



## THE AHP APPROACH FOR DETERMINING E-LEARNING PLATFORM IN UNIVERSITY

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### ABSTRACT

Physical distancing policy as the response to pandemic covid-19 has forced the educational institutes to provide online learning for the students. The students and lecturer have to adapt to using online platforms to continue the learning activities. An E-learning platform is needed for distance learning. This research aims to analyze the preference of e-learning platforms among Google Classroom, YouTube, WhatsApp, and Zoom for students in a private university in Yogyakarta, Indonesia, using the Analytical Hierarchy Process approach. Several criteria are formulated for determining the e-learning platform based on the students' common difficulties during online-based learning, namely service of platform, learning comprehension, internet usage, and network strength. The result shows that learning comprehension has the highest weight (0.363), followed by network strength (0.258), internet usage (0.230), and platform service (0.149). Learning comprehension has become the most important criterion that students consider on selecting an e-learning platform. The final result from the Analytical Hierarchy Process approach proposes the best alternative e-learning platform for students based on the previous criteria. Based on the research, WhatsApp is an e-learning platform with the highest weight of 0.359. Therefore, it is determined for recommendation as to the most suitable e-learning platform for students. It has a high local weight based on each criterion considered in selecting an e-learning platform. The result of this study is expected to be input for lecturers and education institutions to evaluate the platforms they use and e-learning processes.

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## 1. INTRODUCTION

The pandemic of covid-19 has changed all aspects of our life, including education and learning. As explained by WHO in the website entitled Advice for the public: Coronavirus disease (Covid-19) in 2020 <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public> the physical distancing policy made in response to pandemic Covid-19 advises avoiding spending time in crowded places or groups. As explained by Widodo et al., in the research entitled Emergency online learning: How are students' perceptions? In 2021, the Public's obedience due to the physical distancing policy is considered quite effective in handling this pandemic. This policy is also applied in the education sector. Instead of learning by physically attending classes, the students and lecturers have to adapt by using e-learning platforms to continue the learning process. E-learning refers to the concept that the learning process is not conducted through physical meetings directly in the classroom. This concept uses technological assistance to ease the learning process by separating distance and time. E-learning involves utilizing electronic media and devices as resources to enhance accessibility for communication, interaction, and education. This approach fosters the adoption of inventive methods for facilitating comprehension and fostering learning (Pham, et al., 2019). Students can learn with a flexible and personalized platform through online media to continuously enhance their knowledge, skills, and other outcomes (Fazlollahabadi & Muhammadzadeh, 2012).

However, the transition from offline to online-based learning raises a challenge for both lecturers and students. As explained by Widodo et al., in the research entitled Emergency online learning: How are students' perceptions? In 2021, a study showed that most students feel uncomfortable with online-based learning. To keep the quality of online-based learning be as good as offline-based learning, students and lecturers need an e-learning platform that can fulfill all student needs in the online-based learning process.

Many online platforms support teaching and learning activities with different characteristics and features. The platforms such as Google Classroom, YouTube, WhatsApp, and Zoom are examples of platforms often used for online learning during this pandemic (Bahasoan, et al., 2020; Hassan, et al., 2020; Kristina, et al., 2020). Google classroom is an application that provides teachers and students with an online room with a set of features for enhancing the learning activities, such as delivering and tracking assignments and communicating with students and teachers (Iftakhar, 2016). Okmawati (2020) opines that Google Classroom is a complimentary web service created by Google for educational institutions, seeks to streamline the assignment creation, distribution, and grading processes. Its primary objective is to simplify the sharing of files between educators and students. Google Classroom empowers teachers to establish a virtual classroom environment where they can oversee all the necessary documents for their students. YouTube is a social networking site that provides users to share or watch videos. Shoufan (2022) opines that YouTube is a versatile platform that uniquely influences the teaching and learning process in various ways. Many videos about education, entertainment, marketing, and science are constantly being uploaded to YouTube since 2005 (Moghavvemi, et al., 2018). With its feature, YouTube could enhance distance learning activities. The teacher could share learning material in video format, and the students could learn through the video. WhatsApp is an instant messaging application. This application allows the user to exchange pieces of information in text, photos, voice recordings, and videos format (Wijaya, 2018). These features can be used by teachers and students to share the learning material and interact with each other. Zoom is an application used for video conferences. This application provides audio, video, and screen sharing for online teaching (Serhan, 2020).

