed above. The process of calculate the distance between positive ideal value and negative ideal value, shown in Figure 7.

6	Whatsapp	D+	0.1285160494	D-	0.866730211
	Telegram		0.6126684735		0.4735955437
	Zoom		0.8420700769		0.102213055
	Google Meet		0.8627968678		0.1267196835

Figure 7. Process of Calculate the Distance Between Positive Ideal Value and Negative Ideal Value

**3.4.6. Determining the Preference**

Value The Preference value is the value used in determining the ranking of each available alternative. The preference value for each alternative is obtained from the results of the process of calculating the proximity of each alternative to the positive and negative ideal solutions, so that if the alternative that has the highest value is the best alternative [16].

After finding the distance between the positive ideal value and the negative ideal value, the next step is to find the preference value of each communication media being compared. The preference value can be obtained by the formula:

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \tag{5}$$

**3.4.7. Ranking**

The last step is determining the ranking or ranking of the application under study. The rating of the application can be known through the preference value obtained. The greater the preference value of an application, the higher the rating of the application. The following is the result of the calculation process.

	Alternatife	preference	ranking
7	whatsapp	0.87	1
	telegram	0.43	2
	zoom	0.11	3
	google meet	0.12	4

Figure 8. Results of the Counting Process



After research and observations were made by distributing questionnaires to educators, students, and parents of elementary school students, you obtained data which we then processed and summarized in table 8 to table 14. From the ranking results, it can be seen the media According to respondents, the best learning communication method is *Whatsapp*.

According to [17], there are several reasons why not a few people choose *Whatsapp* as a medium of communication, including the relatively low cost required but coupled with the ability to send unlimited messages, the capacity to have continuous conversations with many friends simultaneously, influence groups of family and friends, and privacy relative to other social networks.

By using *Whatsapp* teachers can create groups for their students, these groups can be called a type of "simple social network" for the classroom [18], [19]. Overall, *WhatsApp* has become a shared platform that increases accessibility, encourages collaboration, and intensifies motivation to take an active role in academic assignments [20]. Of course, with this convenience, many people use *Whatsapp* as a medium of communication in learning.

In the next order, there is the *Telegram* application. *Telegram* itself is one of the communication media for sending real-time messages that can be run via *mobile phones*, *desktops*, and *websites* [21]. The *Telegram* application itself has a display form that is almost the same as *Whatsapp*. However, the *Telegram* application has several features that are considered more varied than *Whatsapp*.

The *telegram* application provides various features to process messages between individuals or groups through textual and non-textual messages, besides that the *telegram* application can also be used via voice calls [2]. *Telegram* can also be used as a place to practice multiple choice questions [22] In *Telegram* itself there is a feature such as multiple choice, which later when students have finished answering will immediately appear whether the answer given is right or wrong. In addition, with this, students can also better remember the material taught at school.

The next sequence is the *Zoom Meeting*. The *Zoom Meeting* can be used during the quarantine period to carry out online activities while maintaining physical distance to stop the spread of the virus [23], [24]. *Zoom Meeting* itself is one of the learning communication media that uses video. In using *Zoom Meeting*, itself, of course, it really requires more quota than the two previous applications, namely *WhatsApp* and *Telegram*.

However, learning through *Zoom Meetings* will be easier to understand because the teacher can explain the material directly, so that students don't just read the material. In addition, *Zoom Meeting* features a *record* which can be used to record the meeting at that time so that students can repeat the explanation later.

Furthermore, from the ranking results in the last order, there is the *Google Meet* application. The *Google Meet* application is an application that functions as a communication tool that can be used on all devices for certain purposes, one of which is used for the learning process in elementary schools. *Google Meet* has almost the same functionality as the *Zoom* app.

*Google Meet* offers convenience for business and education users. An example is linking *Gmail.com* directly to join a *Google Meet* video conferencing. *Google Meet* is a relatively new application so there is still a lack of clear understanding that can reduce the use of the application in learning as in previous research [1].

### 3.5. Assessment of research results satisfaction

Table 8 present a satisfaction Survey Results The results showed that almost all respondents gave positive responses (Agree and Strongly Agree) to the results of this study. In each *construct* the average value obtained is:

- a. Usefulness = 3.26
- b. Ease of use = 3.58
- c. Ease of learning = 3.46
- d. Satisfaction = 3.40

Table 8. Results of the Satisfaction Survey Research Results

Question	Value
<b>Usefulness</b>	
1. The above applications successively have an effectiveness level from the highest to the lowest	3.13
2. The above applications successively help increase productivity from the highest to the lowest	3.40
3. The above applications in succession can save time in their use from high to low	3.26
<b>Ease of use</b>	
4. The above applications are successively easy in how to use them from the highest to the lowest	3.66
5. The above applications are successively simple in their use from the highest to the lowest	3.60
6. The above applications are user friendly from the highest to the lowest	3.46
<b>Ease of learning</b>	
7. The above applications are successively easy to learn in their use from the highest to the lowest	3.40
8. The above applications are successively easy to remember how users use the application from the highest to the lowest	3.53
<b>Satisfaction</b>	
9. Are you satisfied with the use of the above applications in a row as a medium of communication in learning from the highest to the lowest	3.33
10. The use of these applications in a row is comfortable to use from the highest to the lowest of	3.53
11. The above applications in succession from highest to lowest have provided the features you want	3.33

Based on the results of the USE questionnaire, it can be concluded that the results of this study have a high level of satisfaction. which is very high (more than 3.00) in each of its *constructs*.

#### 4. CONCLUSION

During the current pandemic, many activities have been diverted using the online system. One of them is in the field of education at the elementary school level. With an online learning system, communication media are needed that help in the learning process such as Youtube, Whatsapp, school Web E-learning, and Google Meet. This study aims to analyze what applications are most appropriate to use in online learning using the TOPSIS method in helping find the best selection and determine a Decision Support System that can assist educators in determining what applications are appropriate for learning in their classrooms. Based on the results of the calculation of the data obtained through questionnaires distributed to teachers, parents, and elementary school students, it was found that the Whatsapp application is the best communication medium for the online learning process in elementary schools based on the criteria for easy use and maintenance, completeness of features, quota requirements, understanding obtained, as well as the ability to re-access information. In addition, this research also produces a simple excel-based TOPSIS application that can be used by educators to determine what application is appropriate to use in the learning process because many criteria are considered by an educator to determine the application.

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