The advancing technology today increases the number of platforms used for online-based learning. However, many factors from e-learning platforms can influence learning activities. Therefore, it would be necessary to determine what platform to use for learning activities. Analytical Hierarchy Process is one of the methods used to evaluate the platforms for online-based learning. Analytical Hierarchy Process is a Multi-Criteria Decision Making (MCDM) model that measures through pairwise comparisons to determine the priority scale based on experts' judgment. The pairwise comparisons are made using a scale of absolute judgments representing how much more one element dominates another concerning a given attribute (Saaty, 2008). AHP can help the decision-maker select the best alternatives or prioritize a series of alternatives based on the criteria considered. AHP has been used in many decision-making types of research and successfully used in various areas, such as marketing, finance, and engineering (Dorado, et al., 2014). Previous research about consumer packaging preference was solved using AHP to decide the packaging type (Jatiningrum, et al., 2019). AHP was also used in many kinds of research related to the educational sector, such as selecting learning methods for undergraduate students and selecting simulation software for engineering education (Dorado, et al., 2014; Siew, et al., 2021). As explained by Marimin in the book entitled Teknik dan aplikasi pengambilan keputusan kriteria majemuk (The technique and application of decision-making with various criteria) in 2004, one of the advantages of using the AHP model for decision-making is that it can be easily understood by all the judges involved because it can be described graphically.

This study is conducted to analyze and explore online-based learning activities through students' perceptions. This research proposes an e-learning platform among four platforms often used for learning activities: Google Classroom, YouTube Video, WhatsApp, and Zoom Meeting, based on the criteria, platform service, learning comprehension, internet usage, and network strength. The respondents of this research are the students of a private university conducting online-based learning due to the pandemic of Covid-19.

## 2. METHOD

This research aims to analyze the students' preferences for e-learning platforms. A preliminary study was conducted to find out the e-learning platforms often used by the students and lecturers and its problem during distance learning through study literature and interviews with students. The criteria for this research are developed

based on the difficulties students face during online learning, namely platform service, learning comprehension, internet usage, and network strength. Meanwhile, Google Classroom, YouTube Video, WhatsApp, and Zoom Meeting are e-learning platforms that are familiarly used based on interviews with students.

Meanwhile, Google Classroom, YouTube Video, WhatsApp, and Zoom Meeting are e-learning platforms that are often used based on interviews with students. An online questionnaire was distributed to the students in a private university in Yogyakarta, Indonesia, which has conducted distance learning since March 2020. A sample of 82 respondents for this research were students who still take subjects and attend online classes using the e-learning platform. The respondents consist of 53.7% male students and 46.3% female students. The questionnaire contained a comparison between criteria and alternatives.

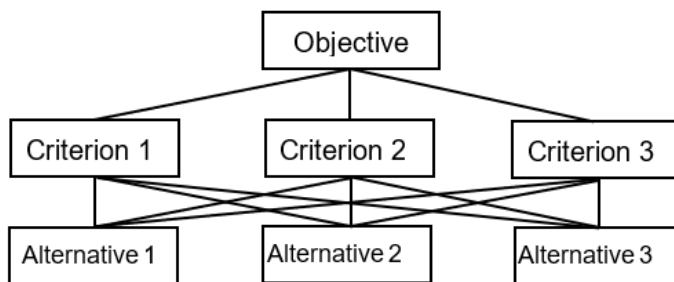
**2.1 Data Analysis**

Data collection in this research was analyzed using Analytical Hierarchy Process (AHP) method and processed using Microsoft Excel. AHP model is used to solve multiple criteria decision-making (MCDM) problems (Siew, et al., 2021). This model uses discrete or continuous pairwise comparisons to find the priority scale. AHP model was developed by Dr. Thomas L. Saaty to organize the information and judgments for selecting the best alternative. The use of AHP begins with creating a hierarchical structure of the problem to be studied. This hierarchical structure consists of 3 levels. The first level is the goal to be achieved, while the second level loads the criteria used for evaluating the alternatives. These criteria are compared by pairwise comparisons to get a numerical importance score for each criterion. The final level is the alternatives that are also compared by pairwise comparisons to find the final suitable solution to achieve the goal.

**2.2 Analytical Hierarchy Process (AHP)**

These are the steps for applying the AHP for solving the problem (Saaty & Vargas, 1993) (Saaty, 2008).

- 1) Identify the problem and its objective. This research aims to determine the selection of e-learning platforms for students in a private university in Yogyakarta, Indonesia. Through a preliminary study, it is known that the criteria considered in selecting an e-learning platform are platform service, comprehension of learning material, internet usage, and network strength.
- 2) Structure the problem and its goal into a hierarchy. The top level of the hierarchy contains objective to be achieved, followed by the criteria in the intermediate level. Then, the set of alternatives in the lowest level. The model of hierarchy is shown in figure 1.



**Figure 1.** SEQ Fig.\_ \\* ARABIC 1 Analytical Hierarchy Process mode

- 3) Construct a set of pairwise comparison matrices. Compare all decision criteria and alternatives pairwise to know their relative importance to the objective. The ratio scale for pairwise comparison is shown in Table 1.

**Table 1.** Ratio scale for pairwise comparison (Saaty, 2008)

Scale	Meaning
1	Equal importance
3	Weak importance to the preferred
5	Essential importance to the preferred
7	Demonstrate importance to the preferred
9	Absolute importance to the preferred
2,4,6,8	Intermediate importance

The comparison is based on respondents' judgments about the relative importance of one element over another. The pairwise comparison is arranged into a pairwise comparison matrix-like presented below.

$$A = [(a_{11} \ a_{21} \ a_{12} \ a_{22} \ \dots \ a_{1j} \ a_{2j} \ \vdots \ \vdots \ a_{i1} \ a_{i2} \ \dots \ a_{ij})] \tag{1}$$

Where  $a_{ij}$  is the degree of preference of element  $i$  to element  $j$ . The pairwise comparison matrix described the influence of each element on the criteria.

- 4) The data from all respondents were aggregated using a geometric mean. The geometric mean formulation is shown below.

$$\sqrt[n]{GM} = \sqrt[n]{a_1 \times a_2 \times a_3 \dots \times a_n} \quad (2)$$

GM is geometric mean, then  $a_1, a_2, a_3,$  and  $a_n$  are value from respondent 1, respondent 2, respondent 3, and respondent  $n$  sequentially.

- 5) Normalize the matrix to determine the relative weights of each element. The normalization can be calculated by dividing the value of each element by the total value of each column.
- 6) Check the consistency ratio (CR) of the matrix. The CR has to be less than 0,1 to indicate that the data for pairwise comparisons are consistent. Suppose the CR score is higher than 0,10. In that case, it means there is inconsistency in the data for the pairwise comparison matrix, and the experts have to re-evaluate or re-judge the preferences of the elements. The formula of CR is shown below

$$CR = \frac{CI}{RI} \quad (2)$$

CI is consistency index and RI is random index.

- 7) Repeat step 3 - 6 for all level in the hierarchy.

### 3. RESULTS/FINDINGS AND DISCUSSION

The data in this research were collected from students of private university in Yogyakarta, Indonesia. The university has been doing distance learning since March 2020 due to pandemic of covid-19. Students who have chosen to become respondents were the students who still taking subjects and attending online classes using e-learning platform.

A preliminary study was conducted through literature study and interview with some students who experienced online learning. According to the interview, students often used four e-learning platforms: Google Classroom, YouTube Video, WhatsApp, and Zoom Meeting. Those alternatives of e-learning platform also had been studied by Singh et al. (2020), Setiawan & Isha (2020), Fahmalatif et al. (2021), and Hendrawati et al. (2021). They stated that the four e-learning platforms were widely used to engage students in online learning. Hendrawati et al. (2021) even explained that Google Classroom and WhatsApp were the most popular e-learning platforms based on students' preferences. Furthermore, four criteria considered for selecting an e-learning platform were also obtained from the interview. They are platform service, learning comprehension, internet usage, and network strength obtained from interviews. These four criteria are the things that students concerned during online learning activities.

The conceptual framework was built according to the interview and literature study results and Analytical Hierarchy Process was used for solving this research. The hierarchy model for this research is shown in Figure 2.

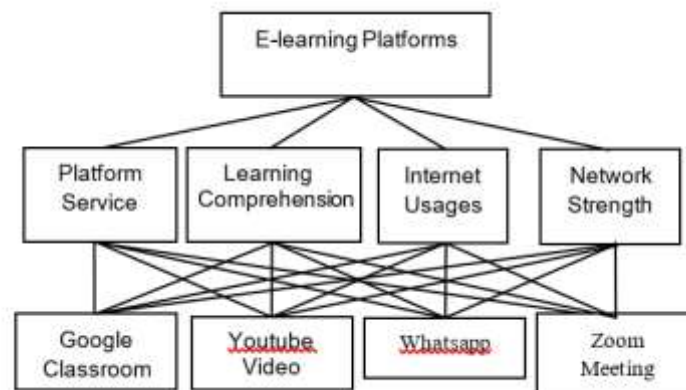


Fig. 2 - SEQ Fig. \\* ARABIC 2 Hierarchy model of e-learning platforms

Level 1, as shown in Figure 2, states the objective of this study, determining an e-learning platform based on student preferences. Then, level 2 states the criteria considered in determining of e-learning platform. Each criterion are explained as follows,

- a. Platform service means the platform's various features that can support online learning activities and educational purposes. Students usually expect the e-learning platform to provide a comprehensive service.
- b. Learning comprehension means the platform's capability to deliver learning material well for students during online learning activities. Some students stated that they have difficulty understanding the material provided through online learning.
- c. Internet usage means the amount of internet data used for online learning activities. In some cases, students have limitations in providing internet quota.

d. Network strength means the power of the internet network required for accessing the platforms during online learning activities. Most students who live in rural areas have problems with the internet network.

According to Figure 2, four e-learning platforms are determined to be the alternatives option in this research: Google Classroom, YouTube Video, WhatsApp, and Zoom Meeting. Those four are the online platforms that the students and lecturers often use for online classes. The following is an explanation of the use of each of these e-learning platforms

- a. Google Classroom, can be used by lecturers to share the material of a particular course, make an announcement about quizzes, exams, or tasks, provide an assessment of student work directly, and discuss the material learned through the forum page. Google Classroom provides a well-organized interface. This makes it easier for lecturers and students to access previous activities carried out at Google Classroom.
- b. YouTube Video, can be used by lecturers to share their learning videos or learning videos from other sources. Sometimes, it is easier for students to understand the material through direct explanations from videos in certain courses.
- c. WhatsApp, can be used by lecturers to share the material of a particular course, make an announcement about quizzes, exams, or tasks, and discuss the material learned through a chat room in a group. This is the most simple and easy-to-use application for communicating, so it also can be used as an e-learning platform.
- d. Zoom Meeting, can be used by lecturers to hold lecture meetings directly with students using video conference. Two-way communication can be conducted in real-time through this platform.

Online questionnaires were distributed using google form around June – July 2020 to students of the private university, the subject of this research. There are a total of 82 students who participated as respondents. The percentage of female respondents was 46,63%. Meanwhile, the male was 53,66%.

AHP could be used to solve multi-decision criteria problems based on one expert judgment as respondent. However, in the implementation, the criteria assessment usually are carried out by several respondents. Data from each respondent were constructed to be a pairwise comparison matrix (PCM). Then, the data were added and aggregated using geomean to formulate the PCM. The result of using geomean for PCM can be seen in Tables 2 and 3. Table 2 shows the decision criteria pairwise comparison matrix; meanwhile, table 3 shows the alternative pairwise comparison matrix based on each criterion.

**Table 2.** Pairwise comparison matrix of decision criteria

	Platform Service	Learning Comprehension	Internet Usage	Network Strength
Platform Service	1	0.596	0.568	0.422
Learning Comprehension	1.767	1	1.909	1.644
Internet Usage	1.742	0.524	1	1.035
Network Strength	2.372	0.608	0.979	1

As shown in table 2, PCM is used to compare various criteria to be weighted. This PCM shows how important one criterion is to another. As an example, learning comprehension is 1.909 times more important than internet usage according to respondents. The provision in building the pairwise comparison matrix is reciprocal comparison. It is only necessary to determine the upper triangular matrix because the lower triangular matrix is only the reprisal value of the upper triangular matrix (Saaty, 2008). Therefore, internet usage compared with learning comprehension has a value of  $1/1.909$  or 0.524. It means that internet usage is only 0.524 more important than learning comprehension.

Table 3 shows a pairwise comparison matrix for alternatives based on each criterion. As an example, according to the internet usage criterion, respondents prefer WhatsApp compared to Zoom Meeting. Respondents experience that WhatsApp is 2.480 times superior to zoom meeting in terms of internet usage. On the other hand, zoom meeting compared to WhatsApp has a value of 0.408 because of the reciprocal value.

**Table 3.** Alternative pairwise comparison matrix

Alternatives	Platform Service			
	Google Classroom	YouTube Video	WhatsApp	Zoom Meeting
Google Classroom	1.000	0.966	0.470	1.684
YouTube	1.060	1.000	0.652	1.631
WhatsApp	2.148	1.533	1.000	2.248
Zoom	0.604	0.624	0.451	1.000

Alternatives	Learning Comprehension			
	Google Classroom	YouTube Video	WhatsApp	Zoom Meeting
Google Classroom	1.000	0.732	0.516	1.487
YouTube	1.328	1.000	1.049	2.239
WhatsApp	1.953	0.953	1.000	1.480
Zoom	0.686	0.453	0.689	1.000

Alternatives	Internet Usages			
	Google Classroom	YouTube Video	WhatsApp	Zoom Meeting
Google Classroom	1.000	0.966	0.470	1.684
YouTube	1.060	1.000	0.652	1.631
WhatsApp	2.148	1.533	1.000	2.248
Zoom	0.604	0.624	0.451	1.000



Google Classroom	1.000	2.106	0.530	2.539
YouTube	0.468	1.000	0.407	1.879
WhatsApp	1.903	2.456	1.000	2.480
Zoom	0.399	0.541	0.408	1.000

Network Strength				
Alternatives	Google Classroom	YouTube Video	WhatsApp	Zoom Meeting
Google Classroom	1.000	2.176	0.413	3.100
YouTube	0.453	1.000	0.357	2.066
WhatsApp	2.400	2.803	1.000	3.143
Zoom	0.326	0.491	0.321	1.000

Each pairwise comparison matrix was processed using the column normalization method to obtain the weights for the criteria and alternatives. The findings of weight calculation for decision criteria by using AHP is shown in figure 3.

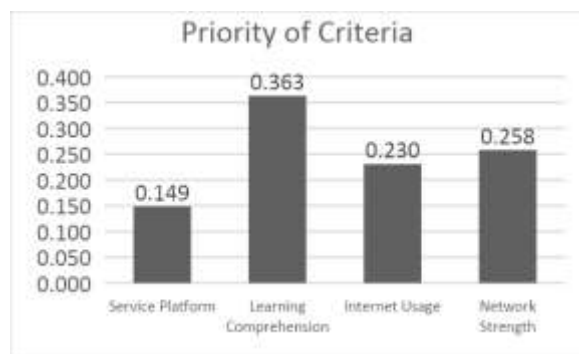


Fig. 3 - Weight of decision criteria

The findings of this research revealed that learning comprehension, network usage, internet usage, and platform service are the priority order of criteria considered in selecting e-learning platforms. Based on figure 3, learning comprehension has the highest weight (0,363) and becomes the first criterion considered by students for selecting an e-learning platform. Previous research about students' perceptions of online learning stated that most students are not comfortable with online-based learning. As explained by Widodo et al., in the research entitled *Emergency online learning: How are students' perceptions?* In 2021, they have difficulties understanding learning material if the learning activities are only through online classes. Students need a platform that could deliver the learning material well and makes it easier for them to understand even though the learning activities were done by distance.

The second criterion which considered students for selecting e-learning platform is network strength (0,258). Some platforms for online learning activities require a stable and robust internet network to access them. Poor internet connection interrupts the learning process. However, good quality internet network in Indonesia is not evenly distributed. It becomes a problem for students who live in some regions, primarily rural areas with a poor internet connection, to access the learning material from their homes (Alsoud & Harasis, 2021; Basri, et al., 2021; Husain, et al., 2020). Students need a flexible platform that is easy to access even though the internet network is not that strong.

The third influential criterion is internet usage by 0.230. There are several complaints from lecturers and students about implementing online-based learning. Internet usage is highly related to cost. As explained by Priatmoko et al., in the research entitled *Distance learning for new students in the era of pandemic coronavirus disease (Covid-19): Implementation and barriers in 2021* based on the previous research, one of the student's and lecturers' complaints is about the high spending they had to purchase internet data. This makes the students are more concerned about internet usage for accessing the e-learning platform.

Students' last criterion when selecting an e-learning platform is platform service by 0.149. Many online platforms can be used for the online learning process during this pandemic with different excellent features and characteristics. The students prefer selecting an e-learning platform based on its excellent features and operations.

CR value was calculated in each pairwise comparison matrix to ensure no inconsistent data in this research. The result of CR value of decision criteria, e-learning platform alternatives based on platform service, e-learning platform alternatives based on learning comprehension, e-learning platform alternatives based on internet usage, and e-learning platform alternatives based on network strength are 0.093, 0.015, 0.021, 0.033, 0.040. The AHP approach is acceptable and reliable if the value of CR is less than 0.10 (Srdevic, et al., 2011). According to the results, no CR value exceeds 0.10. This implies that the data and model is acceptable and reliable. There is no inconsistent data in this research.

Table 4. presents the local weights of decision criteria and alternatives. According to Table 4, WhatsApp has the highest local weight by 0.387 based on the platform service criterion. The second alternative, which has a high value of the local weight, is YouTube Video by 0.220. These two are online platforms usually used daily for communication and entertainment purposes. The high weight value of these two platforms can happen because these two platforms are familiar to students. The third and the fourth alternatives are Google Classroom by 0.220 and Zoom Meeting by 0.151.

**Table 4.** Local weights of decision criteria and alternatives

Criteria	Alternatives	Criterion's Weight	Alternative's Weight
Platform Service	Google Classroom	0.149	0.220
	YouTube Video		0.241
	WhatsApp		0.387
	Zoom Meeting		0.151
Learning Comprehension	Google Classroom	0.363	0.208
	YouTube Video		0.317
	WhatsApp		0.311
	Zoom Meeting		0.164
Internet Usage	Google Classroom	0.230	0.208
	YouTube Video		0.317
	WhatsApp		0.311
	Zoom Meeting		0.164
Network Strength	Google Classroom	0.258	0.277
	YouTube Video		0.164
	WhatsApp		0.456
	Zoom Meeting		0.104

The highest weight in the learning comprehension criterion is YouTube Video by 0.317. Learning materials were shared through YouTube in video format, providing visual and audio instruction to understand the students better. Often, lecturers build learning videos about a particular course and then upload them to YouTube. The lecturer will provide the YouTube link so that students can access it. Students can also repeat the learning video if they still do not understand the material presented. Furthermore, many academic-oriented videos on YouTube allow students to study more from various sources, not only the one shared by the lecturer. The following alternative priority based on learning comprehension is WhatsApp by 0.363, Google Classroom by 0.208, and Zoom by 0.164. WhatsApp allows lecturers to share the learning material in text, document, voice, or video format. The various format of material learning that lecturers could share through WhatsApp could enhance the learning comprehension of students. Zoom Meeting has the lowest weight in the learning comprehension criterion by 0.164. Lectures using zoom have advantages, such as conducting two-way discussions simultaneously. Unfortunately, students are often passive when discussing. This passive discussion may occur because students do not dare to express their opinions directly or because students are not serious about attending lectures. Even though online learning has been carried out synchronously using Zoom Meeting, students are not ready to pay attention to the material presented by the lecturer. This problem supports the previous research, which stated that one barrier to using zoom is that students sometimes do not focus during the learning process (Mannong, 2020). Zoom meetings are also difficult to implement for particular courses that ask students to work on questions related to calculation, like if a student answers the question by writing on the whiteboard in front of the class. This difficulty is due to students' limited devices to support online lectures. Moreover, students often cannot fully concentrate during an online class.

YouTube Video also became the first e-learning platform alternative based on internet usage criteria. YouTube has the highest weight by 0.317, and WhatsApp becomes the second by 0.311. The large size of the file causes a high expenditure on internet data. Both YouTube and WhatsApp allow users to download and save the file to the device. It can make the students save more on internet data because they can open the file of learning material again even when the device is in offline mode. Based on internet usage criteria, the third and fourth alternative priorities are Google Classroom by 0.208 and Zoom by 0.164. Zoom has become the last e-learning platform alternative for internet usage criteria. Zoom is usually used for the feature of a video conference. It needs plenty of internet data to access, and it can cause a high cost of internet data purchasing.

An internet connection is a basic need to access the e-learning platform. The priority of alternatives based on network strength is WhatsApp. WhatsApp has the highest weight by 0.456 and has become the priority for e-learning platform based on network strength criterion. WhatsApp is a quietly easy platform to be accessed even when the internet network is not really good. The previous research also found out the students prefer WhatsApp because it is easy to be accessed and follow the discussion through WhatsApp, even though there is a problem during online learning (Nihayati & Indriani, 2021). The following alternatives priority order is Google Classroom by 0.277, YouTube by 0.164, and the last is Zoom by 0.104. Zoom relies on its main feature, video conference, for learning activities. That feature needs a stable and robust internet network for users to follow the online classes through zoom.

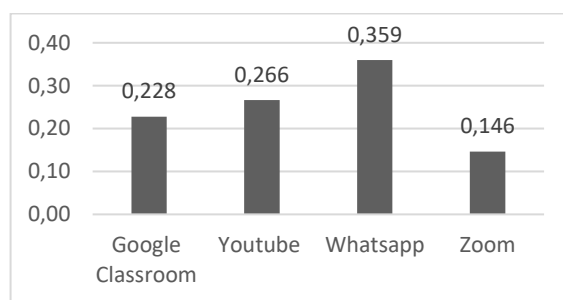


Fig. 4 - Global weight alternative

Figure 4 shows the result of the global weight alternatives calculation. The findings of this study indicate that WhatsApp, YouTube Video, Google Classroom, and Zoom Meeting are e-learning platforms that students are interested in successively by using the AHP approach. According to the calculation for each alternative, WhatsApp has the highest global weight by 0.359. It has become the priority of the e-learning platform chosen by students. WhatsApp has a high local weight in each criterion and becomes the highest weight in the platform service and network strength criterion. WhatsApp is a popular platform not only for students and lecturers, but also popular among many people. As explained by Stacy in the website entitled Statista in 2021 <https://www.statista.com/statistics/258749/most-popular-global-mobile-messenger-apps/>, WhatsApp will become the most popular global mobile messenger in 2021. WhatsApp is a familiar platform that is used by people daily. Its features are easy to use and help the students with learning activities (Wijaya, 2018). WhatsApp provides a simple operation scheme that makes the platform accessible to students and lecturers. The features include exchanging text, document, photo, video, group chat, voice and video call, and WhatsApp on the web. Therefore, WhatsApp enables the students and lecturers to communicate by distance. WhatsApp also allows the students and lecturers to transfer the study material quickly and support the students and lecturers to give immediate feedback on the learning activities (Gon & Rawekar, 2017; Habes, et al., 2022; Nuraeni, 2020). The students and lecturer can use WhatsApp by making it an active discussion forum for learning activities. Learning activities through the discussion forums improve learning effectiveness, solve learning activities, and enable the faster construction and sharing of knowledge (Amry, 2014). The previous research.

Network strength has become one of the students' concerns about online-based learning. Internet network is not distributed well in many regions in Indonesia, especially in rural areas. WhatsApp became the first alternative based on the network strength criterion. The study shows that the students consider WhatsApp as the best platform to access with their internet network strength. WhatsApp has become a platform which easy to access even the internet network is not really good. Online-based learning through WhatsApp isn't need a powerful internet connection unless it has to access video call or voice call feature. This is in line with the interview results by Anhusadar (2020), stating that WhatsApp is easier to use, has good network support, is less complicated compared to other applications, consumes less data, and is not too difficult to use even when the network is not strong (Anhusadar, 2020). This platform is easy to access as long as there is an internet connection to the device (4G/3G/2G/EDGE, or WIFI) (Koomson, 2019; Manna & Ghosh, 2016). This convenience is very different from lectures using Zoom Meetings. Zoom Meeting requires a strong internet signal so that students in areas with weak signal coverage will have difficulty attending lectures. According to students, zoom meetings also require extensive internet usage compared to other e-learning platforms. However, students are often constrained by the internet's limitations (Fahmalatif, et al., 2021; Tauhidah, et al., 2021).

WhatsApp can save the learning materials and access the history in-room chat even in offline mode. This convenience is also related to the internet usage criterion. WhatsApp is the second priority based on the internet usage criterion. It can happen because that feature supports the user in saving more internet data.

WhatsApp also has a high weight on learning comprehension even though not the priority. Students feel easy to follow the learning activities through WhatsApp. The lecturer sent the learning materials through WhatsApp in document, video, photo, or link format. The students could ask for and have feedback through the chat immediately, enabling the interactive explanation of the lesson. The students also can submit the assignment through WhatsApp. Sending learning materials through WhatsApp can be saved on the device, and the students can access it anytime. Using WhatsApp as a healthy discussion forum for students and lecturers could potentially increase the students' learning comprehension. All these advantages of using WhatsApp consider the students to choose WhatsApp becomes their selected e-learning platform.

However, as explained by Nurdianti in the research entitled Disruption in economics learning through WhatsApp group during Covid-19 pandemic in 2020 the advantages of using WhatsApp come along with its challenge. One of the weaknesses of WhatsApp is its feature that video call only involves eight people. Meanwhile, the number of students in a class can be almost 30 people. For better e-learning activities, WhatsApp can be combined with other e-learning platforms to enhance learning performance.

#### 4. CONCLUSION

This paper has demonstrated how to determine and analyze e-learning platform using the AHP approach as a model to solve a multi-criteria decision problem. A case study was conducted on students who take online learning during the Covid-19 pandemic. The determination of an e-learning platform is based on four criteria, platform service, learning comprehension, internet usage, and network strength. The study shows that the most important criterion students consider in selecting the e-learning platform is learning comprehension by a weight of 0.363.



Students prefer a platform that helps them understand the learning material well even though the learning activities were carried out by distance. The finding also shows WhatsApp as the selected e-learning platform by 0.359.

Based on the findings, it was found that WhatsApp has advantages in platform service, internet usage, and networks strength. These advantages will be beneficial for students, especially in rural areas where it is difficult to get a good internet signal. WhatsApp also tends not to require a lot of internet usage. However, its features can help students understand the learning material well and support them in their learning activities. Therefore, AHP is proven to be used to determine an e-learning platform based on students' preferences. For future research, it is recommended to implement a revised version of AHP to solve multi-criteria decision problems. It could be using a fuzzy number for AHP (Liu, et al., 2009).

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